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# Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>20</sup>  
<sup>a</sup> Mechanical Engineering Department, Faculty of Techniques, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia

<sup>b</sup> Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia

<sup>c</sup> Chemical Engineering Department, UNTAG University in Semarang, 50235 Gajah Mungkur, Semarang, Indonesia

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## Abstract

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This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market. Currently, the applied competency test model is the 'Continuity' model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students' fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model. To research the effect of the 'Discontinuity' model implementation on the students' competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the 'Discontinuity' competency test model gives a significant improvement in the students' competency test scores. This reasonably happened due to the implementation of the 'Discontinuity' model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress level of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.

*Keywords: Vocational education; automotive; competency; Discontinuity model; competency test management*

## 1. Introduction

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The presence of vocational education in this present circumstance brings a significant impact on the correlation between education and the labour market. Students are given two choices whether they will continue their studies to regular school or vocational education. Vocational education becomes a good choice for students who wants to directly look for a job after graduating from school and could be a shortcut to involved in the labour market directly. The percentage of practical knowledge of vocational education is higher than that in regular school. Thus, vocational education aims to prepare students <sup>8</sup> the step forward for entering the labour market with a highly skilled in a specific field of jobs. In general, there are three types of vocational education systems, which are school-based vocational education, dual apprenticeship, and informal training (Guo & Wang, 2020). In a developing country, school-based vocational education is more applicable than the other systems considering manpower inequality. Students that enrol in a vocational education school exhibit outstanding practical skills supported by their early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). However, in some

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)  
E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a formal curriculum and standardized competency is very important to bring manpower equality which means the students are eligible for the industrial and business company requirements after graduated from vocational education. Moreover, vocational education also brings a significant impact on the economic sector for the country by reducing the youth unemployment population (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational education school-leavers on the labour market. The studies showed that the educational programs that were strongly oriented toward vocational skills and knowledge for the students have a positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011; Muja et al., 2019).

### *The Importance of Competency for Vocational Education*

However, in order to prepare the students' capability during the transition from high school to the labour market, the improvement of students' competency should be highly considered. Competency is a combination of skills, behaviour/attitude, and multiple knowledge that can be demonstrated by students where the skills, attitudes, and knowledge are obtained from the materials conceptualization that has been learned during the period of study. The level of vocational competency influences positively the chance of graduates of being matched to occupation with the specific educational domain. Furthermore, the application of on-the-job training will be much more efficient when implementing the generic competencies to adjust vocational competencies to the requirement of the job (Heijke et al., 2003). Due to the increase in the labour market qualification, the standard of student competence should be increased. This concern should be followed by the development of the students' assessment. Several points should be considered in order to improve the competency, which are authentic assessment, an improvement in quality lab sheet, student competency standard system, specific scoring rubric, and feedback from the students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment could be achieved (Rahman et al., 2014).

In this industrial era, developing country such as Indonesia tends to force the economic sector by improving the industrial sector through massive production and export activity (Hiyatno et al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector, vocational education contributes to human resources development and minimize the gap between the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set up a good competency including skills and organizational knowledge for the graduates which means the graduates are ready for entering the workplace environment. To meet the industrial requirements, the graduates should be able to work effectively by combining the knowledge, skills, and other work-related capacities into specific competence needed (Loon & Bartram, 2007). This matter could be achieved by implementing the internship program during the period of study in a vocational education school which has a related industrial field (Ocampo et al., 2020).

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles repair or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system. Currently, these five tasks are implemented to the students by using the 'Continuity' model which means that the students should finish all the tasks continuously within 5 hours. However, the 'Continuity' model tends to cause work fatigue during the competency test, while the work fatigue will decrease the student's concentration and focus which will significantly cause poor competency test results. Nurhayati et al. investigated the effect of the increase in the production time on the productivity achieved. During the investigation, the muscle fatigue has occurred at a very high level of production time and the results showed that the productivity achieved are below the productivity target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough, headache, and many more which can cause the worker absence. In addition, lack of focus and concentration in the workplace due to work fatigue means a lack of safety awareness which can cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for the 'Continuity' test model showed unsatisfied results where the students feel under pressure during the five hours



competency test and under the assessor supervision. Moreover, most of the students suffer from pressure which is not only physical but also mentally pressured. This condition caused the students' competency score results are not optimal. This will decrease the students' opportunity to get their best results in the competency test, while the competency test score determines their opportunity for competing in labour market. Therefore, further evaluation of the 'Continuity' competency test model in vocational education schools is highly necessary for this global industrial era.

#### *Management of The Competency Test*

In vocational education, competency turns into an important aspect for the graduates as a benchmark that should be achieved by the students during their period of study to get a better job opportunity in labour market. Competency has two essential values which are first, authorities in carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and second, the capability to implement the knowledge, skills, and experience (Mulder, 2007). Competency test in vocational education school should have a comprehensive and multi-dimensional construction. Generally, there are three different competency levels, those are conceptual competence, procedural competence, and interpretative competence (Winther & Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job assignments that match the specific needs of the world business industry. Competency test is essential for the students in terms of the final decision whether the students pass or fail during their study in vocational education as well as to avoid the incompetent graduates in labour market (Johnson, 2008). Alternatively, the substance of the competency test is not only for testing the students but also to seek the validation of the students. The validation process itself focuses on how students work on each assignment such as used tools accuracy, their work attitude, and adhere to SOP, instead of the final results-oriented only (pass or fail).

However, in this current vocational education school in Central Java, Indonesia, the implemented competency test is only focused on the final result without considering the process and performance of the students in detail during the competency test. The competency test is conducted only one time simultaneously at the end of the students' period of study according to the curriculum order. This management of the competency test is considered less effective due to the implementation of the competency test is limited at a certain time. The impact adversely students' performance during the competency test as well as the assessors' validation of the students' performance. In addition, owing to the last semester implementation of the competency test, the students tend to struggle to do retest if they fail during the competency test due to the limited schedule. Therefore, the innovation on the management of the competency test is highly necessary in order to significantly improve the quality of vocational education graduates. Proper management of the competency test is proposed in this research which aimed to give the students a bigger opportunity to perform better and get their best result during the competency test. The proper management of the competency test allows the students to take the assignments at any time as long as the quota meets the minimum requirements. The school will provide a minimum quota for each task to be carried out. Thus, the assessor could give detailed assessment and validation based on the requested ongoing assignment whether the students are passed or failed on their competency test. However, if the student failed, they will be given a chance to practice more in the workshop during their study, then they could take another competency test in the next semester. The proposed management of the competency test is involving teachers, internal assessors, and external assessors (field experts: mechanics or automotive experts).

#### *The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labour market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &

Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to the vocational education graduates are focus on the industrial labour market (Ahmed, 2016; Pema & Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labour market and improve job opportunities.

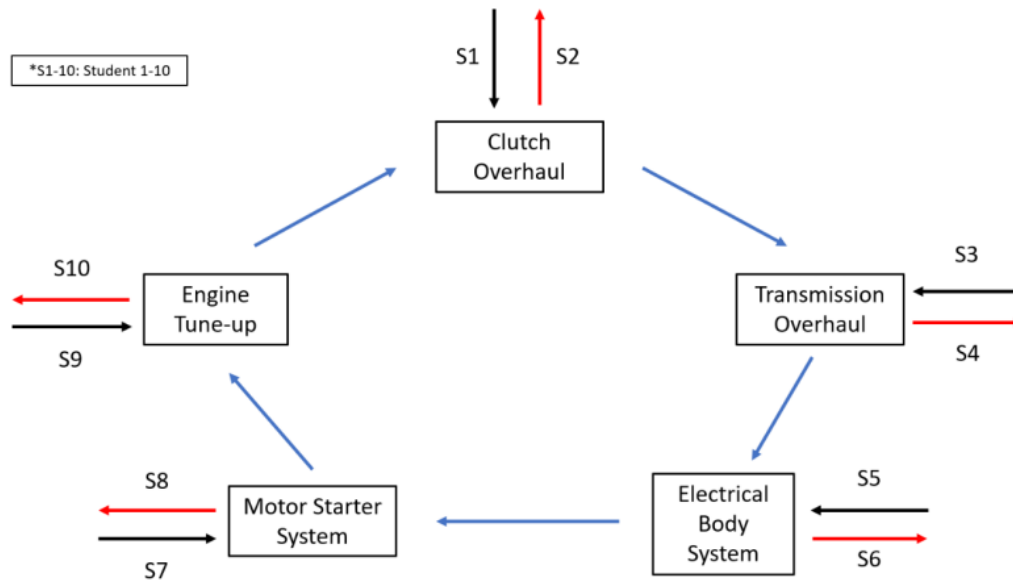
#### *The 'Discontinuity' Competency Test Model*

Therefore, in this present study, the alternative model of competency test for vocational education called the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the 'Discontinuity' model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 hours with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O'Neill & Panuwatwanich, 2013). This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analysing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational improvement.

## **2. Methods**

This study was focused on a descriptive quantitative method with data collected through a questionnaire that describes the educational reality regarding the level of students' satisfaction with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). Two different models were implemented to collect the data which were 'Continuity' and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The 'Continuity' model means the students must finish 5 competency tasks continuously within 5 hours with a very limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain time (1 hour) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the 'Discontinuity' model is shown in Figure

1. The 'Discontinuity' model is considered to be more feasible and could significantly improve the students' competency test final score.



**Figure 1.** Schematic diagram of the 'Discontinuity' competency test model.

This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyse the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students fatigue during the competence test, students score acquisition, and competency test management.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The students' evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. The samples consisted of 5 teachers from each school which have a total of 50 teachers and 10 students from each school which have a total of 100 students. The research data were collected through the application of the "Continuity" and "Discontinuity" competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using

Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the author.

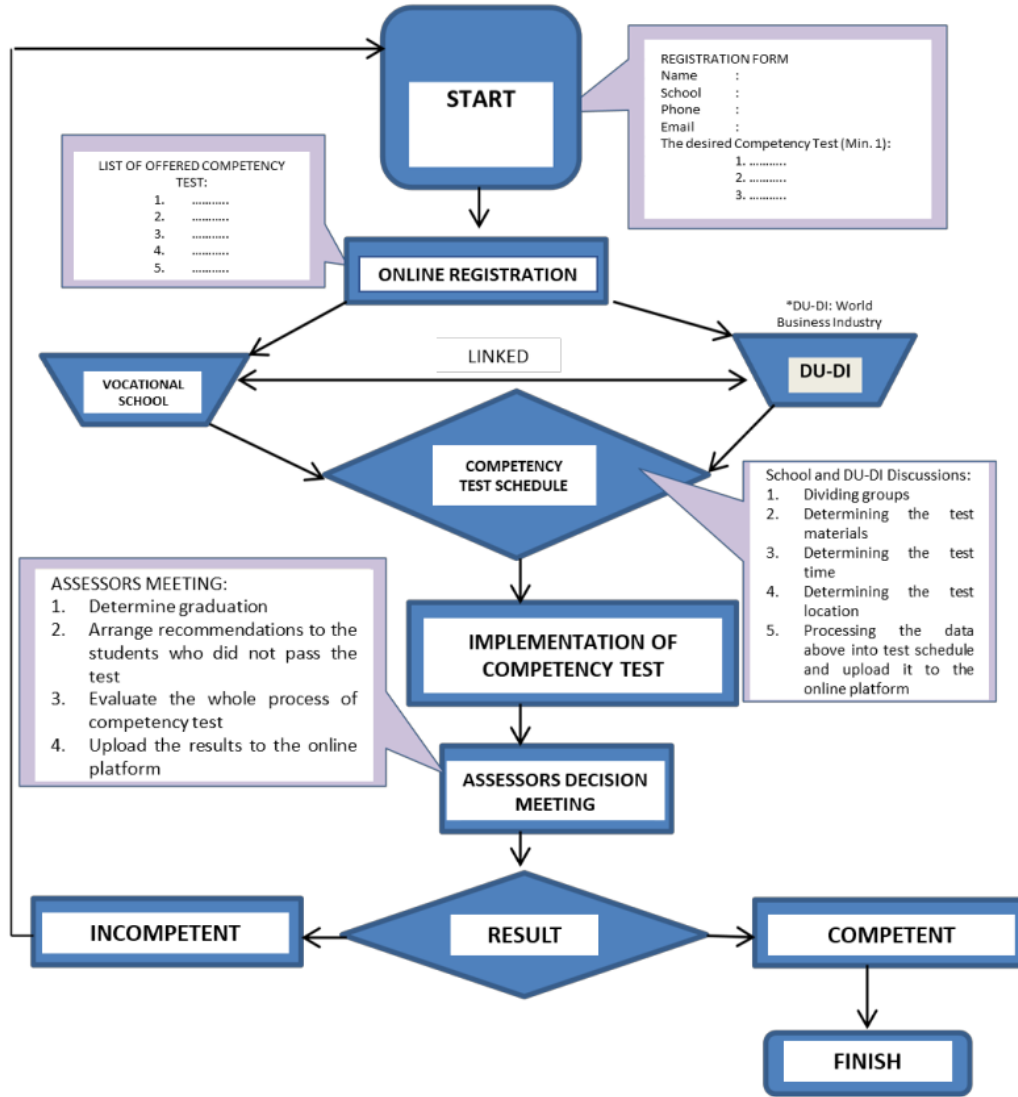


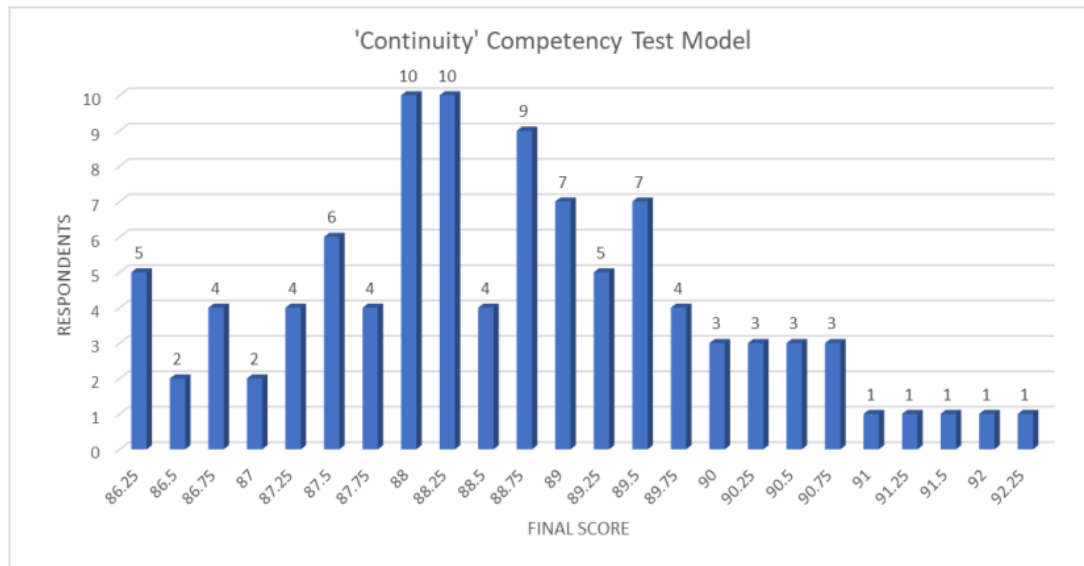
Figure 2. Schematic diagram of the proposed competency test management.

### 3. Results and Discussion

This present study revealed the comparison between the ‘Continuity’ test model and the ‘Discontinuity’ test model that has been done in vocational schools in Central Java, Indonesia within the period of March



to April 2020. Figure 3 and Figure 4 indicates the correlation between the number of respondents and the final score of the competency test using the 'Continuity' and the 'Discontinuity' model respectively.



**Figure 3.** Schematic graph of the 'Continuity' competency test model results.

Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

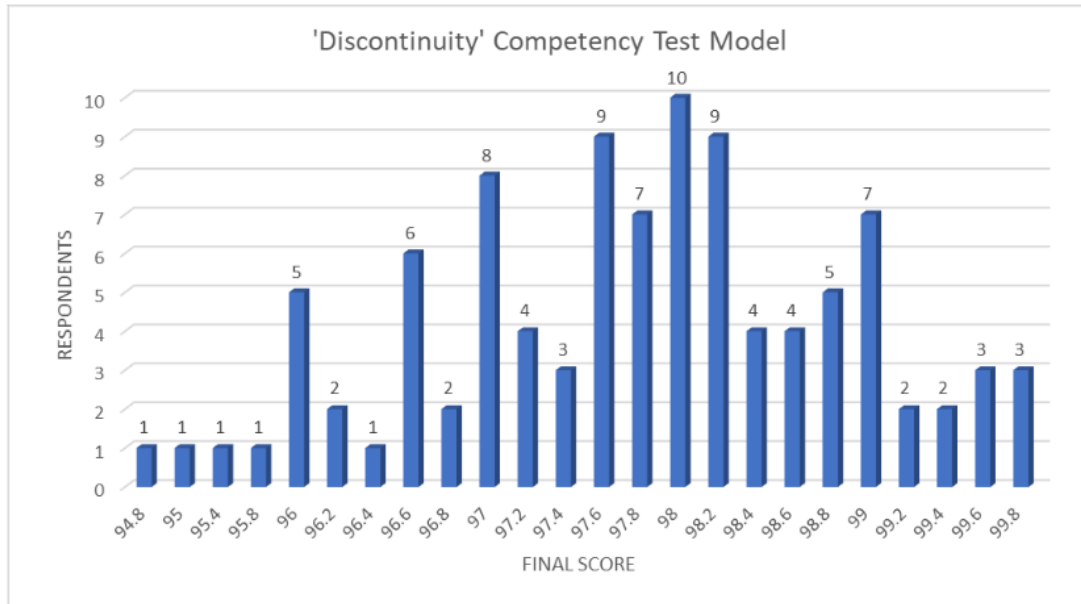
**Table 1.** Students' competency score based on criteria classification of the 'Continuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the 'Continuity' competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the 'Good' level. The numbers of students with 'Good' level were 86 students. Meanwhile, the students with 'Very good' level were only 14 students which indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the 'Continuity' competency test model which was only achieved by one student. This score level indicates the students' capability and convenience during the competency test. In this global industrial era, a 'very good' level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test results



of the students should be carried out. Otherwise, the vocational education schools fail to become a bridge between the graduates and the labour market.



**Figure 4.** Schematic graph of the 'Discontinuity' competency test model results.

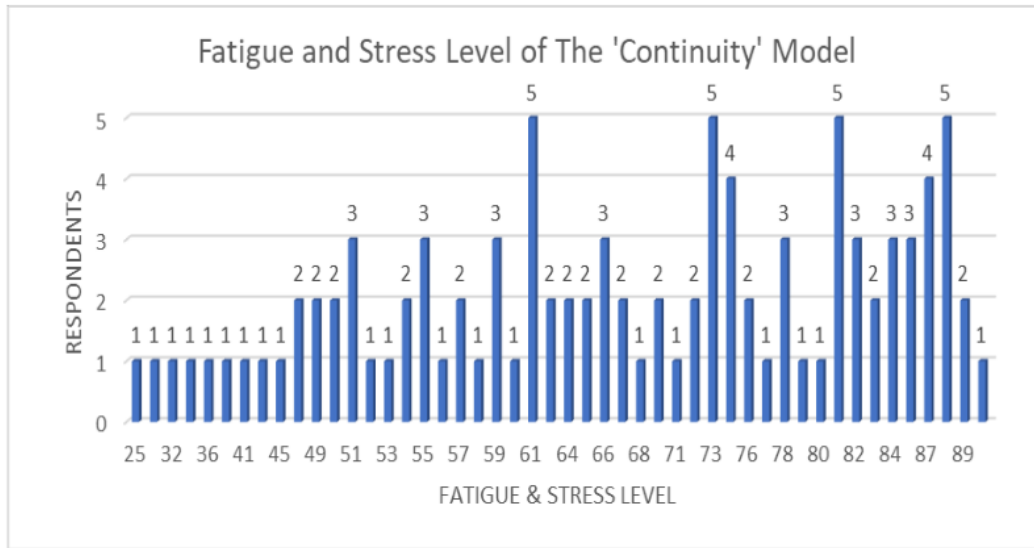
Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 2.** Students' competency score based on criteria classification of the 'Discontinuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

Meanwhile, based on the 'Discontinuity' competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at 'Very good' level. The lowest score was 94.8, while the highest score for the 'Discontinuity' competency test model was 99.8. Although both 'Continuity' and 'Discontinuity' competency test model results were still acceptable, the 'Discontinuity' competency test model emphasize the optimum final score of the students. One hour of rest and break time that given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in labour market.



**Figure 5.** Schematic graph of the fatigue and stress level of the 'Continuity' competency test model.

Criteria:

15 – 30 : Very not tiring

31 – 45 : Not tiring

46 – 60 : Enough

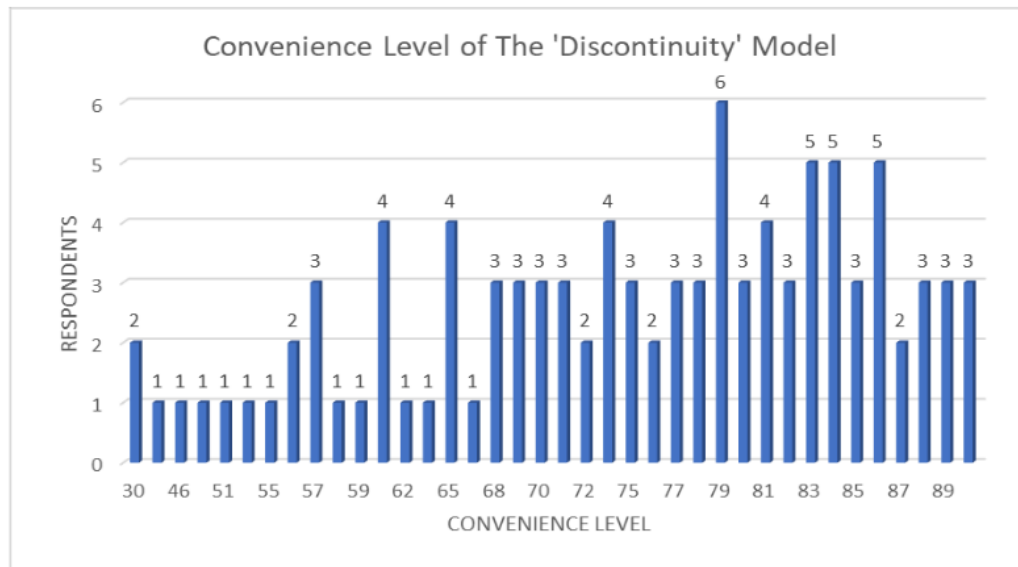
61 – 75 : Tiring

76 – 90 : Very tiring

**Table 3.** Students' fatigue level criteria classification of the 'Continuity' model.

Criteria	Very Not Tiring	Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

Figure 5 and Table 3 indicated the fatigue level survey that has been given to the respondents regarding the 'Continuity' competency test model. The results revealed that students tend to feel very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated at the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affecting the students' fatigue and stress level.



**Figure 6.** Schematic graph of the fatigue and stress level of the 'Discontinuity' competency test model.

Criteria:

15 – 30 : Very uncomfortable

31 – 45 : Uncomfortable

46 – 60 : Enough

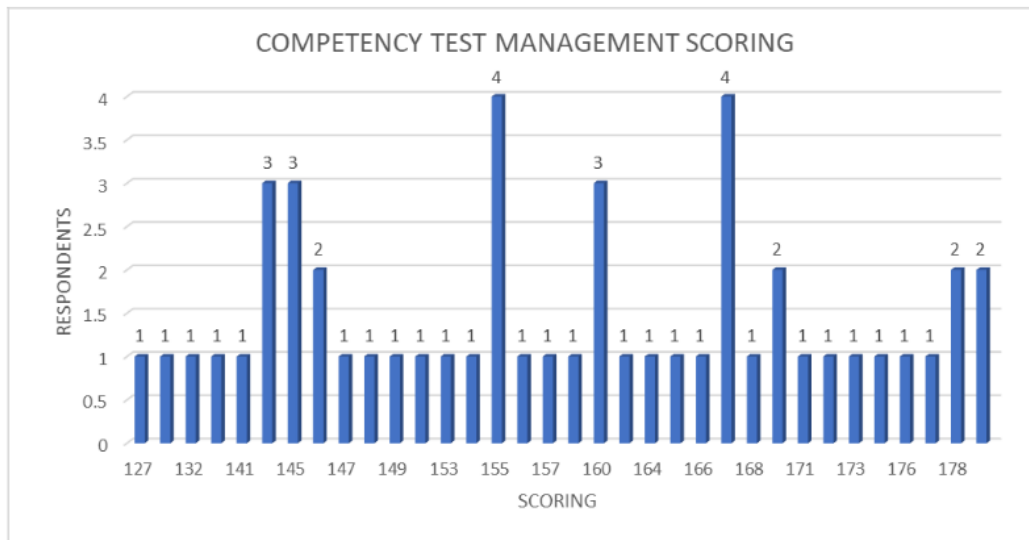
61 – 75 : Comfortable

76 – 90 : Very comfortable

**Table 4.** Students' convenience level criteria classification of the 'Discontinuity' model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

Figure 6 and Table 4 revealed the survey result that has been given to the students according to their opinion on the implication of the 'Discontinuity' model regarding their convenience during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the students are comfortable and very comfortable with the application of the 'Discontinuity' test model. It is in accordance with their final score of the competency test results which indicated significant improvement and better results during the competency test. 53 students stated at the 'very comfortable' category, 32 students stated at the 'comfortable' category, 12 students stated at 'enough' category, 1 student stated at the 'uncomfortable' category, and only 2 students stated at 'very uncomfortable' category. This result proves that the application of the 'Discontinuity' test model gives better comfortability to the students as well as reduce their fatigue and stress level. Therefore, the final score of the competency test could be increased significantly. The 'Discontinuity' model gives the students the opportunity to take a break for an hour in between the tasks in order to recover their focus and concentration to conduct the next following competency test. Therefore, they can refresh their mind to avoid high-stress level during competency test and take a break to relax their body due to the high intensity and pressure of the competency test. This 'Discontinuity' competency test model is established to fulfill the students' desire to get the optimum competency test result to support their assets and increase their opportunity in labour market. In terms of quality, the vocational education school in which implementing this method could significantly gain massive improvement by graduating students with a high competency level.



**Figure 7.** Schematic graph of the proposed competency test management scoring.

Criteria:

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 5.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total Respondents	-	-	-	16	34

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated 'very agree' and 16 teachers stated 'agree'. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students' opportunities in the labour market improved owing to the students' competency final score improvement.

#### 4. Conclusion

Fatigue and stress levels of the vocational education students could adversely impact the competency test result. The current competency test model for vocational education in Central Java, Indonesia is a 'Continuity' competency test model. This model tends to give low scores on students' competency test results due to the lack of time to break where the students must finish five tasks within 5 hours, thus, it causes the students' focus and concentration to decrease significantly. To overcome this problem, the implementation of the 'Discontinuity' model was proposed. By giving one-hour time to break for the student and the competency test could be done alternately, fatigue, and stress level of the students could significantly decrease. Consequently, the result shows that the final score of the student's competency test

result was significantly improved. All the ‘Discontinuity’ model-based results showed in the ‘very good’ category. In addition, the survey results showed that the students feel more comfortable using the ‘Discontinuity’ competency test model than that ‘Continuity’ competency test model as well as the teachers satisfied with the proposed competency test model. The improvement in the competency test result is very important for the student who will be facing the labour market after graduated from vocational education. However, the industry considers students with a high competency score to join their company rather than the lower score one. In addition, a new competency test management is proposed in this study by allowing the students to take the competency test at any time since their first semester of study through an online platform that directly connected with vocational school management and DU-DI (World Business Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency test management. However, the proposed competency test management will ease the students and teachers to achieve an optimum final score of the competency test as well as improve the vocational school quality.

## Declarations

### Author contribution statement

Abdurrahman: Conceptualization; Methodology; Performed research; Analysed and interpreted the data; Wrote the paper.

Parmin and S. Muryanto: Validation; Visualization; Supervision; Reviewed and edited the paper.

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### Competing interest statement

The authors declare no conflict of interest.

### Additional information

No additional information is available for this paper.

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CC: "Parmin Parmin" [parmin@mail.unnes.ac.id](mailto:parmin@mail.unnes.ac.id), "Stefanus Muryanto" [stmuryanto@untagsmg.ac.id](mailto:stmuryanto@untagsmg.ac.id)

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Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

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Journal: Heliyon

Dear Dr. Abdurrahman,

Thank you for submitting your manuscript to Heliyon.

We have completed the review of your manuscript and a summary is appended below. The reviewers recommend major revisions are required before publication can be considered.

If you are able to address all reviewer comments in full, I invite you to resubmit your manuscript. We ask that you respond to each reviewer comment by either outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism. This should be carried out in a point-by-point fashion as illustrated here:

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We understand that the global COVID-19 situation may well be causing disruption for you and your colleagues. If that is the case for you and it has an impact on your ability to make revisions to address the concerns that came up in the review process, please let us know so we can discuss with you potential revision deadline extensions. Please also note that Heliyon focuses on technically correct science and so you are only expected to include revisions that are necessary to ensure that the content and the conclusions of the research are technically correct.

I look forward to receiving your revised manuscript.

Kind regards,

Jin Su Jeong, Ph.D. Ph.D.

Associate Editor - Education

Heliyon

Editor and Reviewer comments:

Reviewer #1: Methods: (1) Give details of the time of each Competency Test Unit? What is the basis that the time for each competency unit is the same or different?

(2) How is the sampling technique?

What is the total population and sample of 10 school data?

What are the researchers' reasons, sample selection and why was it only carried out in Central Java to provide a comprehensive argument?

Why is it only done at public schools, don't all private vocational schools also apply competency tests?

(3) Describe how the instrument is generated for research?

Give a sample of your instrument, how it is assessed, and what is the difference between the level of the instrument between the teacher, the head of the department, and the head of the laboratory?

Why were students not involved in the research? We see that there are stress variables aimed at students.

(4) Emphasize data collection techniques and data analysis techniques as well as data interpretation in decision making from evaluation research

Results: Do these results apply to all tests that are being performed?

Are the characteristics of each test the same? if applicable?

It is better if the evaluation is carried out on every competency test carried out, so that it can be seen in what



competency test, at what minute do students start to feel tired? In these conditions, the role of the researcher is to provide solutions to the problems that occur.

Interpretation: Add data to support the ongoing fatigue and stress? and Provide a conceptual description of the two models, to clarify understanding?

Other comments: Add a subsection that describes the important findings of the research you conducted? or findings that support broad knowledge and apply to TVET globally

Reviewer #2:

I give for consideration to formulate a research question or hypothesis. Discussion chapter is missing. It would be suitable for summarizing overall results, comparing them with other results of other authors, etc. or research question evaluation. In conclusion, please evaluate the limitations of the research carried out and its evaluation.

\*\*\*\*\*

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Abdurrahman

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Pada tanggal Sen, 15 Feb 2021 pukul 12.49 Abdurrahman Abdurrahman <[abdurrahman@mail.unnes.ac.id](mailto:abdurrahman@mail.unnes.ac.id)> menulis:

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## HELIYON-D-20-08525 Response to Reviewers' Comments

### **Comment #1: [Abstract – p#2, l#24-25]**

*Adjust to the research objective, namely evaluation. If the increase is more in action research or experiment.*

### **Response to Comment #1:**

We agree with the reviewer that adjustment is needed. Results of our investigation show that time interval, namely a break between two test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour. The manuscript has been revised accordingly.

### **Original Version (OV) #1:**

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market.

### **Revised Version (RV) #1:**

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency with the possibility to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market. Results of our investigation show that time interval, namely a break between two successive test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour.

**Comment #2: [Abstract – p# 2 lines 28-30]**

*Tell us how the researcher did his research? How many samples are involved, how to collect data, how to analyze data?*

**Response to Comment #2:**

The manuscript has been revised as per reviewer's comment. More elaboration is to be found in the Methods section.

**OV #2:**

Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model.

**RV #2:**

Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model. One hundred students from ten vocational schools with five instructors for each school were tested online. The test allowed the students to select the competence materials based on the students' previous experience.

**Comment #3: [Abstract – p #2 lines #34-35]**

*The research results are not described, other than that the findings from the research have not yet appeared.*

**Response to Comment #3:**

The manuscript has been revised accordingly.

**OV #3:**

This reasonably happened due to the implementation of the 'Discontinuity' model gives the students time to break for an hour of each competency task. Without this break time fatigue and stress level of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.

**RV #3:**

This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Most of the students tested (86%) obtained satisfactory level. Excellent results were obtained by 14% of all the students. It can be concluded therefore, that the application of the discontinuity model could be superior to the continuous one. Without this break time fatigue and stress level of the students will significantly increase which adversely affect the students’ competency final score. In addition, the new management of the competency test was proposed in this research.

**Comment #4: [Introduction p #21 # 55-57**

*Add the competency test data that occurred in Indonesia.*

**Response to Comment #4:**

The manuscript has been revised accordingly.

**OV #4:**

The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). Indeed, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020).

**RV #4:**

The vocational education schools carry out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). Indonesian vocational schools are believed to have implemented appropriate educational objectives (Suharno et al., 2020). However, findings from a number of researchers show that improvement is still required.

Indeed, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020).

**Comment #5: [Introduction – p 3 l 12 – 14]**

*Add the following research results: Muhammad Nurtanto, Zainal Arifin, Herminarto Sofyan, Warju Warju, Soffan Nurhaji "Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme.*

**Response to Comment #5:**

We agree with the reviewer. The article was cited.

**OV #5:**

The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011; Muja et al., 2019).

**RV #5:**

The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011; Muja et al., 2019). Moreover, as stated by Nurtanto et al. [2020], assessment of the competency tests carried out in vocational schools would greatly improve if ethical aspects are included. Such aspects would be further considered seriously in the authors' future investigations.

**Comment #6: [Introduction – p #3, l #44-46]**

*Add an explanation regarding the choices from the competency tests offered in Indonesia. What is the position of the competency test conducted by the competency test (LSP)? Does it have the same confession?*

**Response to Comment #6:**

The revised manuscript has been revised incorporated the response to the comment.

**OV #6:**

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles reparation or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system.

**RV #6: p #3, l #44-46**

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles reparation or maintenance. The current competency test conducted was approved by the Indonesian stake holders, i.e. LSP (Board of Profession Certification). The authors of the current paper believe that novelty of the present test was the choice offered to the students whenever they felt ready for the test. The previous test was only available at final semesters. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system.

**Comment #7: (Introduction – p #4 lines #51 - 53)**

*Add data to support the ongoing fatigue and stress?*

**Response to Comment #7:**

In the original version of the manuscript the data of fatigue and stress related to the continuous test has been elaborated in the paragraphs that follow. The statement in the paragraphs supporting the data is highlighted in yellow. Therefore, the whole section on: The Effect of Fatigue and Stress Level, would remain the same.

**OV #7:**

*The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labour market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad & Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue



and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to the vocational education graduates are focus on the industrial labour market (Ahmed, 2016; Pema & Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labour market and improve job opportunities.

#### **RV #7:**

##### *The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labour market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &

Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers fatigue and stress level increases (Hsouana et al., 2019; Safitri & Rusdiana, 2010). The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad & Brown, 1995).

**Comment #8: (Introduction – p #5 lines 28 - 41)**

*Provide a conceptual description of the two models, to clarify understanding?*

**Response to Comment #8:**

To clarify the concepts the manuscript has been revised. The revision is highlighted.

**OV #8:**

The ‘Discontinuity’ Competency Test Model

Therefore, in this present study, the alternative model of competency test for vocational education called the ‘Discontinuity’ test model has been proposed and investigated in detail. The concept of the ‘Discontinuity’ model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 hours with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O’Neill & Panuwatwanich, 2013). **This current study aims to**

observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analysing the competency test score of the vocational education students in **Central Java, Indonesia**. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, **Indonesia** (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational improvement.

#### **RV #8:**

This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analysing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational improvement. The previous test comprised of five units and was administered continuously without any break. In addition, the students were not free to select the units in which they are most conversant whenever they feel ready to do so.

#### **Comment #9: (Methods – p #6 Figure 1)**

*Give details of the time of each Competency Test Unit? What is the basis that the time for each competency unit is the same or different?*

#### **Response to Comment #9:**

The reviewer's comment concerning Figure 1 has been answered. The Figure was revised accordingly. It is explained that:

one (1) test unit took 60 minutes to complete. The five test units were equally similar, therefore they were taken with the same amount of time.

#### **OV #9:**

Figure 1 Schematic diagram of the 'Discontinuity' competency test model.

**RV #9:**

Figure 1 Schematic diagram of the ‘Discontinuity’ competency test model [one competency unit = 60 mins]

**Comment #10: [Methods - p #6 lines #33 – 42]**

*How is the sampling technique?*

*What is the total population and sample of 10 school data?*

*What are the researchers' reasons, sample selection and why was it only carried out in Central Java to provide a comprehensive argument?*

*Why is it only done at public schools, don't all private vocational schools also apply competency tests?*

**Response to Comment #10:**

We agree with the reviewer. Elaboration is needed, and has been done. The elaboration is shown highlighted in the revised text between Fig. 1 and Fig. 2

The current research used a purposive sampling, namely those schools having automotive programs. The total population and the sample data were both given in the text. To ensure sampling homogeneity only public schools were investigated. The homogeneity includes curriculum and teacher competence or qualifications. It is the authors' intention to carry out a similar test for private schools.

**OV #10:**

This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyse the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students fatigue during the competence test, students score acquisition and competency test management.

## RV #10:

This study was conducted in Central Java, Indonesia, involving students and teachers from ten Vocational High Schools. Due to the different characteristics between public and private vocational schools, only the public ones were currently investigated. In addition, such selection of involving only public schools was also meant to ensure sampling homogeneity, primarily included the curricula and qualifications of the teachers. The experiment consisted of the common stages of research, i.e. formulation of problem statement and objectives, designing the experimental instrument, determining the sampling techniques, data collection and analysis, conclusion on experimental findings.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The students' evaluation of the competency test covered the following skills: task skill, task management skill, contingency management skill, environment skill, and transfer skill. It was proposed that such proposed management will ease the students to get the optimum result of their competency test. The students were allowed to take the test at any time after the first semester of their study as long as the minimum requirements are met. The test content was formulated in collaboration between the vocational schools and the stakeholders, namely the industrial sectors involving automotive skills. The schematic diagram of the competency test is shown in Figure 2.

Each student (100 students in all) completed five (5) units of the competency test. These units were: engine tune-up, engine overhaul, transmission overhaul, electrical, and motor starter, respectively. The test using the continuous mode was carried out first. Then, the next day the students repeated the test with the discontinuous mode. Each test unit took 60 minutes to complete, hence undertaking the continuous test mode would require a continuous time period of five hours.

Each unit of the five tests was designed by the first author (Abdr) to have the same level of difficulty. Having been supervising automotive practicals at vocational high schools for over thirty years it is believed he is conversant with the five test units investigated. Therefore, it was considered that the validity of the tests was sufficiently assured. In addition, the test materials as well as their implementation were also examined and subsequently approved by the relevant stakeholders.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. The samples consisted of 5 teachers from each school which have a total of 50 teachers and 10 students from each school which have a total of 100 students. The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the authors.

**Comment #11: [Methods – p# 6, lines #46-51]**

*Describe how the instrument is generated for research?.*

*Give a sample of your instrument, how it is assessed, and what is the difference between the level of the instrument between the teacher, the head of the department, and the head of the laboratory?*

*Why were students not involved in the research? We see that there are stress variables aimed at students.*

**Response to Comment #11:**

We agree with the reviewer. The article has been rewritten to accommodate the comment.

Rebuttal: as can be seen in the text the students were involved in this research.

**OV #11:**

The students’ evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.



### **RV #11:**

The students' evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2. The instrument used was previously approved by the principals of the intended vocational schools. Moreover, it has also been approved by the ethics committee within the authors' institution. Elaboration of the instrument is as follows.

Two types of instruments were used in this study. The first type of it was applied to the students, while the second was intended for teachers, lab heads, and school principals, respectively. As is customary in vocational school practices, teachers, lab heads as well as school principals are mandated the same, i.e. to teach the students. Managing the school and the labs are both additional duties for the teachers. Therefore, the experimental instrument applied to the three groups of teachers was essentially similar. The instrument consisted of 30 questions and was designed to uncover the opinion of these groups of teachers on the competency Test Model offered in this study. Each question provided six choices: 1, 2, 3, 4, 5, and 6. Choice number one (1) indicates "very" in a negative sense, while the other extreme, i.e. number six (6) signifies the same weighting positively. As an example, the model presently offered allows the students to freely select the testing time whenever they are ready for it. Then, agreeing to this test method would mean "very agree" and carries six (6) points. Consequently, number (1) would mean the opposite extreme, i.e. "very disagree". As regards the scoring, the minimal score was  $1 \times 30 = 30$ , and the maximum one equals  $6 \times 30 = 180$ .

**Comment # 12: [Methods – p #6 lines #58-59]**

*Emphasize data collection techniques and data analysis techniques as well as data interpretation in decision making from evaluation research.*

**Response to Comments #12:**

Rebuttal: the answer to the reviewer’s comment can already be found anywhere in the Methods section. Revision is not required. The text remains the same.

**OV #12:**

The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the authors.

**RV #12:**

The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyze the advantages and disadvantages of the proposed management given by the authors.

**Comment #13: [Results and Discussion – p #8 lines 4-5]**

*Do these results apply to all tests that are being performed?*

*Are the characteristics of each test the same? if applicable?*

*It is better if the evaluation is carried out on every competency test carried out, so that it can be seen in what competency test, at what minute do students start to feel tired? In these conditions, the role of the researcher is to provide solutions to the problems that occur.*

**Response to Comment #13:**

As can be seen in Fig 1, five test units were given with similar characteristics. We disagree with the reviewer’s comments. In our investigation all the factors proposed have been investigated, with the intention to resolve the previous problem using continuity tests. The revised version of

the text accommodates some revision. Moreover, the grammatical errors in the text have been corrected.

**OV #13:**

Figure 3 and Figure 4 indicates the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.

**RV #13:**

Figures 3 and 4 indicate the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.

**Comment #14: [**

*Add a subsection that describes the important findings of the research you conducted? or findings that support broad knowledge and apply to TVET globally.*

**Response to Comment #14: [Results and Discussion – last paragraph]**

The subsection as required has been added.

**OV #14:**

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labour market improved owing to the students’ competency final score improvement.

**RV #14:**

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’

and 16 teachers stated 'agree'. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students' opportunities in the labour market improved owing to the students' competency final score improvement. As implemented in the present research the students were allowed to undertake the test(s) in which they find the most conversant in. Secondly, time intervals or time breaks were given during the test so that students could have a temporary rest to restore stamina. As shown in the test results, such preference, i. e. selecting the test materials most mastered as well as the provision of time break, results in the students to obtain a much better performance.

**Comment #15: [Conclusion – 1<sup>st</sup> par, 1<sup>st</sup> and 2<sup>nd</sup> sentences].**

*Does this apply to normal conditions or the new normal? When viewed from data collection, the model evaluation was carried out during pandemic conditions. So it is better if the conclusions are more careful and reinforce the conditions intended.*

**Response to Comment #15:**

Rebuttal: the research was carried out just before the COVID-19 pandemic, namely the fourth week of February 2020 until the second week of March 2020. The timing was still in compliance with the regional government decrees concerning the health protocols as required. Therefore, the evaluation and findings of this investigation was considered as applicable to normal conditions.

**Comment #16: [References – p #13]**

*The following research is relevant to your research that should be added:*

1. Nurtanto, M., Arifin, Z., Sofyan, H., Warju, W., & Nurhaji, S. (2020). Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme. *Journal of Technical Education and Training*, 12(2), 34–45. <https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/5152>

2. Nurtanto, M., Pardjono, P., Widarto -, & Ramdani, S. D. (2020). The Effect of STEM-EDP in Professional Learning on Automotive Engineering Competence in Vocational High School. *Journal for the Education of Gifted Young Scientists*, 8(2), 633–649. <https://doi.org/10.17478/jegys.645047>

**Response to Comment #16:**

We have scrutinized the two papers as suggested. They are relevant to our current paper and have been cited accordingly. The two articles were listed in References.

**Comment #17: [References]**

*Adjust the reference rules.*

**Response to Comment # 17:**

Thank you for the reviewer's comment. Adjustment has been made as required.

6. Second Revision: Accepted with Major Revision  
(24-04-2021)





Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

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## Decision on submission HELIYON-D-20-08525R1 to Heliyon

4 messages

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Heliyon <em@editorialmanager.com>

Sat, Apr 24, 2021 at 3:41 PM

Reply-To: Heliyon &lt;info@heliyon.com&gt;

To: Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

Manuscript. Number.: HELIYON-D-20-08525R1

Title: Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Journal: Heliyon

Dear Dr. Abdurrahman,

We have now received all of the reviewers' comments on your recent submission to Heliyon.

The reviewers have advised that your manuscript should become suitable for publication in our journal after appropriate revisions.

If you are able to address the reviewers' comments, which you can find below, I would like to invite you to revise and resubmit your manuscript. We ask that you respond to each reviewer comment by either outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism. This should be carried out in a point-by-point fashion as illustrated here: <https://www.cell.com/heliyon/guide-for-authors#Revisions>To allow the editors and reviewers to easily assess your revised manuscript, we also ask that you upload a version of your manuscript highlighting any revisions made. You may wish to use Microsoft Word's Track Changes tool or, for LaTeX files, the latexdiff Perl script (<https://ctan.org/pkg/latexdiff>).To submit your revised manuscript, please log in as an author at <https://www.editorialmanager.com/heliyon/>, and navigate to the "Submissions Needing Revision" folder under the Author Main Menu. Your revision due date is May 24, 2021.

We understand that the COVID-19 pandemic may well be causing disruption for you and your colleagues. If that is the case for you and it has an impact on your ability to make revisions to address the concerns that came up in the review process, please reach out to us.

I look forward to receiving your revised manuscript.

Kind regards,

Jin Su Jeong, Ph.D. Ph.D.  
Associate Editor - Education  
Heliyon

Editor and Reviewer comments:

Reviewer #1: Methods: Check again. Sample details and their arguments for determination, who were the respondents selected and why?, how was the data collected?, how were the data analysis techniques?, how did the researcher decide that the instrument was standardized and capable of being a test standard?

Results: The statistical data in the study is very limited, the researcher loses the differences between the two models, the characteristics of the respondents, and the competencies in them. The presentation data is still monotonous.

Interpretation: Adjust the results presentation notes. In-depth discussion is strengthened by statements (concepts) or empirical data from previous researchers. Bring out the important findings from the research

Other comments: Clarify the research question and adjust the conclusions in the study. Review the use of terms in a global context.

**Reviewer #5: Methods:**

1. Please ensure your research design is correct as mentioned in the prominent research textbook. In your case, I believed is either ex-post facto or survey design (not survey questionnaire although you also utilized survey questionnaire as instrument).
2. Explain your sample in one place only and make sure you explain it thoroughly such as how you divide your group.
3. The teachers is no include as your sample in this case.

**Results:**

1. Descriptive statistics results shown is good but not enough to claim your the result in the study.
2. Should include inferential statistics to claim about any differences in the groups.

**Interpretation:**

1. Should include the inferential statistics.

**Other comments:**

Should highlight the main issue especially on continuity model problem and why suggestion of discontinuity model in earlier section NOT only emphasized on vocational education.

\*\*\*\*\*

**Data in Brief (optional):**

We invite you to convert your supplementary data (or a part of it) into an additional journal publication in Data in Brief, a multi-disciplinary open access journal. Data in Brief articles are a fantastic way to describe supplementary data and associated metadata, or full raw datasets deposited in an external repository, which are otherwise unnoticed. A Data in Brief article (which will be reviewed, formatted, indexed, and given a DOI) will make your data easier to find, reproduce, and cite.

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**2 attachments**

 **HELIYON-D-20-08525\_R1.pdf**  
3085K

 **HELIYON-D-20-08525\_reviewer orig.docx**

7. The author requests the additional time to finish the revision until 31 May 2021



Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

---

**Re: Your revision is due [210519-002993]**

3 messages

---

**Heliyon** <info@heliyon.com>  
Reply-To: Heliyon <info@heliyon.com>  
To: abdurrahman@mail.unnes.ac.id

Wed, May 19, 2021 at 10:14 AM

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Best Regards

The Heliyon Team

---

**From:** Abdurrahman Abdurrahman  
**Date:** 19/05/2021 03.14 AM

Dear Editor Team,

Thank you very much for reminding the due date of the revision's submission. We are now still working on our revision and apparently it takes more time than we were expected. Therefore, we would like to humbly request additional time for the submission to **31 May 2021**.

Your kind attention and understanding are highly appreciated.

Best regards,  
Dr. Abdurrahman.

On Mon, May 17, 2021 at 2:50 PM Heliyon <em@editorialmanager.com> wrote:

Ref.: Ms. No. HELIYON-D-20-08525R1

Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia  
Heliyon

Dear Dr. Abdurrahman,

Thank you for submitting your manuscript "Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia", which has now been sent to you for revision, to Heliyon. This is a reminder to complete your revision.

As this revision is now due within 7 days, we wanted to take the opportunity to check on your progress with the revision. If you think you will need additional time to complete your revision, please send us a quick message letting us know your general timeline. It is absolutely fine if you need additional time, but having an idea of when to expect your revision would be helpful.

To submit your revision, please log into Editorial Manager at: <https://www.editorialmanager.com/HELIYON/>.

We look forward to hearing from you, and thank you again for supporting Heliyon, an open access journal that is part of the Cell Press family.

Kind regards,

Heliyon

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**Heliyon** <info@heliyon.com>  
Reply-To: Heliyon <info@heliyon.com>  
To: abdurrahman@mail.unnes.ac.id

Wed, May 19, 2021 at 11:46 AM

Dear Dr Abdurrahman,

Thank you for your email regarding your request to extend the due date to submit your revised paper HELIYON-D-20-08525R1.

The deadline has been extended until May 31, 2021. Please submit the paper on or before the said date.

Please feel free to contact me if you need further assistance.

Kind regards

Sharon Joy Lintao  
Researcher Support  
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---

**From:** Administrator  
**Date:** Wednesday, May 19, 2021 03:14 AM GMT

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Best Regards

The Heliyon Team

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**From:** Abdurrahman Abdurrahman  
**Date:** Wednesday, May 19, 2021 03:14 AM GMT

[Quoted text hidden]

[Quoted text hidden]

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**Abdurrahman Abdurrahman** <abdurrahman@mail.unnes.ac.id>  
To: stefanus Muryanto <stmuryanto@untagsmg.ac.id>

Thu, May 27, 2021 at 9:11 PM

[Quoted text hidden]

8. Revision 2: Revised version received (31 May 2021)  
- Response to reviewer



Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

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## Confirming submission to Heliyon

2 messages

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**Heliyon** <em@editorialmanager.com>  
Reply-To: Heliyon <info@heliyon.com>  
To: Abdurrahman Abdurrahman <abdurrahman@mail.unnes.ac.id>

Mon, May 31, 2021 at 8:31 PM

\*This is an automated message.\*

Manuscript Number: HELIYON-D-20-08525R2

Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Dear Dr. Abdurrahman,

We have received the above referenced manuscript you submitted to the Education section of Heliyon. To track the status of your manuscript, please log in as an author at <https://www.editorialmanager.com/heliyon/>, and navigate to the "Revisions Being Processed" folder.

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Heliyon

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**Abdurrahman Abdurrahman** <abdurrahman@mail.unnes.ac.id>  
To: Heliyon <info@heliyon.com>

Mon, May 31, 2021 at 8:35 PM

Dear Editor,

We are writing this email in order to deliver a confidential note to the Editor,  
We regret to inform you that it is rather difficult to fully comprehend the reviewers' comments due to non-standard English used by the reviewers.

Highly appreciated for your kind consideration and attention.  
Thank you in advance.

Regards,  
Abdurrahman  
[Quoted text hidden]



# HELIYON-D-20-08525R1

## Response to Reviewers' Comments

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### HELIYON-D-20-08525R1 Response to Reviewers' Comments

Editor and Reviewer comments (your email of Sat, Apr 24, 3:42 PM)

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## **Reviewer #1:**

### **Comments #1 on Methods:**

Check again. Sample details and their arguments for determination, who were the respondents selected and why?, how was the data collected?, how were the data analysis techniques?, how did the researcher decide the instrument was standardized and capable of being a test standard?

### **Response to Comments #1:**

REBUTTAL: The authors have thoroughly checked the entire manuscript again and again. All the issues raised by Reviewer #1 regarding the Methods are already in place in the text. No significant amendment was made. In the revised version of the manuscript the minor revisions were highlighted.

### **Comments #2 on Results:**

The statistical data in the study is very limited, the researcher loses the differences between the two models, the characteristics of the respondents, and the competencies in them. The presentation data is still monotonous.

### **Interpretation:**

Adjust the results presentation notes. In-depth discussion is strengthened by statements (concepts) or empirical data from previous researchers. Bring out the important findings from the research.

### **Response to Comments #2:**

Some adjustments were carried out to address the reviewer's comment, i.e. some statements have been rewritten and results from previous/other similar research were cited. To some extent, we agree with the reviewer's comment. However, we do have some REBUTTAL. The revised version of the manuscript shows the adjustments and they were highlighted.

### **Our Rebuttal:**

For the current study, it is felt by the authors that a simple statistical analysis would be sufficient [Amrhein et. al., 2019]. As stated by one of the prominent figures in the area of statistical significance in research, i. e. Prof Valentin Amrhein\*, there are a number of research factors that are often far more important than statistical assessment. These factors may include background evidence, study design, data quality as well as comprehending the underlying mechanisms. In

certain situations, even removing statistical significance is recommended. Other prominent scholars in the area of statistics related to educational research were cited in the revised text.

**Comments:**

It was stated by Reviewer#1, that “the researcher loses the differences between the two models“.

**Response:**

REBUTTAL: The authors are inclined to disagree with the above statement. As elaborated throughout the text the differences between the two are definitely obvious.

**Other comments:**

Clarify the research question and adjust the conclusion in the study. Review the use of terms in a global context.

**Response to other comments:**

Conclusion has been rectified as required

**Reviewer #5:**

**Comments #1 on Methods:**

1. Please ensure your research design is correct as mentioned in the prominent research textbook. In your case, I believed is either ex-post facto or survey design (not survey questionnaire although you also utilized survey questionnaire as instrument).
2. Explain your sample in one place only and make sure you explain it thoroughly such as how you divide your group.
3. The teachers is no include as your sample in this case

**Response:**

The authors have difficulty in comprehending the comments due to seemingly non-standart English. As for the issues raised by the reviewer, the authors are inclined to disagree with the remarks. In the revised version of our manuscript our REBUTTAL is highlighted.

### **Comments #2 on Results:**

1. Descriptive statistics results shown is good but not enough to claim you're the result in the study.
2. Should include inferential statistics to claim about any differences in the groups.

### **Response:**

Again, sincerely the authors find it difficult to really understand the reviewer's remarks. Additionally, the authors are inclined to disagree with the remarks. In the Results and Discussion section of the revised manuscript they have argued rather strongly against the use of inferential statistics backed by some prominent figures in the area of statistics as well as educational sectors.

### **Interpretation**

1. Should include the inferential statistics.

### **Response.**

REBUTTAL.

The use of inferential statistics is also questionable. In the Results and Discussion section of the revised manuscript, some literature justifying the descriptive statistics is cited.

### **Other Comments:**

Should highlight the main issue especially on continuity model problem and why suggestion of discontinuity model in earlier section NOT only emphasized on vocational education.

### **Response**

Undoubtedly, it seems that the comment is stated in a non-standard English, although the authors can definitely grasp the substance.

REBUTTAL:

The authors would like to admit that they regret about the reviewer's comment as above. All the issues mentioned by the reviewer have already discussed at length in the Introduction; so much so that the Introduction was divided into four sub-sections. Therefore, no revision was carried out.

9. Third Revision: Accepted with major revision (13 Aug 2021)



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To submit your revised manuscript, please log in as an author. Your revision due date is Sep 12, 2021.

We understand that the COVID-19 pandemic may well be causing you to have concerns that came up in the review process, please reach out if you need any support.

I look forward to receiving your revised manuscript.

Kind regards,

Jin Su Jeong, Ph.D. Ph.D.  
Associate Editor - Education  
Heliyon

Editor and Reviewer comments:

Reviewer #5: Methods:

The author still not mentioned the design used in the study. Please explain in details about the experimental design such as pre

Results:

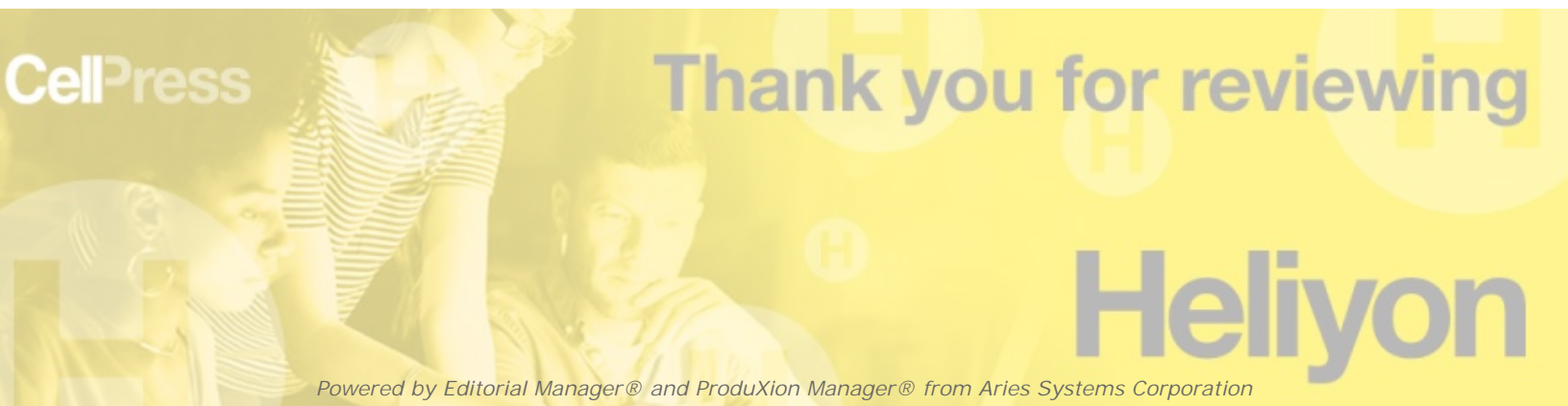
The author claimed that there are different between both test results. There is a significant difference between the two model inte

10. Revision 3: Revised version received (29 Aug 2021)  
- Response to reviewer

# Heliyon

## Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia --Manuscript Draft--

<b>Manuscript Number:</b>	HELIYON-D-20-08525R1
<b>Article Type:</b>	Original Research Article
<b>Section/Category:</b>	Education
<b>Keywords:</b>	Vocational Education; automotive; competency; Discontinuity model; competency test management
<b>Abstract:</b>	<p>This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market. Results of our investigation show that time interval, namely a break between two successive test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour. Currently, the applied competency test model is the 'Continuity' model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students' fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model. One hundred students from ten vocational schools with five instructors for each school were tested online. The test allowed the students to select the competence materials based on the students' previous experience. To research the effect of the 'Discontinuity' model implementation on the students' competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the 'Discontinuity' competency test model gives a significant improvement in the students' competency test scores. This reasonably happened due to the implementation of the 'Discontinuity' model gives the students time to break for an hour of each competency task. Most of the students tested (86%) obtained satisfactory level. Excellent results were obtained by 14% of all the students. It can be concluded therefore, that the application of the discontinuity model could be superior to the continuous one. Without this break time, fatigue and stress level of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.</p>





# HELIYON-D-20-08525

## Reviewers' Comments

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## HELIYON-D-20-08525 Response to Reviewers' Comments

### **Comment #1: [Abstract – p#2, l#24-25]**

*Adjust to the research objective, namely evaluation. If the increase is more in action research or experiment.*

### **Response to Comment #1:**

We agree with the reviewer that adjustment is needed. Results of our investigation show that time interval, namely a break between two test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour. The manuscript has been revised accordingly.

### **Original Version (OV) #1:**

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market.

### **Revised Version (RV) #1:**

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency with the possibility to replace the current competency test model that has been implemented for several decades which the author concerns about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labour market. Results of our investigation show that time interval, namely a break between two successive test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour.

**Comment #2: [Abstract – p# 2 lines 28-30]**

*Tell us how the researcher did his research? How many samples are involved, how to collect data, how to analyze data?*

**Response to Comment #2:**

The manuscript has been revised as per reviewer's comment. More elaboration is to be found in the Methods section.

**OV #2:**

Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model.

**RV #2:**

Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model. One hundred students from ten vocational schools with five instructors for each school were tested online. The test allowed the students to select the competence materials based on the students' previous experience.

**Comment #3: [Abstract – p #2 lines #34-35]**

*The research results are not described, other than that the findings from the research have not yet appeared.*

**Response to Comment #3:**

The manuscript has been revised accordingly.

**OV #3:**

This reasonably happened due to the implementation of the 'Discontinuity' model gives the students time to break for an hour of each competency task. Without this break time fatigue and stress level of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.

**RV #3:**

This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Most of the students tested (86%) obtained satisfactory level. Excellent results were obtained by 14% of all the students. It can be concluded therefore, that the application of the discontinuity model could be superior to the continuous one. Without this break time fatigue and stress level of the students will significantly increase which adversely affect the students’ competency final score. In addition, the new management of the competency test was proposed in this research.

**Comment #4: [Introduction p #21 # 55-57**

*Add the competency test data that occurred in Indonesia.*

**Response to Comment #4:**

The manuscript has been revised accordingly.

**OV #4:**

The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). Indeed, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020).

**RV #4:**

The vocational education schools carry out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). Indonesian vocational schools are believed to have implemented appropriate educational objectives (Suharno et al., 2020). However, findings from a number of researchers show that improvement is still required.

Indeed, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020).

**Comment #5: [Introduction – p 3 l 12 – 14]**

*Add the following research results: Muhammad Nurtanto, Zainal Arifin, Herminarto Sofyan, Warju Warju, Soffan Nurhaji "Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme.*

**Response to Comment #5:**

We agree with the reviewer. The article was cited.

**OV #5:**

The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011; Muja et al., 2019).

**RV #5:**

The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011; Muja et al., 2019). Moreover, as stated by Nurtanto et al. [2020], assessment of the competency tests carried out in vocational schools would greatly improve if ethical aspects are included. Such aspects would be further considered seriously in the authors' future investigations.

**Comment #6: [Introduction – p #3, l #44-46]**

*Add an explanation regarding the choices from the competency tests offered in Indonesia. What is the position of the competency test conducted by the competency test (LSP)? Does it have the same confession?*

**Response to Comment #6:**

The revised manuscript has been revised incorporated the response to the comment.

**OV #6:**

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles reparation or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system.

**RV #6: p #3, l #44-46**

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles reparation or maintenance. The current competency test conducted was approved by the Indonesian stake holders, i.e. LSP (Board of Profession Certification). The authors of the current paper believe that novelty of the present test was the choice offered to the students whenever they felt ready for the test. The previous test was only available at final semesters. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system.

**Comment #7: (Introduction – p #4 lines #51 - 53)**

*Add data to support the ongoing fatigue and stress?*

**Response to Comment #7:**

In the original version of the manuscript the data of fatigue and stress related to the continuous test has been elaborated in the paragraphs that follow. The statement in the paragraphs supporting the data is highlighted in yellow. Therefore, the whole section on: The Effect of Fatigue and Stress Level, would remain the same.

**OV #7:**

*The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labour market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad & Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue

and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to the vocational education graduates are focus on the industrial labour market (Ahmed, 2016; Pema & Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labour market and improve job opportunities.

#### **RV #7:**

##### *The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labour market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &



Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers fatigue and stress level increases (Hsouana et al., 2019; Safitri & Rusdiana, 2010). The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad & Brown, 1995).

**Comment #8: (Introduction – p #5 lines 28 - 41)**

*Provide a conceptual description of the two models, to clarify understanding?*

**Response to Comment #8:**

To clarify the concepts the manuscript has been revised. The revision is highlighted.

**OV #8:**

The ‘Discontinuity’ Competency Test Model

Therefore, in this present study, the alternative model of competency test for vocational education called the ‘Discontinuity’ test model has been proposed and investigated in detail. The concept of the ‘Discontinuity’ model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 hours with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O’Neill & Panuwatwanich, 2013). **This current study aims to**

observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analysing the competency test score of the vocational education students in **Central Java, Indonesia**. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, **Indonesia** (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational improvement.

#### **RV #8:**

This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analysing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational improvement. The previous test comprised of five units and was administered continuously without any break. In addition, the students were not free to select the units in which they are most conversant whenever they feel ready to do so.

#### **Comment #9: (Methods – p #6 Figure 1)**

*Give details of the time of each Competency Test Unit? What is the basis that the time for each competency unit is the same or different?*

#### **Response to Comment #9:**

The reviewer's comment concerning Figure 1 has been answered. The Figure was revised accordingly. It is explained that:

one (1) test unit took 60 minutes to complete. The five test units were equally similar, therefore they were taken with the same amount of time.

#### **OV #9:**

Figure 1 Schematic diagram of the 'Discontinuity' competency test model.

**RV #9:**

Figure 1 Schematic diagram of the ‘Discontinuity’ competency test model [one competency unit = 60 mins]

**Comment #10: [Methods - p #6 lines #33 – 42]**

*How is the sampling technique?*

*What is the total population and sample of 10 school data?*

*What are the researchers' reasons, sample selection and why was it only carried out in Central Java to provide a comprehensive argument?*

*Why is it only done at public schools, don't all private vocational schools also apply competency tests?*

**Response to Comment #10:**

We agree with the reviewer. Elaboration is needed, and has been done. The elaboration is shown highlighted in the revised text between Fig. 1 and Fig. 2

The current research used a purposive sampling, namely those schools having automotive programs. The total population and the sample data were both given in the text. To ensure sampling homogeneity only public schools were investigated. The homogeneity includes curriculum and teacher competence or qualifications. It is the authors' intention to carry out a similar test for private schools.

**OV #10:**

This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyse the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students fatigue during the competence test, students score acquisition and competency test management.

## RV #10:

This study was conducted in Central Java, Indonesia, involving students and teachers from ten Vocational High Schools. Due to the different characteristics between public and private vocational schools, only the public ones were currently investigated. In addition, such selection of involving only public schools was also meant to ensure sampling homogeneity, primarily included the curricula and qualifications of the teachers. The experiment consisted of the common stages of research, i.e. formulation of problem statement and objectives, designing the experimental instrument, determining the sampling techniques, data collection and analysis, conclusion on experimental findings.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The students' evaluation of the competency test covered the following skills: task skill, task management skill, contingency management skill, environment skill, and transfer skill. It was proposed that such proposed management will ease the students to get the optimum result of their competency test. The students were allowed to take the test at any time after the first semester of their study as long as the minimum requirements are met. The test content was formulated in collaboration between the vocational schools and the stakeholders, namely the industrial sectors involving automotive skills. The schematic diagram of the competency test is shown in Figure 2.

Each student (100 students in all) completed five (5) units of the competency test. These units were: engine tune-up, engine overhaul, transmission overhaul, electrical, and motor starter, respectively. The test using the continuous mode was carried out first. Then, the next day the students repeated the test with the discontinuous mode. Each test unit took 60 minutes to complete, hence undertaking the continuous test mode would require a continuous time period of five hours.

Each unit of the five tests was designed by the first author (Abdr) to have the same level of difficulty. Having been supervising automotive practicals at vocational high schools for over thirty years it is believed he is conversant with the five test units investigated. Therefore, it was considered that the validity of the tests was sufficiently assured. In addition, the test materials as well as their implementation were also examined and subsequently approved by the relevant stakeholders.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. The samples consisted of 5 teachers from each school which have a total of 50 teachers and 10 students from each school which have a total of 100 students. The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the authors.

**Comment #11: [Methods – p# 6, lines #46-51]**

*Describe how the instrument is generated for research?.*

*Give a sample of your instrument, how it is assessed, and what is the difference between the level of the instrument between the teacher, the head of the department, and the head of the laboratory?*

*Why were students not involved in the research? We see that there are stress variables aimed at students.*

**Response to Comment #11:**

We agree with the reviewer. The article has been rewritten to accommodate the comment.

Rebuttal: as can be seen in the text the students were involved in this research.

**OV #11:**

The students’ evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

### **RV #11:**

The students' evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2. The instrument used was previously approved by the principals of the intended vocational schools. Moreover, it has also been approved by the ethics committee within the authors' institution. Elaboration of the instrument is as follows.

Two types of instruments were used in this study. The first type of it was applied to the students, while the second was intended for teachers, lab heads, and school principals, respectively. As is customary in vocational school practices, teachers, lab heads as well as school principals are mandated the same, i.e. to teach the students. Managing the school and the labs are both additional duties for the teachers. Therefore, the experimental instrument applied to the three groups of teachers was essentially similar. The instrument consisted of 30 questions and was designed to uncover the opinion of these groups of teachers on the competency Test Model offered in this study. Each question provided six choices: 1, 2, 3, 4, 5, and 6. Choice number one (1) indicates "very" in a negative sense, while the other extreme, i.e. number six (6) signifies the same weighting positively. As an example, the model presently offered allows the students to freely select the testing time whenever they are ready for it. Then, agreeing to this test method would mean "very agree" and carries six (6) points. Consequently, number (1) would mean the opposite extreme, i.e. "very disagree". As regards the scoring, the minimal score was  $1 \times 30 = 30$ , and the maximum one equals  $6 \times 30 = 180$ .

**Comment # 12: [Methods – p #6 lines #58-59]**

*Emphasize data collection techniques and data analysis techniques as well as data interpretation in decision making from evaluation research.*

**Response to Comments #12:**

Rebuttal: the answer to the reviewer’s comment can already be found anywhere in the Methods section. Revision is not required. The text remains the same.

**OV #12:**

The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the authors.

**RV #12:**

The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyze the advantages and disadvantages of the proposed management given by the authors.

**Comment #13: [Results and Discussion – p #8 lines 4-5]**

*Do these results apply to all tests that are being performed?*

*Are the characteristics of each test the same? if applicable?*

*It is better if the evaluation is carried out on every competency test carried out, so that it can be seen in what competency test, at what minute do students start to feel tired? In these conditions, the role of the researcher is to provide solutions to the problems that occur.*

**Response to Comment #13:**

As can be seen in Fig 1, five test units were given with similar characteristics. We disagree with the reviewer’s comments. In our investigation all the factors proposed have been investigated, with the intention to resolve the previous problem using continuity tests. The revised version of

the text accommodates some revision. Moreover, the grammatical errors in the text have been corrected.

**OV #13:**

Figure 3 and Figure 4 indicates the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.

**RV #13:**

Figures 3 and 4 indicate the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.

**Comment #14: [**

*Add a subsection that describes the important findings of the research you conducted? or findings that support broad knowledge and apply to TVET globally.*

**Response to Comment #14: [Results and Discussion – last paragraph]**

The subsection as required has been added.

**OV #14:**

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labour market improved owing to the students’ competency final score improvement.

**RV #14:**

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’



and 16 teachers stated 'agree'. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students' opportunities in the labour market improved owing to the students' competency final score improvement. As implemented in the present research the students were allowed to undertake the test(s) in which they find the most conversant in. Secondly, time intervals or time breaks were given during the test so that students could have a temporary rest to restore stamina. As shown in the test results, such preference, i. e. selecting the test materials most mastered as well as the provision of time break, results in the students to obtain a much better performance.

**Comment #15: [Conclusion – 1<sup>st</sup> par, 1<sup>st</sup> and 2<sup>nd</sup> sentences].**

*Does this apply to normal conditions or the new normal? When viewed from data collection, the model evaluation was carried out during pandemic conditions. So it is better if the conclusions are more careful and reinforce the conditions intended.*

**Response to Comment #15:**

Rebuttal: the research was carried out just before the COVID-19 pandemic, namely the fourth week of February 2020 until the second week of March 2020. The timing was still in compliance with the regional government decrees concerning the health protocols as required. Therefore, the evaluation and findings of this investigation was considered as applicable to normal conditions.

**Comment #16: [References – p #13]**

*The following research is relevant to your research that should be added:*

1. Nurtanto, M., Arifin, Z., Sofyan, H., Warju, W., & Nurhaji, S. (2020). *Development of Model for Professional Competency Assessment (PCA) in Vocational Education: Study of the Engine Tune-Up Injection System Assessment Scheme. Journal of Technical Education and Training, 12(2), 34–45. <https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/5152>*

2. Nurtanto, M., Pardjono, P., Widarto -, & Ramdani, S. D. (2020). *The Effect of STEM-EDP in Professional Learning on Automotive Engineering Competence in Vocational High School. Journal for the Education of Gifted Young Scientists, 8(2), 633–649. <https://doi.org/10.17478/jegys.645047>*

**Response to Comment #16:**

We have scrutinized the two papers as suggested. They are relevant to our current paper and have been cited accordingly. The two articles were listed in References.

**Comment #17: [References]**

*Adjust the reference rules.*

**Response to Comment # 17:**

Thank you for the reviewer's comment. Adjustment has been made as required.

# Evaluation on The Automotive Skill Competency Test Through ‘Discontinuity’ Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>a</sup> *Mechanical Engineering Department, Faculty of Engineering, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>b</sup> *Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>c</sup> *Chemical Engineering Department, UNTAG University in Semarang, 50233 Bendhan Dhuwur, Semarang, Indonesia*

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## Abstract

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students’ accomplishment during the competency test, aimed to improve competency test results to increase the students’ job opportunity in the labour market. Results of our investigation show that time interval, namely a break between two successive test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students’ fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue on the ‘Continuity’ model. One hundred students from ten vocational schools with five instructors for each school were tested online. The test allowed the students to select the competence materials based on the students’ previous experience. To research the effect of the ‘Discontinuity’ model implementation on the students’ competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)  
E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

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4 improvement in the students' competency test scores. This reasonably happened due to the  
5 implementation of the 'Discontinuity' model gives the students time to break for an hour of each  
6 competency task. Most of the students tested (86%) obtained satisfactory level. Excellent results  
7 were obtained by 14% of all the students. It can be concluded therefore, that the application of  
8 the discontinuity model could be superior to the continuous one. Without this break time, fatigue  
9 and stress level of the students will significantly increase which adversely affect the students'  
10 competency final score. In addition, the new management of the competency test was proposed  
11 in this research.  
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20 *Keywords: Vocational education; automotive; competency; Discontinuity model; competency*  
21 *test management*  
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## 24 **1. Introduction**

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27 The presence of vocational education in this present circumstance brings a significant impact  
28 on the correlation between education and the labour market. Students are given two choices  
29 whether they will continue their studies to regular school or vocational education. Vocational  
30 education becomes a good choice for students who wants to directly look for a job after  
31 graduating from school and could be a shortcut to involve in the labour market directly. The  
32 percentage of practical knowledge of vocational education is higher than that in regular school.  
33 Thus, vocational education aims to prepare students one step forward for entering the labour  
34 market with a highly skilled in a specific field of jobs. In general, there are three types of  
35 vocational education systems, which are school-based vocational education, dual apprenticeship,  
36 and informal training (Guo & Wang, 2020). In a developing country, school-based vocational  
37 education is more applicable than the other systems considering manpower inequality. Students  
38 who enrol in a vocational education school exhibit outstanding practical skills supported by their  
39 early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school  
40 carried out the high-intensity practical study with a specific industrial-based curriculum and  
41 competency (Muja et al., 2019). Indonesian vocational schools are believed to have implemented  
42 appropriate educational objectives (Suharno et al., 2020). However, findings from a number of  
43 researchers show that improvement is still required. Indeed, in some developing countries,  
44 manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster  
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4 & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a  
5 formal curriculum and standardized competency is very important to bring manpower equality  
6 which means the students are eligible for the industrial and business company requirements after  
7 graduated from vocational education. Moreover, vocational education also brings a significant  
8 impact on the economic sector for the country by reducing the youth unemployment population  
9 (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational  
10 education school-leavers on the labour market. The studies showed that the educational programs  
11 that were strongly oriented towards vocational skills and knowledge for the students have a  
12 positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011;  
13 Muja et al., 2019). Moreover, as stated by Nurtanto et al. [2020], assessment of the competency  
14 tests carried out in vocational schools would greatly improve if ethical aspects are included. Such  
15 aspects would be further considered seriously in the authors' future investigations.  
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### 27 *The Importance of Competency for Vocational Education*

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30 In order to prepare the students' capability during the transition from high school to the labour  
31 market, the improvement of students' competency should be highly considered. Competency is a  
32 combination of skills, behaviour/attitude, and multiple knowledge that can be demonstrated by  
33 students where the skills, attitudes, and knowledge are obtained from the materials  
34 conceptualization that has been learned during the period of study. The level of vocational  
35 competency influences positively the chance of graduates of being matched to occupation with  
36 the specific educational domain. Furthermore, the application of on-the-job training will be much  
37 more efficient when implementing the generic competencies to adjust vocational competencies  
38 to the requirement of the job (Heijke et al., 2003). Due to the increase in the labour market  
39 qualification, the standard of student competence should be increased. This concern should be  
40 followed by the development of the students' assessment. Several points should be considered in  
41 order to improve the competency, which are authentic assessment, an improvement in quality lab  
42 sheet, student competency standard system, specific scoring rubric, and feedback from the  
43 students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment  
44 could be achieved (Rahman et al., 2014).  
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57 In this industrial era, developing country such as Indonesia tends to force the economic sector  
58 by improving the industrial sector through massive production and export activity (Hidayatno et  
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4 al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector,  
5 vocational education contributes to human resources development and minimize the gap between  
6 the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set  
7 up a good competency including skills and organizational knowledge for the graduates which  
8 means the graduates are ready for entering the workplace environment. To meet the industrial  
9 requirements, the graduates should be able to work effectively by combining the knowledge,  
10 skills, and other work-related capacities into specific competence needed (Loon & Bartram,  
11 2007). This matter could be achieved by implementing the internship program during the period  
12 of study in a vocational education school which has a related industrial field (Ocampo et al.,  
13 2020).

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23 Competency test has been commonly used in most of the vocational education in Central  
24 Java, Indonesia, especially in the automotive field to ensure the capability of the students to  
25 conduct vehicles repair or maintenance. The current competency test conducted was  
26 approved by the Indonesian stake holders, i.e. LSP (Board of Profession Certification). The  
27 authors of the current paper believe that novelty of the present test was the choice offered to the  
28 students whenever they felt ready for the test. The previous test was only available at final  
29 semesters. The specific tasks are given to the students such as engine tune-up, clutch overhaul,  
30 gearbox transmission overhaul, electrical body system, and starter system. Currently, these five  
31 tasks are implemented to the students by using the 'Continuity' model which means that the  
32 students should finish all the tasks continuously within 5 hours. However, the 'Continuity' model  
33 tends to cause work fatigue during the competency test, while the work fatigue will decrease the  
34 student's concentration and focus which will significantly cause poor competency test results.  
35 Nurhayati et al. investigated the effect of the increase in the production time on the productivity  
36 achieved. During the investigation, the muscle fatigue has occurred at a very high level of  
37 production time and the results showed that the productivity achieved are below the productivity  
38 target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a  
39 long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough,  
40 headache, and many more which can cause the worker absence. In addition, lack of focus and  
41 concentration in the workplace due to work fatigue means a lack of safety awareness which can  
42 cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for  
43 the 'Continuity' test model showed unsatisfied results where the students feel under pressure  
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4 during the five hours competency test and under the assessor supervision. Moreover, most of the  
5 students suffer from pressure which is not only physical but also mentally pressured. This  
6 condition caused the students' competency score results are not optimal. This will decrease the  
7 students' opportunity to get their best results in the competency test, while the competency test  
8 score determines their opportunity for competing in labour market. Therefore, further evaluation  
9 of the 'Continuity' competency test model in vocational education schools is highly necessary  
10 for this global industrial era.  
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### 18 ***Management of The Competency Test***

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21 In vocational education, competency turns into an important aspect for the graduates as a  
22 benchmark that should be achieved by the students during their period of study to get a better job  
23 opportunity in labour market. Competency has two essential values which are first, authorities in  
24 carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and  
25 second, the capability to implement the knowledge, skills, and experience (Mulder, 2007).  
26 Competency test in vocational education school should have a comprehensive and multi-  
27 dimensional construction. Generally, there are three different competency levels, those are  
28 conceptual competence, procedural competence, and interpretative competence (Winther &  
29 Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job  
30 assignments that match the specific needs of the world business industry. Competency test is  
31 essential for the students in terms of the final decision whether the students pass or fail during  
32 their study in vocational education as well as to avoid the incompetent graduates in labour  
33 market (Johnson, 2008). Alternatively, the substance of the competency test is not only for  
34 testing the students but also to seek the validation of the students. The validation process itself  
35 focuses on how students work on each assignment such as used tools accuracy, their work  
36 attitude, and adhere to SOP, instead of the final results-oriented only (pass or fail).  
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50 However, in this current vocational education school in Central Java, Indonesia, the  
51 implemented competency test is only focused on the final result without considering the process  
52 and performance of the students in detail during the competency test. The competency test is  
53 conducted only one time simultaneously at the end of the students' period of study according to  
54 the curriculum order. This management of the competency test is considered less effective due to  
55 the implementation of the competency test is limited at a certain time. The impact adversely  
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4 students' performance during the competency test as well as the assessors' validation of the  
5 students' performance. In addition, owing to the last semester implementation of the competency  
6 test, the students tend to struggle to do retest if they fail during the competency test due to the  
7 limited schedule. Therefore, the innovation on the management of the competency test is highly  
8 necessary in order to significantly improve the quality of vocational education graduates. Proper  
9 management of the competency test is proposed in this research which aimed to give the students  
10 a bigger opportunity to perform better and get their best result during the competency test. The  
11 proper management of the competency test allows the students to take the assignments at any  
12 time as long as the quota meets the minimum requirements. The school will provide a minimum  
13 quota for each task to be carried out. Thus, the assessor could give detailed assessment and  
14 validation based on the requested ongoing assignment whether the students are passed or failed  
15 on their competency test. However, if the student failed, they will be given a chance to practice  
16 more in the workshop during their study, then they could take another competency test in the  
17 next semester. The proposed management of the competency test is involving teachers, internal  
18 assessors, and external assessors (field experts: mechanics or automotive experts).

### 32 33 *The Effect of Fatigue and Stress Level*

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36 The high intensity of the workload in the industrial sector tends to produce high fatigue and  
37 stress levels of the worker. This concept is also similar to the competency test particularly in  
38 automotive skills for vocational education students. During the automotive skill competency test,  
39 the students were forced to finish heavy duty within a limited time. However, this will  
40 significantly produce a poor competency result which will decrease the opportunity of the  
41 students entering the labour market due to the students' fatigue and stress level increase. The  
42 study about the effect of fatigue and stress levels on productivity has been investigated over the  
43 decades. The results prove that the environment and work pressure significantly affect the body  
44 temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &  
45 Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours,  
46 working conditions, and high workloads. These aspects are significantly affecting low  
47 productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue  
48 and stress level increased were observed such as reduced levels of awareness, low concentration  
49 and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al.,  
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4 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also  
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6 lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart  
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8 disease, and mental illness which the workers tend to use sick leave and reduce productivity  
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10 (Åkerstedt et al., 2014). However, the recommendations such as time management, working time  
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12 arrangement, rest and break time optimization, fitness, and sports program are highly necessary  
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14 in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri &  
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16 Rusdiana, 2010). The study about the effect of fatigue and stress levels on productivity has been  
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18 investigated over the decades. The results prove that the environment and work pressure  
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20 significantly affect the body temperature of the workers whereas significantly affecting the  
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22 muscle fatigue and stress (Chad & Brown, 1995). Qualitatively, fatigue, and stress level are  
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24 attributed to extended working hours, working conditions, and high workloads. These aspects are  
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26 significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019).  
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28 Several impacts on the fatigue and stress level increased were observed such as reduced levels of  
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32 job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health,  
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34 fatigue, and stress level can also lead to long-term health problems such as muscular tension,  
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38 leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as  
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40 time management, working time arrangement, rest and break time optimization, fitness, and  
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42 sports program are highly necessary in order to avoid workers fatigue and stress level increases  
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44 (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

43 Looking into the importance of rest and break time management and the time arrangement in  
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45 the industrial sector, vocational education schools should implement a similar method due to the  
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47 vocational education graduates are focus on the industrial labour market (Ahmed, 2016; Pema &  
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49 Mehay, 2012). The implementation of the fatigue and stress level management could be assigned  
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51 to the students' competency test model. However, most vocational education schools in  
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53 Indonesia are facing poor fatigue and stress management on their students during competency  
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55 tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the  
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57 demand for the industrial sector on human resources is increasing with high criteria required. To  
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59 overcome this problem, vocational education schools should increase their graduates'  
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4 competency test scores, thus their graduates could easily compete in the labour market and  
5 improve job opportunities.  
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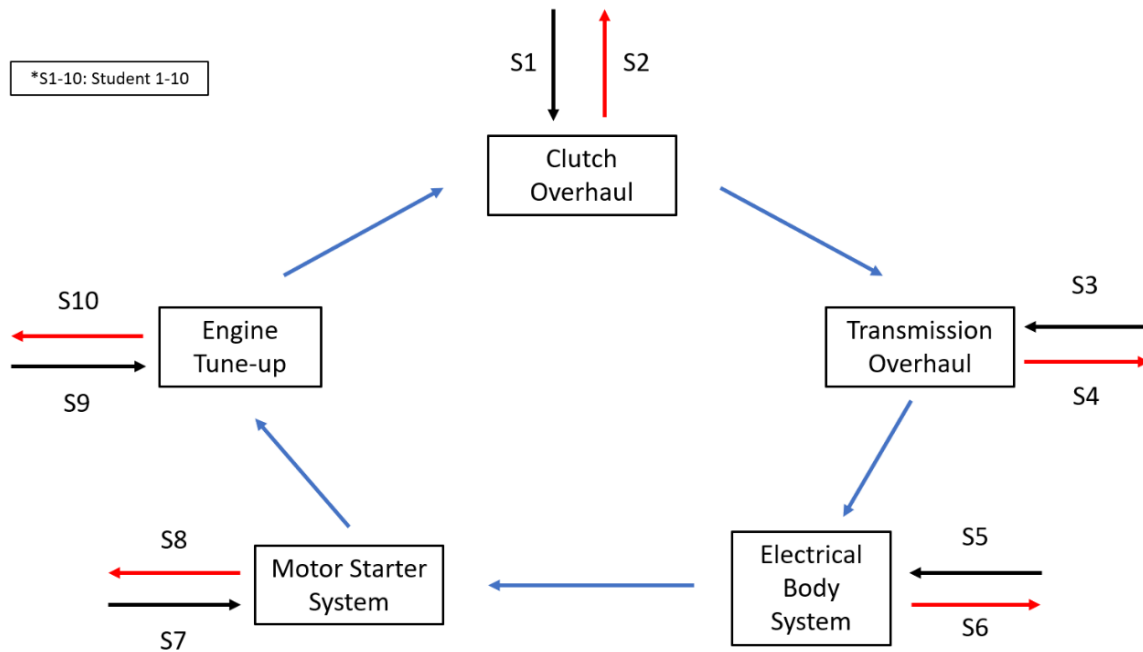
### 8 9 *The ‘Discontinuity’ Competency Test Model*

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11 Therefore, in this present study, the alternative model of competency test for vocational  
12 education called the ‘Discontinuity’ test model has been proposed and investigated in detail. The  
13 concept of the ‘Discontinuity’ model is by giving the student time to break and rest while  
14 shifting with another student to conduct the competency test. The five tasks of the competency  
15 test could be done within 10 hours with a break time of 1 hour in between each task. By giving  
16 the break time of 1 hour, the competency test could be done by 10 students per day by doing the  
17 competency test alternately. The break time is very important and has been commonly used in  
18 the industrial sector to improve productivity and reduce the fatigue level of the workers  
19 (Gregson, 2020; Lim et al., 2020; O’Neill & Panuwatwanich, 2013). This current study aims to  
20 observe the student’s convenience on the application of the ‘Continuity’ and ‘Discontinuity’ test  
21 model by analysing the competency test score of the vocational education students in Central  
22 Java, Indonesia. This study is a development from the previous study which was conducted in a  
23 narrower area and the taken sample was only from one vocational education school in Semarang  
24 city, Indonesia (Abdurrahman et al., 2019). However, the developed ‘Discontinuity’ model in  
25 this study covers larger areas which are involving 10 vocational education schools in Central  
26 Java, Indonesia, and provide a better result for educational improvement. **The previous test  
27 comprised of five units and was administered continuously without any break. In addition, the  
28 students were not free to select the units in which they are most conversant whenever they feel  
29 ready to do so.**  
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## 47 **2. Methods**

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50 This study was focused on a descriptive quantitative method with data collected through a  
51 questionnaire that describes the educational reality regarding the level of students’ satisfaction  
52 with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). Two different  
53 models were implemented to collect the data which were ‘Continuity’ and ‘Discontinuity’ model  
54 competency tests of automotive skills in vocational education schools. The ‘Continuity’ model  
55 means the students must finish five competency tasks continuously within five hours with a very  
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limited time to break. Meanwhile, the ‘Discontinuity’ model means the students will be given a certain time (1 hour) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the ‘Discontinuity’ model is shown in Figure 1. The ‘Discontinuity’ model is considered to be more feasible and could significantly improve the students’ competency test final score.



**Figure 1.** Schematic diagram of the ‘Discontinuity’ competency test model  
(one competency unit = 60 mins)

This study was conducted in Central Java, Indonesia, involving students and teachers from ten Vocational High Schools. Due to the different characteristics between public and private vocational schools, only the public ones were currently investigated. In addition, such selection of involving only public schools was also meant to ensure sampling homogeneity, primarily included the curricula and qualifications of the teachers. The experiment consisted of the common stages of research, i.e. formulation of problem statement and objectives, designing the experimental instrument, determining the sampling techniques, data collection and analysis, conclusion on experimental findings.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational

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4 school regarding their judgment of the proposed management to be implemented. The students'  
5 evaluation of the competency test covered the following skills: task skill, task management skill,  
6 contingency management skill, environment skill, and transfer skill. It was proposed that such  
7 proposed management will ease the students to get the optimum result of their competency test.  
8 The students are allowed to take the test at any time after the first semester of their study as long  
9 as the minimum requirements are met. The test content was formulated in collaboration between  
10 the vocational schools and the stakeholders, namely the industrial sectors involving automotive  
11 skills. The schematic diagram of the competency test is shown in Figure 2.

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19 Each student (100 students in all) completed five (5) units of the competency test. These units  
20 were: engine tune-up, engine overhaul, transmission overhaul, electrical, and motor starter,  
21 respectively. The test using the continuous mode was carried out first. Then, the next day the  
22 students repeated the test with the discontinuous mode.

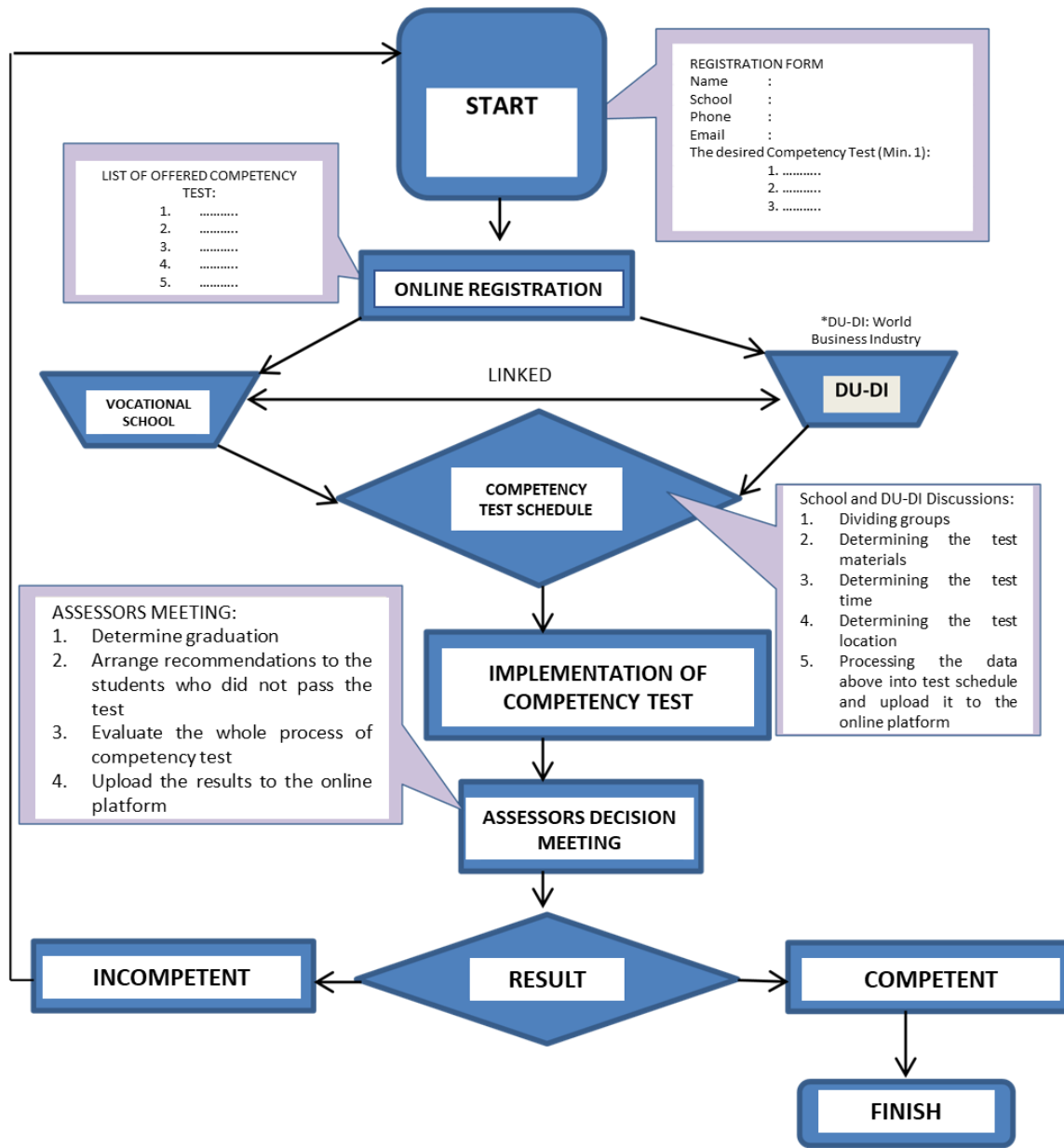
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26 Each test unit took 60 minutes to complete, hence undertaking the continuous test mode would  
27 require a continuous time period of five hours.

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30 Each unit of the five tests was designed by the first author (Abdr) to have the same level of  
31 difficulty. Having been supervising automotive practicals at vocational high schools for over  
32 thirty years it is believed he is conversant with the five test units investigated. Therefore, it was  
33 considered that the validity of the tests was sufficiently assured. In addition, the test materials as  
34 well as their implementation were also examined and subsequently approved by the relevant  
35 stakeholders.

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41 The students' evaluation of the proposed competency test management should consist of the  
42 following skills, those are; task skill, task management skill, contingency management skill,  
43 environment skill, and transfer skill. This proposed management will ease the students to get the  
44 optimum result of their competency test. The students are allowed to take the competency test at  
45 any time since the first semester of their study as long as meet the minimum requirements. The  
46 proposed competency test management could be accessed by the students through an online  
47 platform which is provided by the collaboration between the vocational schools and the world  
48 business industry. The schematic diagram of the proposed management of the competency test is  
49 shown in Figure 2. The instrument used was previously approved by the principals of the  
50 intended vocational schools. Moreover, it has also been approved by the ethics committee within  
51 the authors' institution. Elaboration of the instrument is as follows.

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4 Two types of instruments were used in this study. The first type of it was applied to the  
5 students, while the second was intended for teachers, lab heads, and school principals,  
6 respectively. As is customary in vocational school practices, teachers, lab heads as well as school  
7 principals are mandated the same, i.e. to teach the students. Managing the school and the labs are  
8 both additional duties for the teachers. Therefore, the experimental instrument applied to the  
9 three groups of teachers was essentially similar. The instrument consisted of 30 questions and  
10 was designed to uncover the opinion of these groups of teachers on the competency Test Model  
11 offered in this study. Each question provided six choices: 1, 2, 3, 4, 5, and 6. Choice number one  
12 (1) indicates “very” in a negative sense, while the other extreme, i.e. number six (6) signifies the  
13 same weighting positively. As an example, the model presently offered allows the students to  
14 freely select the testing time whenever they are ready for it. Then, agreeing to this test method  
15 would mean “very agree” and carries six (6) points. Consequently, number (1) would mean the  
16 opposite extreme, i.e. “very disagree”. As regards the scoring, the minimal score was  $1 \times 30 =$   
17 30, and the maximum one equals  $6 \times 30 = 180$ .  
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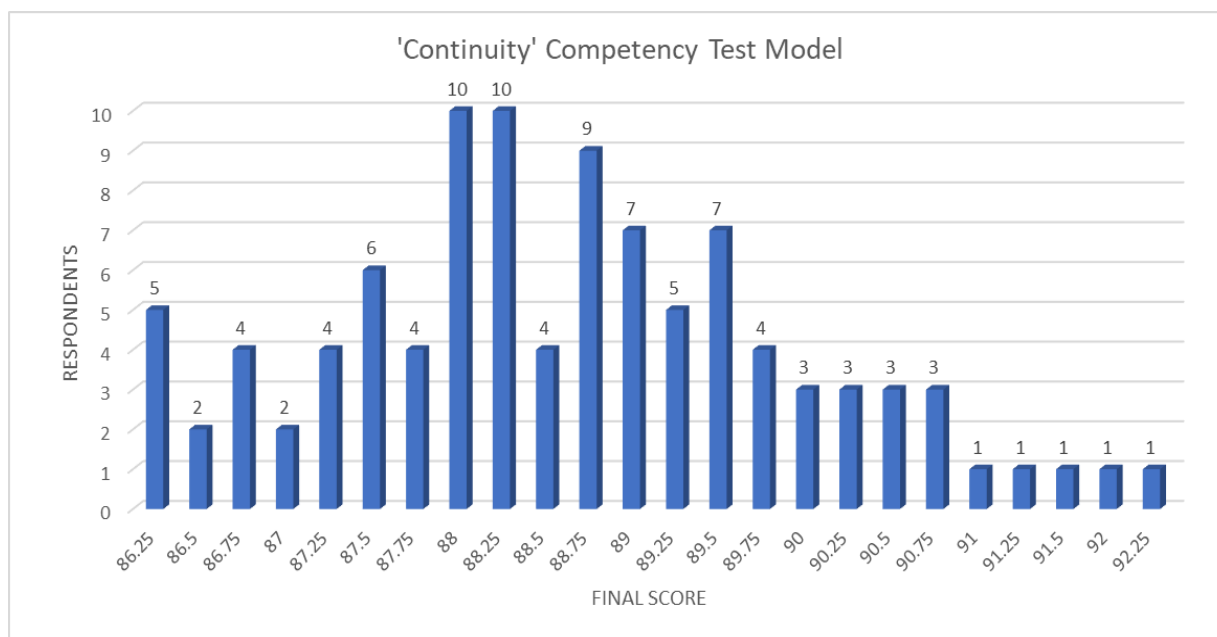
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**Figure 2.** Schematic diagram of the proposed competency test management.

### 3. Results and Discussion

This present study revealed the comparison between the ‘Continuity’ test model and the ‘Discontinuity’ test model that has been done in the selected vocational schools. Figures 3 and 4 indicate the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.



**Figure 3.** Schematic graph of the ‘Continuity’ competency test model results.

Criteria:

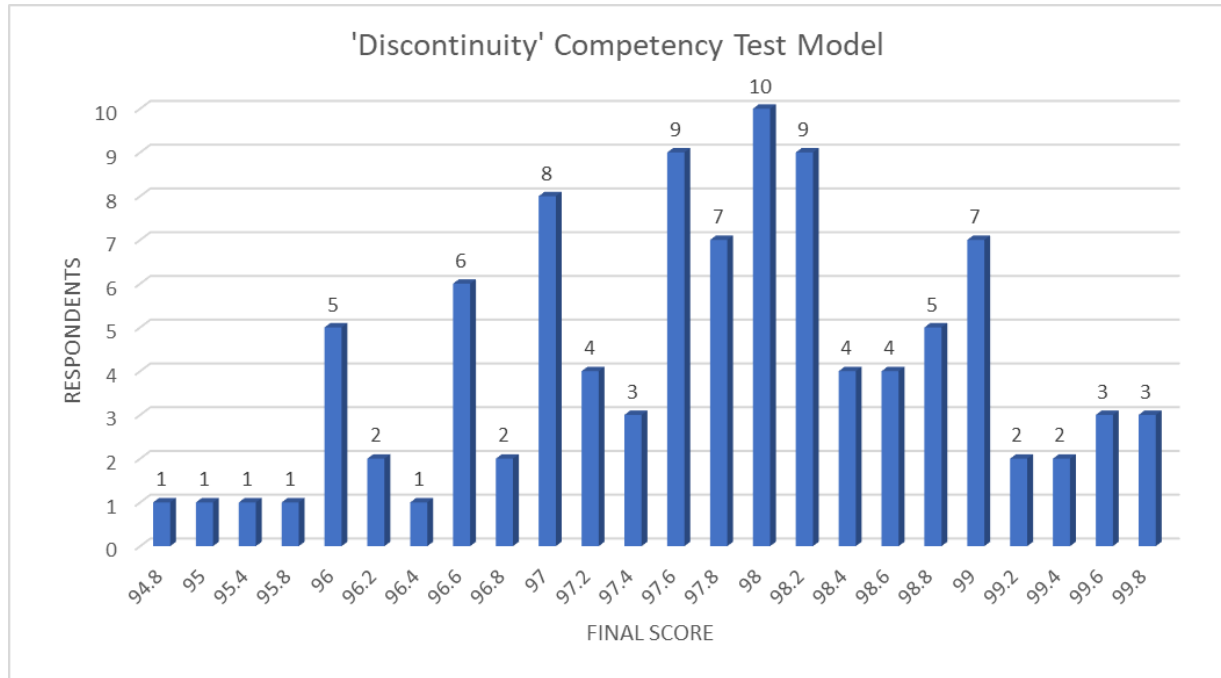
- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 1.** Students’ competency score based on criteria classification of the ‘Continuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the ‘Continuity’ competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the ‘Good’ level. The numbers of students with ‘Good’ level were 86 students. Meanwhile, the students with ‘Very good’ level were only 14 students which indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the ‘Continuity’ competency test model which was only achieved

by one student. This score level indicates the students' capability and convenience during the competency test. In this global industrial era, a 'very good' level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test results of the students should be carried out. Otherwise, the vocational education schools fail to become a bridge between the graduates and the labour market.



**Figure 4.** Schematic graph of the 'Discontinuity' competency test model results.

- Criteria:
- 50 – 60 : Very low
  - 61 – 70 : Low
  - 71 – 80 : Enough
  - 81 – 90 : Good
  - 91 – 100 : Very good

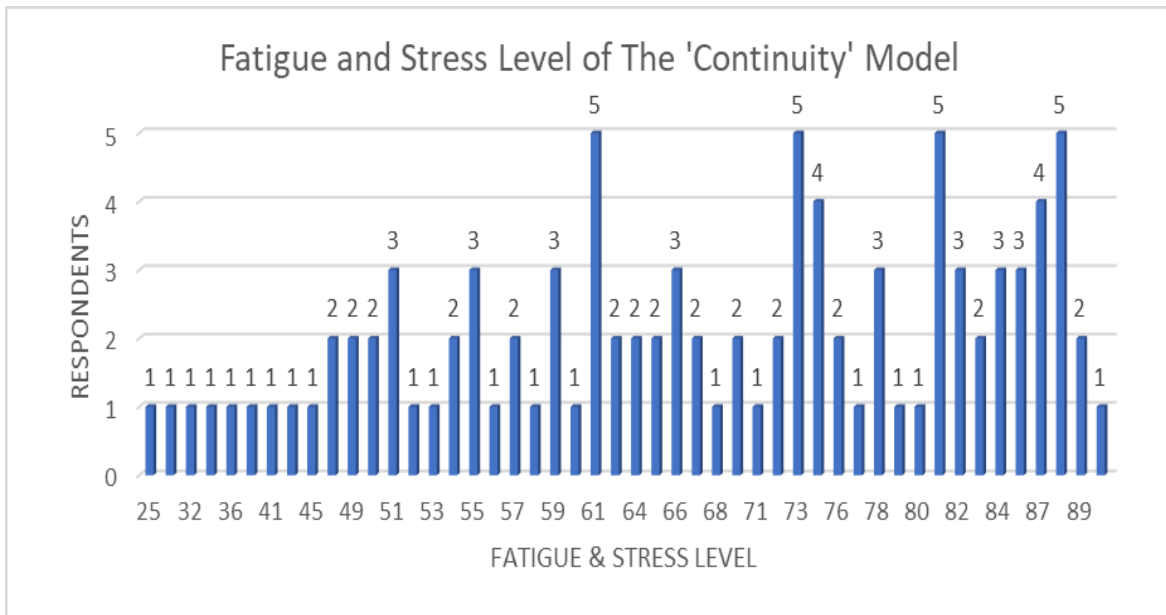
**Table 2.** Students' competency score based on criteria classification of the 'Discontinuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

Meanwhile, based on the 'Discontinuity' competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at 'Very good' level. The lowest



score was 94.8, while the highest score for the ‘Discontinuity’ competency test model was 99.8. Although both ‘Continuity’ and ‘Discontinuity’ competency test model results were still acceptable, the ‘Discontinuity’ competency test model emphasize the optimum final score of the students. One hour of rest and break time that given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in labour market.



**Figure 5.** Schematic graph of the fatigue and stress level of the ‘Continuity’ competency test model.

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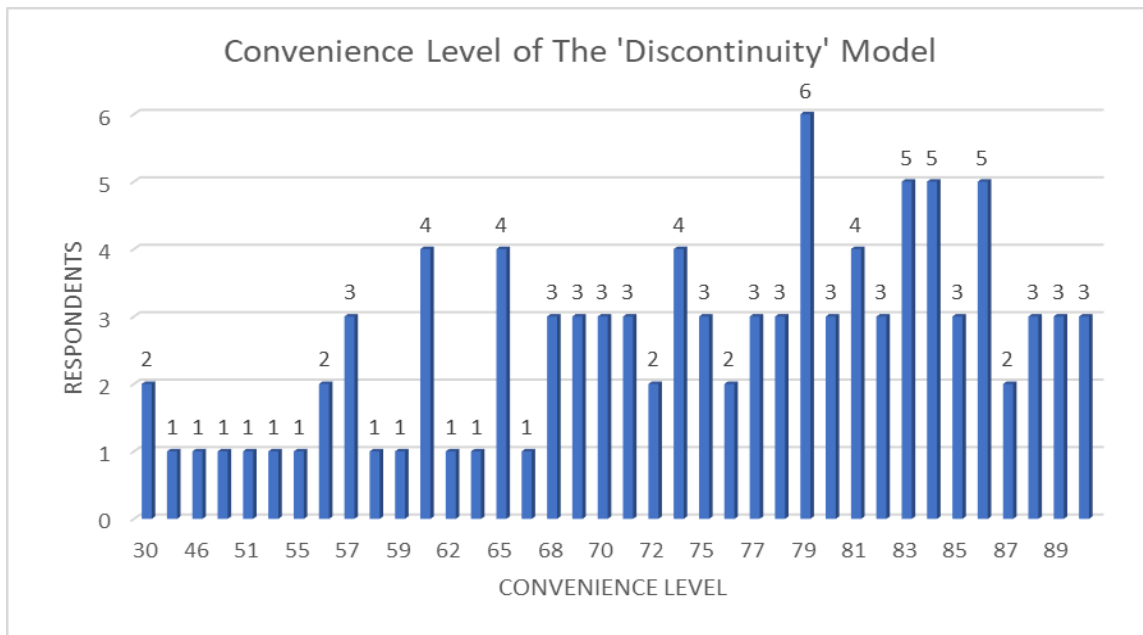
- 15 – 30 : Not very tiring
- 31 – 45 : Not tiring
- 46 – 60 : Enough
- 61 – 75 : Tiring
- 76 – 90 : Very tiring

**Table 3.** Students’ fatigue level criteria classification of the ‘Continuity’ model.

Criteria	Not Tiring	Very Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

Figure 5 and Table 3 indicated the fatigue level survey that has been given to the respondents regarding the ‘Continuity’ competency test model. The results revealed that students tend to feel

very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated at the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affecting the students' fatigue and stress level.



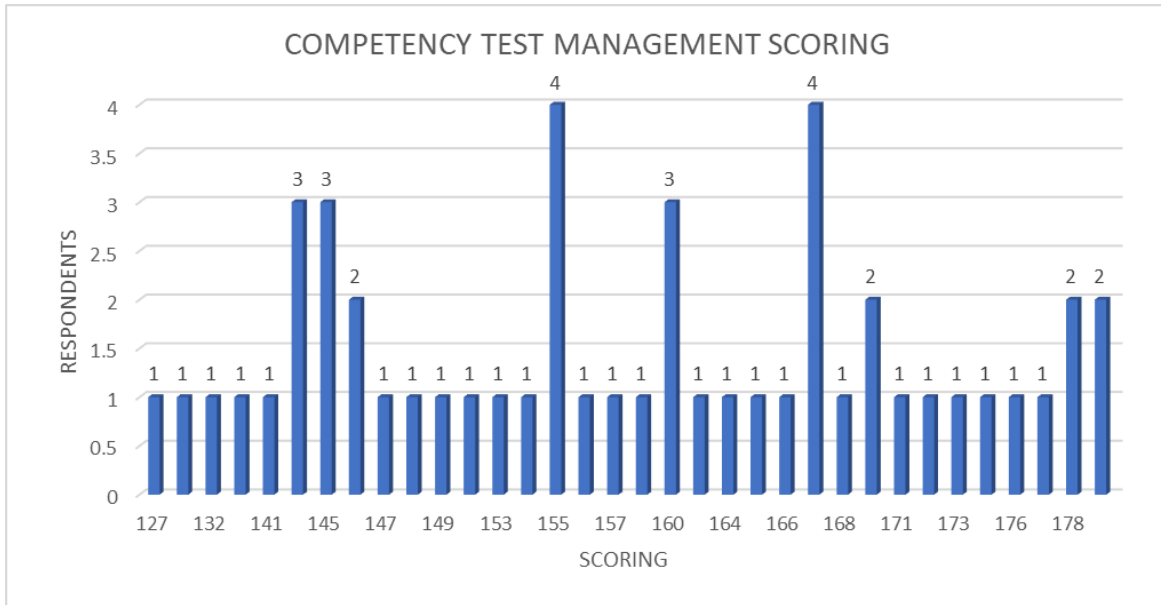
**Figure 6.** Schematic graph of the fatigue and stress level of the 'Discontinuity' competency test model.

- Criteria:
- 15 – 30 : Very uncomfortable
  - 31 – 45 : Uncomfortable
  - 46 – 60 : Enough
  - 61 – 75 : Comfortable
  - 76 – 90 : Very comfortable

**Table 4.** Students' convenience level criteria classification of the 'Discontinuity' model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

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4 Figure 6 and Table 4 revealed the survey result that has been given to the students according  
5 to their opinion on the implication of the ‘Discontinuity’ model regarding their convenience  
6 during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the  
7 students are comfortable and very comfortable with the application of the ‘Discontinuity’ test  
8 model. It is in accordance with their final score of the competency test results which indicated  
9 significant improvement and better results during the competency test. 53 students stated at the  
10 ‘very comfortable’ category, 32 students stated at the ‘comfortable’ category, 12 students stated  
11 at ‘enough’ category, 1 student stated at the ‘uncomfortable’ category, and only 2 students stated  
12 at ‘very uncomfortable’ category. This result proves that the application of the ‘Discontinuity’  
13 test model gives better comfortability to the students as well as reduce their fatigue and stress  
14 level. Therefore, the final score of the competency test could be increased significantly. The  
15 ‘Discontinuity’ model gives the students the opportunity to take a break for an hour in between  
16 the tasks in order to recover their focus and concentration to conduct the next following  
17 competency test. Therefore, they can refresh their mind to avoid high-stress level during  
18 competency test and take a break to relax their body due to the high intensity and pressure of the  
19 competency test. This ‘Discontinuity’ competency test model is established to fulfill the  
20 students’ desire to get the optimum competency test result to support their assets and increase  
21 their opportunity in labour market. In terms of quality, the vocational education school in which  
22 implementing this method could significantly gain massive improvement by graduating students  
23 with a high competency level.  
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**Figure 7.** Schematic graph of the proposed competency test management scoring.

Criteria:

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 5.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total	-	-	-	16	34
Respondents					

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labour market improved owing to the students’ competency final score improvement. **As implemented in the present research the students were**

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4 allowed to undertake the test(s) in which they find the most conversant in. Secondly, time  
5 intervals or time breaks were given during the test so that students could have a temporary rest to  
6 restore stamina. As shown in the test results, such preference, i. e. selecting the test materials  
7 most mastered as well as the provision of time break, results in the students to obtain a much  
8 better performance.  
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#### 14 **4. Conclusion**

16 Fatigue and stress levels of the vocational education students could adversely impact the  
17 competency test result. The current competency test model for vocational education in Central  
18 Java, Indonesia is a ‘Continuity’ competency test model. This model tends to give low scores on  
19 students’ competency test results due to the lack of time to break where the students must finish  
20 five tasks within 5 hours, thus, it causes the students’ focus and concentration to decrease  
21 significantly. To overcome this problem, the implementation of the ‘Discontinuity’ model was  
22 proposed. By giving one-hour time to break for the student and the competency test could be  
23 done alternately, fatigue, and stress level of the students could significantly decrease.  
24 Consequently, the result shows that the final score of the student’s competency test result was  
25 significantly improved. All the ‘Discontinuity’ model-based results showed in the ‘very good’  
26 category. In addition, the survey results showed that the students feel more comfortable using the  
27 ‘Discontinuity’ competency test model than that ‘Continuity’ competency test model as well as  
28 the teachers satisfied with the proposed competency test model. The improvement in the  
29 competency test result is very important for the student who will be facing the labour market  
30 after graduated from vocational education. However, the industry considers students with a high  
31 competency score to join their company rather than the lower score one. In addition, a new  
32 competency test management is proposed in this study by allowing the students to take the  
33 competency test at any time since their first semester of study through an online platform that  
34 directly connected with vocational school management and DU-DI (World Business Industry).  
35 The feasibility scoring survey of the proposed management revealed that both teachers and staff  
36 of the respective vocational schools in Central Java, Indonesia agree to implement the proposed  
37 competency test management. However, the proposed competency test management will ease the  
38 students and teachers to achieve an optimum final score of the competency test as well as  
39 improve the vocational school quality.  
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4 **Declarations**

5  
6 *Author contribution statement*

7  
8 Abdurrahman: Conceptualization; Methodology; Performed research; Analysed and  
9 interpreted the data; Wrote the paper.

10  
11 Parmin: Validation; Visualization; Supervision; Reviewed and edited the paper.

12  
13 S. Muryanto: reviewed the original manuscript; wrote the revision.

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# Evaluation on The Automotive Skill Competency Test Through ‘Discontinuity’ Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>a</sup> *Mechanical Engineering Department, Faculty of Engineering, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>b</sup> *Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>c</sup> *Chemical Engineering Department, UNTAG University in Semarang, 50233 Bendhan Dhuwur, Semarang, Indonesia*

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## Abstract

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students’ accomplishment during the competency test, aimed to improve competency test results to increase the students’ job opportunity in the labour market. Results of our investigation show that time interval, namely a break between two successive test units, can be a beneficial strategy for the implementation of competency test. The time interval applied was one hour. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students’ fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue on the ‘Continuity’ model. One hundred students from ten vocational schools with five instructors for each school were tested online. The test allowed the students to select the competence materials based on the students’ previous experience. To research the effect of the ‘Discontinuity’ model implementation on the students’ competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)  
E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

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4 improvement in the students' competency test scores. This reasonably happened due to the  
5 implementation of the 'Discontinuity' model gives the students time to break for an hour of each  
6 competency task. Most of the students tested (86%) obtained satisfactory level. Excellent results  
7 were obtained by 14% of all the students. It can be concluded therefore, that the application of  
8 the discontinuity model could be superior to the continuous one. Without this break time, fatigue  
9 and stress level of the students will significantly increase which adversely affect the students'  
10 competency final score. In addition, the new management of the competency test was proposed  
11 in this research.  
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20 *Keywords: Vocational education; automotive; competency; Discontinuity model; competency*  
21 *test management*  
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## 24 **1. Introduction**

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27 The presence of vocational education in this present circumstance brings a significant impact  
28 on the correlation between education and the labour market. Students are given two choices  
29 whether they will continue their studies to regular school or vocational education. Vocational  
30 education becomes a good choice for students who wants to directly look for a job after  
31 graduating from school and could be a shortcut to involve in the labour market directly. The  
32 percentage of practical knowledge of vocational education is higher than that in regular school.  
33 Thus, vocational education aims to prepare students one step forward for entering the labour  
34 market with a highly skilled in a specific field of jobs. In general, there are three types of  
35 vocational education systems, which are school-based vocational education, dual apprenticeship,  
36 and informal training (Guo & Wang, 2020). In a developing country, school-based vocational  
37 education is more applicable than the other systems considering manpower inequality. Students  
38 who enrol in a vocational education school exhibit outstanding practical skills supported by their  
39 early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school  
40 carried out the high-intensity practical study with a specific industrial-based curriculum and  
41 competency (Muja et al., 2019). Indonesian vocational schools are believed to have implemented  
42 appropriate educational objectives (Suharno et al., 2020). However, findings from a number of  
43 researchers show that improvement is still required. Indeed, in some developing countries,  
44 manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster  
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4 & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a  
5 formal curriculum and standardized competency is very important to bring manpower equality  
6 which means the students are eligible for the industrial and business company requirements after  
7 graduated from vocational education. Moreover, vocational education also brings a significant  
8 impact on the economic sector for the country by reducing the youth unemployment population  
9 (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational  
10 education school-leavers on the labour market. The studies showed that the educational programs  
11 that were strongly oriented towards vocational skills and knowledge for the students have a  
12 positive influence and better integration into the labour market (Bol & van de Werfhorst, 2011;  
13 Muja et al., 2019). Moreover, as stated by Nurtanto et al. [2020], assessment of the competency  
14 tests carried out in vocational schools would greatly improve if ethical aspects are included. Such  
15 aspects would be further considered seriously in the authors' future investigations.  
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### 27 ***The Importance of Competency for Vocational Education***

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30 In order to prepare the students' capability during the transition from high school to the labour  
31 market, the improvement of students' competency should be highly considered. Competency is a  
32 combination of skills, behaviour/attitude, and multiple knowledge that can be demonstrated by  
33 students where the skills, attitudes, and knowledge are obtained from the materials  
34 conceptualization that has been learned during the period of study. The level of vocational  
35 competency influences positively the chance of graduates of being matched to occupation with  
36 the specific educational domain. Furthermore, the application of on-the-job training will be much  
37 more efficient when implementing the generic competencies to adjust vocational competencies  
38 to the requirement of the job (Heijke et al., 2003). Due to the increase in the labour market  
39 qualification, the standard of student competence should be increased. This concern should be  
40 followed by the development of the students' assessment. Several points should be considered in  
41 order to improve the competency, which are authentic assessment, an improvement in quality lab  
42 sheet, student competency standard system, specific scoring rubric, and feedback from the  
43 students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment  
44 could be achieved (Rahman et al., 2014).  
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57 In this industrial era, developing country such as Indonesia tends to force the economic sector  
58 by improving the industrial sector through massive production and export activity (Hidayatno et  
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4 al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector,  
5 vocational education contributes to human resources development and minimize the gap between  
6 the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set  
7 up a good competency including skills and organizational knowledge for the graduates which  
8 means the graduates are ready for entering the workplace environment. To meet the industrial  
9 requirements, the graduates should be able to work effectively by combining the knowledge,  
10 skills, and other work-related capacities into specific competence needed (Loon & Bartram,  
11 2007). This matter could be achieved by implementing the internship program during the period  
12 of study in a vocational education school which has a related industrial field (Ocampo et al.,  
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23 Competency test has been commonly used in most of the vocational education in Central  
24 Java, Indonesia, especially in the automotive field to ensure the capability of the students to  
25 conduct vehicles repair or maintenance. The current competency test conducted was  
26 approved by the Indonesian stake holders, i.e. LSP (Board of Profession Certification). The  
27 authors of the current paper believe that novelty of the present test was the choice offered to the  
28 students whenever they felt ready for the test. The previous test was only available at final  
29 semesters. The specific tasks are given to the students such as engine tune-up, clutch overhaul,  
30 gearbox transmission overhaul, electrical body system, and starter system. Currently, these five  
31 tasks are implemented to the students by using the 'Continuity' model which means that the  
32 students should finish all the tasks continuously within 5 hours. However, the 'Continuity' model  
33 tends to cause work fatigue during the competency test, while the work fatigue will decrease the  
34 student's concentration and focus which will significantly cause poor competency test results.  
35 Nurhayati et al. investigated the effect of the increase in the production time on the productivity  
36 achieved. During the investigation, the muscle fatigue has occurred at a very high level of  
37 production time and the results showed that the productivity achieved are below the productivity  
38 target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a  
39 long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough,  
40 headache, and many more which can cause the worker absence. In addition, lack of focus and  
41 concentration in the workplace due to work fatigue means a lack of safety awareness which can  
42 cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for  
43 the 'Continuity' test model showed unsatisfied results where the students feel under pressure  
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4 during the five hours competency test and under the assessor supervision. Moreover, most of the  
5 students suffer from pressure which is not only physical but also mentally pressured. This  
6 condition caused the students' competency score results are not optimal. This will decrease the  
7 students' opportunity to get their best results in the competency test, while the competency test  
8 score determines their opportunity for competing in labour market. Therefore, further evaluation  
9 of the 'Continuity' competency test model in vocational education schools is highly necessary  
10 for this global industrial era.  
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### 18 ***Management of The Competency Test*** 19 20

21 In vocational education, competency turns into an important aspect for the graduates as a  
22 benchmark that should be achieved by the students during their period of study to get a better job  
23 opportunity in labour market. Competency has two essential values which are first, authorities in  
24 carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and  
25 second, the capability to implement the knowledge, skills, and experience (Mulder, 2007).  
26 Competency test in vocational education school should have a comprehensive and multi-  
27 dimensional construction. Generally, there are three different competency levels, those are  
28 conceptual competence, procedural competence, and interpretative competence (Winther &  
29 Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job  
30 assignments that match the specific needs of the world business industry. Competency test is  
31 essential for the students in terms of the final decision whether the students pass or fail during  
32 their study in vocational education as well as to avoid the incompetent graduates in labour  
33 market (Johnson, 2008). Alternatively, the substance of the competency test is not only for  
34 testing the students but also to seek the validation of the students. The validation process itself  
35 focuses on how students work on each assignment such as used tools accuracy, their work  
36 attitude, and adhere to SOP, instead of the final results-oriented only (pass or fail).  
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50 However, in this current vocational education school in Central Java, Indonesia, the  
51 implemented competency test is only focused on the final result without considering the process  
52 and performance of the students in detail during the competency test. The competency test is  
53 conducted only one time simultaneously at the end of the students' period of study according to  
54 the curriculum order. This management of the competency test is considered less effective due to  
55 the implementation of the competency test is limited at a certain time. The impact adversely  
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4 students' performance during the competency test as well as the assessors' validation of the  
5 students' performance. In addition, owing to the last semester implementation of the competency  
6 test, the students tend to struggle to do retest if they fail during the competency test due to the  
7 limited schedule. Therefore, the innovation on the management of the competency test is highly  
8 necessary in order to significantly improve the quality of vocational education graduates. Proper  
9 management of the competency test is proposed in this research which aimed to give the students  
10 a bigger opportunity to perform better and get their best result during the competency test. The  
11 proper management of the competency test allows the students to take the assignments at any  
12 time as long as the quota meets the minimum requirements. The school will provide a minimum  
13 quota for each task to be carried out. Thus, the assessor could give detailed assessment and  
14 validation based on the requested ongoing assignment whether the students are passed or failed  
15 on their competency test. However, if the student failed, they will be given a chance to practice  
16 more in the workshop during their study, then they could take another competency test in the  
17 next semester. The proposed management of the competency test is involving teachers, internal  
18 assessors, and external assessors (field experts: mechanics or automotive experts).

### 32 ***The Effect of Fatigue and Stress Level***

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36 The high intensity of the workload in the industrial sector tends to produce high fatigue and  
37 stress levels of the worker. This concept is also similar to the competency test particularly in  
38 automotive skills for vocational education students. During the automotive skill competency test,  
39 the students were forced to finish heavy duty within a limited time. However, this will  
40 significantly produce a poor competency result which will decrease the opportunity of the  
41 students entering the labour market due to the students' fatigue and stress level increase. The  
42 study about the effect of fatigue and stress levels on productivity has been investigated over the  
43 decades. The results prove that the environment and work pressure significantly affect the body  
44 temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &  
45 Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours,  
46 working conditions, and high workloads. These aspects are significantly affecting low  
47 productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue  
48 and stress level increased were observed such as reduced levels of awareness, low concentration  
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4 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also  
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6 lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart  
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10 (Åkerstedt et al., 2014). However, the recommendations such as time management, working time  
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12 arrangement, rest and break time optimization, fitness, and sports program are highly necessary  
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14 in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri &  
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16 Rusdiana, 2010). The study about the effect of fatigue and stress levels on productivity has been  
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18 investigated over the decades. The results prove that the environment and work pressure  
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20 significantly affect the body temperature of the workers whereas significantly affecting the  
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22 muscle fatigue and stress (Chad & Brown, 1995). Qualitatively, fatigue, and stress level are  
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24 attributed to extended working hours, working conditions, and high workloads. These aspects are  
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26 significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019).  
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28 Several impacts on the fatigue and stress level increased were observed such as reduced levels of  
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30 awareness, low concentration and focus, reduced motivation and impaired mood as well as low  
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32 job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health,  
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34 fatigue, and stress level can also lead to long-term health problems such as muscular tension,  
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36 musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick  
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38 leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as  
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40 time management, working time arrangement, rest and break time optimization, fitness, and  
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42 sports program are highly necessary in order to avoid workers fatigue and stress level increases  
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44 (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

43 Looking into the importance of rest and break time management and the time arrangement in  
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45 the industrial sector, vocational education schools should implement a similar method due to the  
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47 vocational education graduates are focus on the industrial labour market (Ahmed, 2016; Pema &  
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49 Mehay, 2012). The implementation of the fatigue and stress level management could be assigned  
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51 to the students' competency test model. However, most vocational education schools in  
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53 Indonesia are facing poor fatigue and stress management on their students during competency  
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55 tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the  
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57 demand for the industrial sector on human resources is increasing with high criteria required. To  
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59 overcome this problem, vocational education schools should increase their graduates'  
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competency test scores, thus their graduates could easily compete in the labour market and improve job opportunities.

### *The 'Discontinuity' Competency Test Model*

Therefore, in this present study, the alternative model of competency test for vocational education called the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the 'Discontinuity' model is by giving the student time to break and rest while shifting with another student competency test. The five tasks of the competency test could be done within 1 hour with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O'Neill & Panuwatwanich, 2013). This current study aims to observe the student's 'Discontinuity' and 'Discontinuity' test model by analysing the objectives in the research. vocational education students in Central Java, Indonesia. This study which was conducted in a narrower area and the arguments for determination, who were the education school in Semarang city, Indonesia (Abdullah, 2019). This study developed 'Discontinuity' model in this study covers large vocational education schools in Central Java, Indonesia, and the standardized and capable of being a test improvement. The previous test comprised of five units and was administered continuously without any break. In addition, the students were not free to stop whenever they feel ready to do so.

Explanation of the research question (RQ)?

Methodology relates to how the researcher is responsible for his research and achieves the objectives in the research.

Check again. Sample details and their arguments for determination, who were the respondents selected and why, how was the data collected, how were the data analysis techniques, how did the researcher decide that the instrument was standardized and capable of being a test standard?

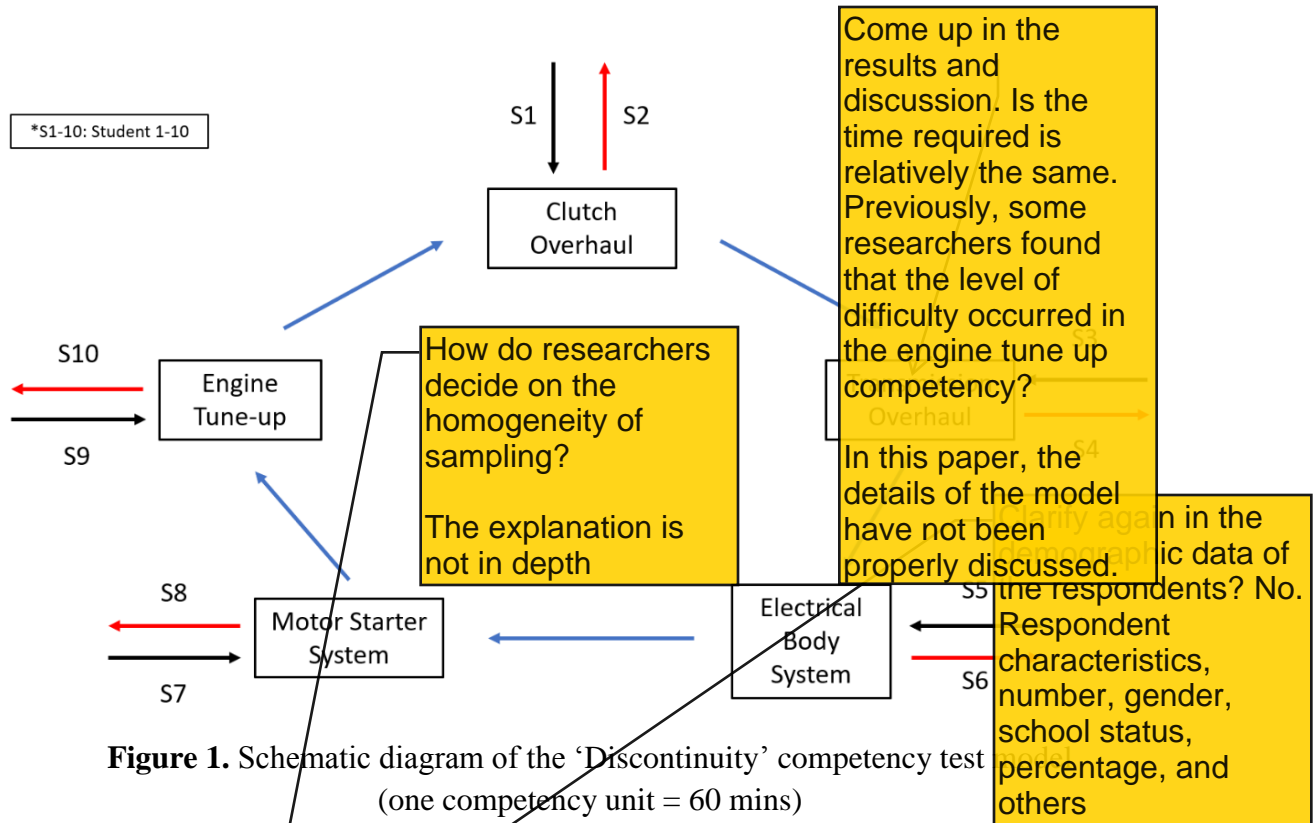
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What are the indicators of satisfaction, according to Sanchez Prieto, et al? through a

## **2. Methods**

This study was focused on a descriptive quantitative method with data through a questionnaire that describes the educational reality regarding the level of students' satisfaction with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). Two different models were implemented to collect the data which were 'Continuity' and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The 'Continuity' model means the students must finish five competency tasks continuously within five hours with a very

limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain time (1 hour) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the 'Discontinuity' model is shown in Figure 1. The 'Discontinuity' model is considered to be more feasible and could significantly improve the students' competency test final score.



**Figure 1.** Schematic diagram of the 'Discontinuity' competency test (one competency unit = 60 mins)

This study was conducted in Central Java, Indonesia, involving students and teachers from ten Vocational High Schools. Due to the different characteristics between public and private vocational schools, only the public ones were currently investigated. In addition, such selection of involving only public schools was also meant to ensure sampling homogeneity, primarily included the curricula and qualifications of the teachers. The experiment consisted of the common stages of research, i.e. formulation of problem statement and objectives, designing the experimental instrument, determining the sampling techniques, data collection and analysis, and conclusion on experimental findings.

In terms of the proposed management of the competency test, the questionnaire was distributed to the respective teachers, head of the department, and head of the laboratory of each

The evaluation indicators decision was appropriate, but how the evaluation method was still ambiguous. Especially diverse competences. Researchers must be able to tell the difference! Add a reference to the evaluation

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judgment of the proposed management to be implemented. The students' competency test covered the following skills: task skill, task management skill, contingency management skill, environment skill, and transfer skill. It was proposed that such an arrangement will ease the students to get the optimum result of their competency test. They are allowed to take the test at any time after the first semester of their study as long as the minimum requirements are met. The test content was formulated in collaboration between the vocational schools and the stakeholders, namely the industrial sectors involving automotive skills. The schematic diagram of the competency test is shown in Figure 2.

Each student (100 students in all) completed five (5) units of the competency test. These units were: engine tune-up, engine overhaul, transmission overhaul, electrical, and motor starter, respectively. The test using the continuous mode was carried out first. Then, the next day the students repeated the test with the discontinuous mode.

Each test unit took 60 minutes to complete, hence undertaking the test would require a continuous time period of five hours.

Each unit of the five tests was designed by the first author (Abdi) to have the same level of difficulty. Having been supervising automotive practicals at vocational high schools for over thirty years it is believed he is conversant with the five test units investigated. Therefore, it was considered that the validity of the tests was sufficiently assured. In addition, the test materials as well as their implementation were also examined and subsequently approved by the relevant stakeholders.

The students' evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2. The instrument used was previously approved by the principals of the intended vocational schools. Moreover, it has also been approved by the ethics committee within the authors' institution. Elaboration of the instrument is as follows.

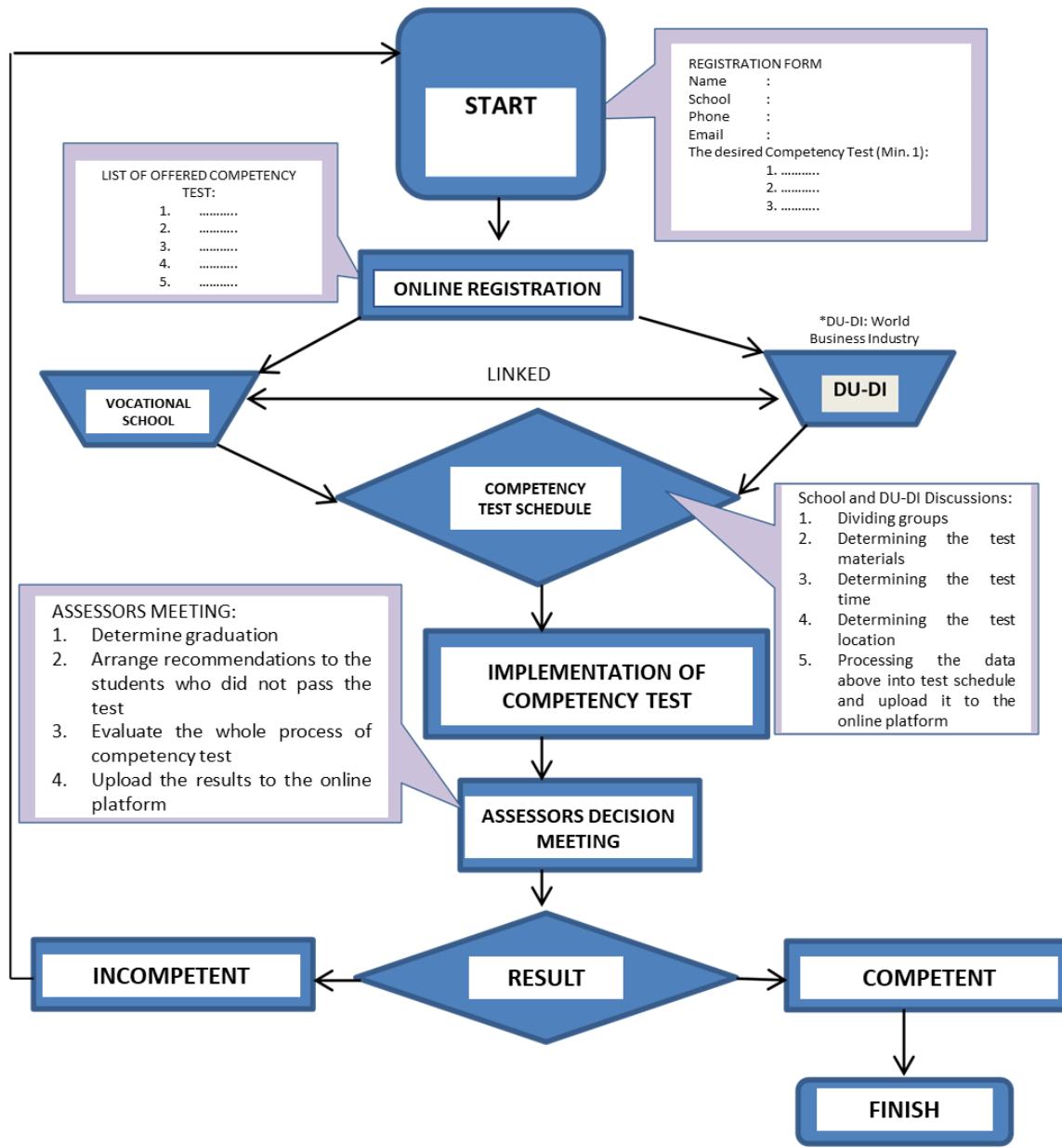
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Readers experience confusion, if it is not clear what indicators or important variables are questioned? Why?

Two types of ... in this study. The first type of it was applied to the students, while the ... intended for teachers, lab heads, and school principals, respectively. As is ... school practices, teachers, lab heads as well as school principals are mandated the same, i.e. to teach the students. Managing the school and the labs are both additional duties for the teachers. Therefore, the experimental instrument applied to the three groups of teachers was essentially similar. The instrument consisted of 30 questions and was designed to uncover the opinion of these groups of teachers on the competency Test Model offered in this study. Each question provided six choices: 1, 2, 3, 4, 5, and 6. Choice number one (1) indicates “very” in a negative sense, while the other extreme, i.e. number six (6) signifies the same weighting positively. As an example, the model presently offered allows the students to freely select the testing time whenever they are ready for it. Then, agreeing to this test method would mean “very agree” and carries six (6) points. Consequently, number (1) would mean the opposite extreme, i.e. “very disagree”. As regards the scoring, the minimal score was  $1 \times 30 = 30$ , and the maximum one equals  $6 \times 30 = 180$ .

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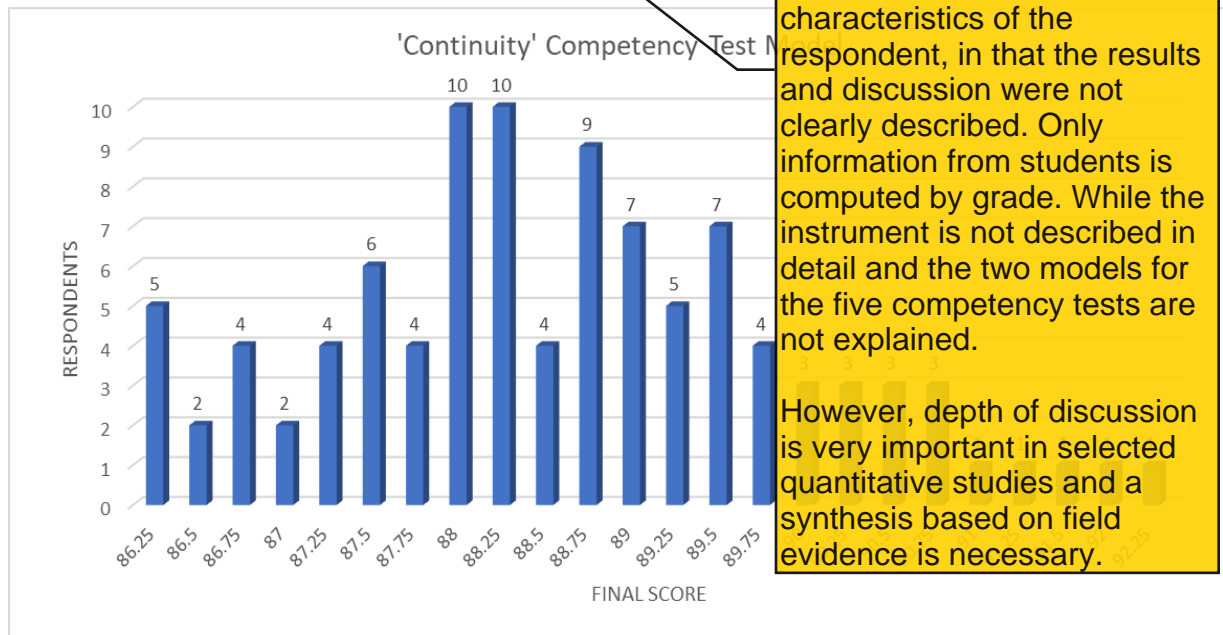


**Figure 2.** Schematic diagram of the proposed competency test management.

Give an argument that the competency test is in accordance with the LSP P1 standard.  
or have other arguments

### 3. Results and Discussion

This present study revealed the comparison between the 'Continuity' test model and the 'Discontinuity' test model that has been done in the selected area. The results indicate the correlation between the number of respondents and the final score test using the 'Continuity' and the 'Discontinuity' model respectively.



**Figure 3.** Schematic graph of the 'Continuity' competency test model results.

Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

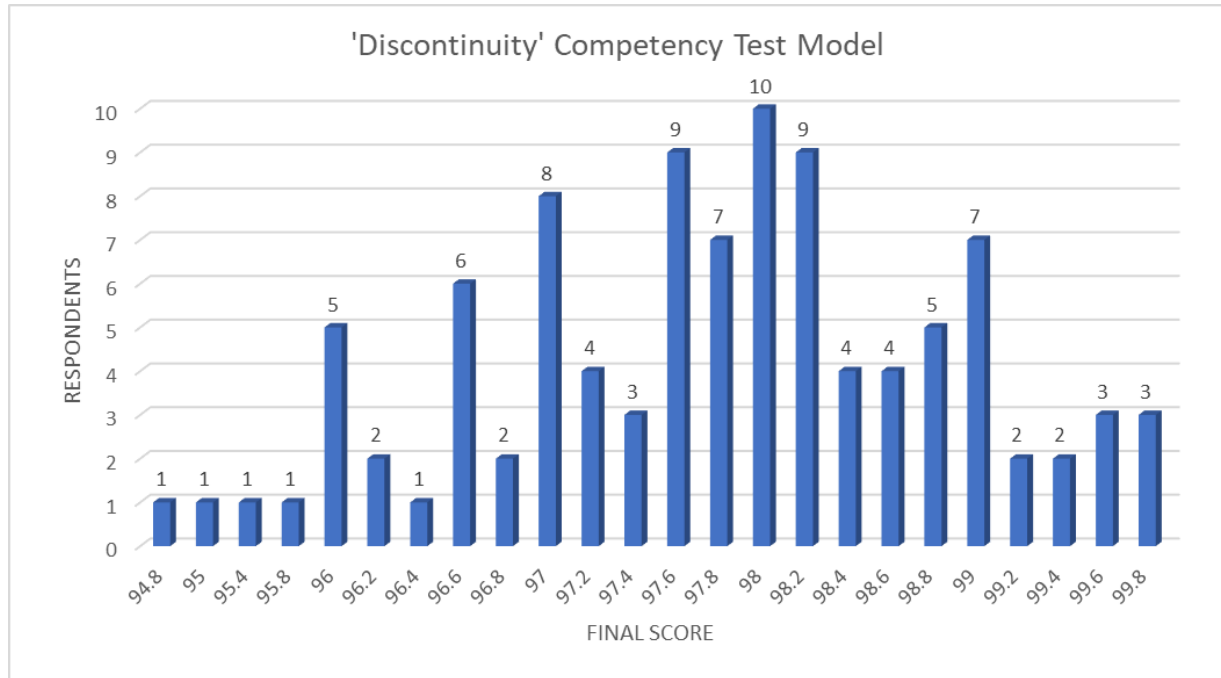
Less informative and in-depth. The study is less representative of the data and empirical support is very weak.

**Table 1.** Students' competency score based on criteria class using the 'Continuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the 'Continuity' competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the 'Good' level. The numbers of students with 'Good' level were 86 students. Meanwhile, the students with 'Very good' level were only 14 students which indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the 'Continuity' competency test model which was only achieved

by one student. This score level indicates the students' capability and convenience during the competency test. In this global industrial era, a 'very good' level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test results of the students should be carried out. Otherwise, the vocational education schools fail to become a bridge between the graduates and the labour market.



**Figure 4.** Schematic graph of the 'Discontinuity' competency test model results.

- Criteria:
- 50 – 60 : Very low
  - 61 – 70 : Low
  - 71 – 80 : Enough
  - 81 – 90 : Good
  - 91 – 100 : Very good

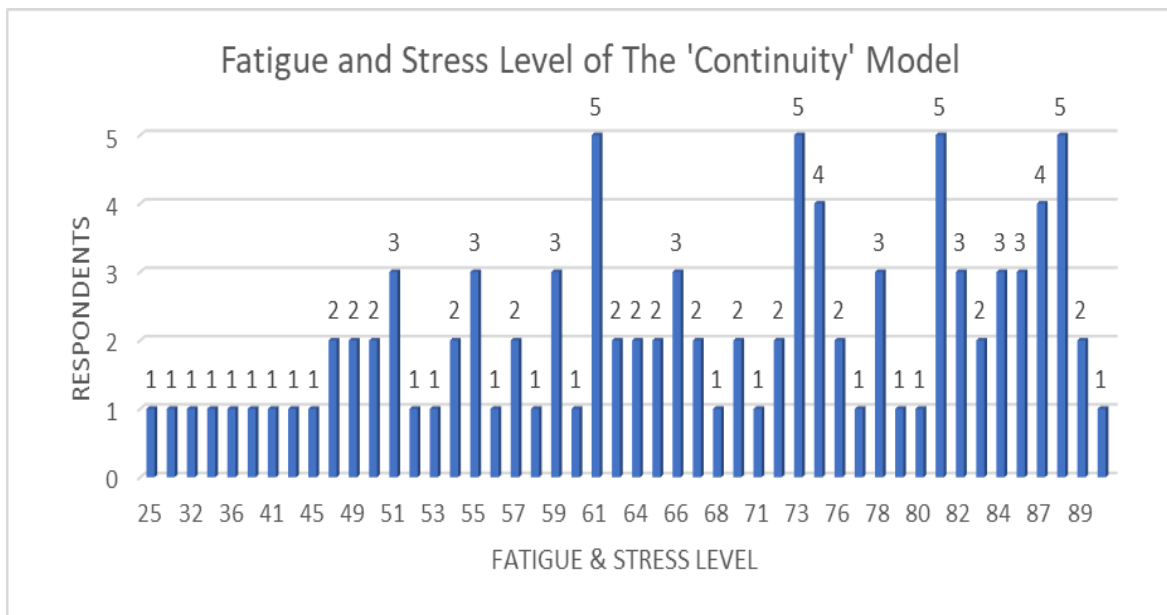
**Table 2.** Students' competency score based on criteria classification of the 'Discontinuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

Meanwhile, based on the 'Discontinuity' competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at 'Very good' level. The lowest



score was 94.8, while the highest score for the ‘Discontinuity’ competency test model was 99.8. Although both ‘Continuity’ and ‘Discontinuity’ competency test model results were still acceptable, the ‘Discontinuity’ competency test model emphasize the optimum final score of the students. One hour of rest and break time that given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in labour market.



**Figure 5.** Schematic graph of the fatigue and stress level of the ‘Continuity’ competency test model.

Criteria:

- 15 – 30 : Not very tiring
- 31 – 45 : Not tiring
- 46 – 60 : Enough
- 61 – 75 : Tiring
- 76 – 90 : Very tiring

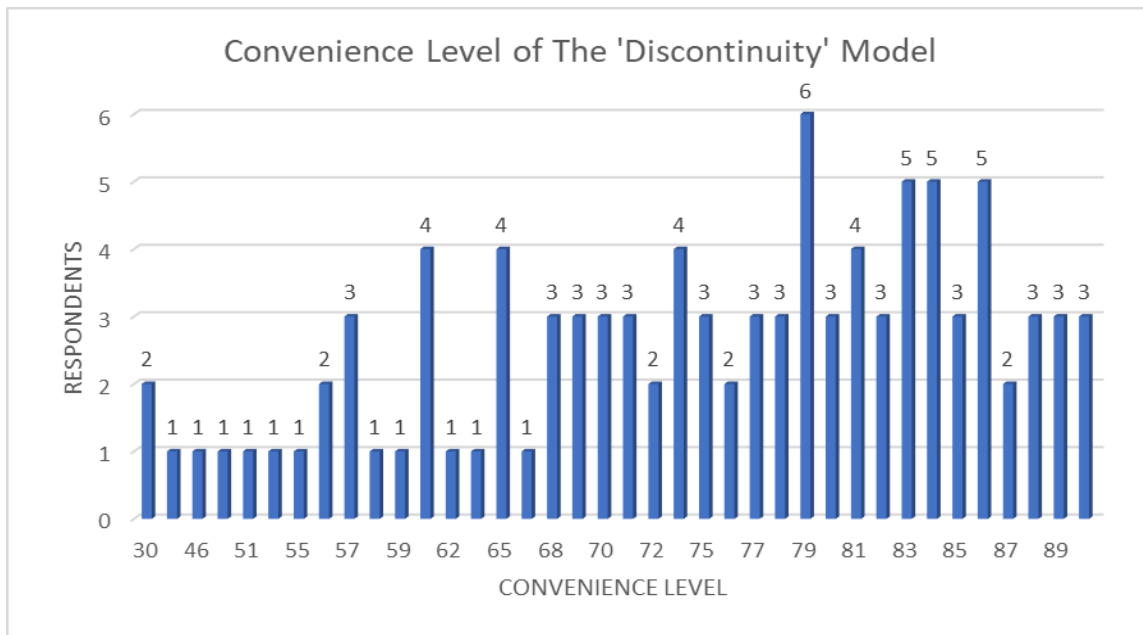
**Table 3.** Students’ fatigue level criteria classification of the ‘Continuity’ model.

Criteria	Not Tiring	Very Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

Figure 5 and Table 3 indicated the fatigue level survey that has been given to the respondents regarding the ‘Continuity’ competency test model. The results revealed that students tend to feel



very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated at the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affecting the students' fatigue and stress level.



**Figure 6.** Schematic graph of the fatigue and stress level of the 'Discontinuity' competency test model.

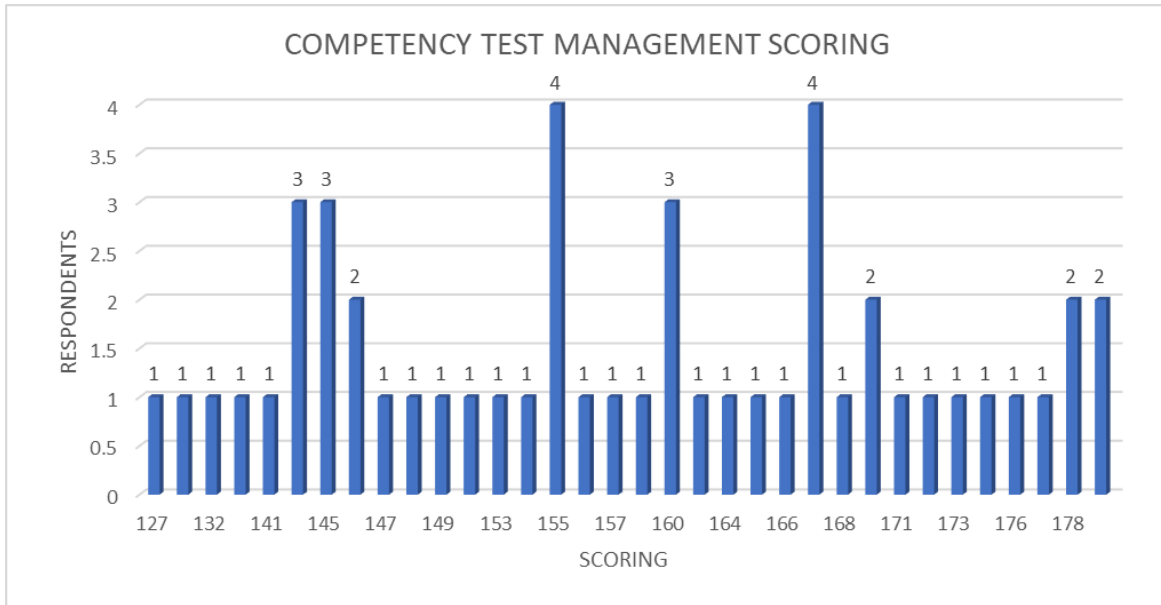
Criteria:

- 15 – 30 : Very uncomfortable
- 31 – 45 : Uncomfortable
- 46 – 60 : Enough
- 61 – 75 : Comfortable
- 76 – 90 : Very comfortable

**Table 4.** Students' convenience level criteria classification of the 'Discontinuity' model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

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4 Figure 6 and Table 4 revealed the survey result that has been given to the students according  
5 to their opinion on the implication of the ‘Discontinuity’ model regarding their convenience  
6 during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the  
7 students are comfortable and very comfortable with the application of the ‘Discontinuity’ test  
8 model. It is in accordance with their final score of the competency test results which indicated  
9 significant improvement and better results during the competency test. 53 students stated at the  
10 ‘very comfortable’ category, 32 students stated at the ‘comfortable’ category, 12 students stated  
11 at ‘enough’ category, 1 student stated at the ‘uncomfortable’ category, and only 2 students stated  
12 at ‘very uncomfortable’ category. This result proves that the application of the ‘Discontinuity’  
13 test model gives better comfortability to the students as well as reduce their fatigue and stress  
14 level. Therefore, the final score of the competency test could be increased significantly. The  
15 ‘Discontinuity’ model gives the students the opportunity to take a break for an hour in between  
16 the tasks in order to recover their focus and concentration to conduct the next following  
17 competency test. Therefore, they can refresh their mind to avoid high-stress level during  
18 competency test and take a break to relax their body due to the high intensity and pressure of the  
19 competency test. This ‘Discontinuity’ competency test model is established to fulfill the  
20 students’ desire to get the optimum competency test result to support their assets and increase  
21 their opportunity in labour market. In terms of quality, the vocational education school in which  
22 implementing this method could significantly gain massive improvement by graduating students  
23 with a high competency level.  
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**Figure 7.** Schematic graph of the proposed competency test management scoring.

Criteria:

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 5.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total	-	-	-	16	34
Respondents					

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 5 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labour market improved owing to the students’ competency final score improvement. As implemented in the present research the students were

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4 allowed to undertake the test(s) in which they find the most conversant in. Secondly, time  
5 intervals or time breaks were given during the test. This could have a temporary rest to  
6 restore stamina. As shown in the test results, such preference, i.e. selecting the test materials  
7 most mastered as well as the provision of time break, results in the students to obtain a much  
8 better performance.

Match your research question?

#### 4. Conclusion

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Fatigue and stress levels of the vocational students could adversely impact the competency test result. The current competency test model for vocational education in Central Java, Indonesia is a 'Continuity' competency test model. This model tends to give low scores on students' competency test results due to the lack of time to break where the students must finish five tasks within 5 hours, thus, it causes the students' focus and concentration to decrease significantly. To overcome this problem, the implementation of the 'Discontinuity' model was proposed. By giving one-hour time to break for the student and the competency test could be done alternately, fatigue, and stress level of the students could significantly decrease. Consequently, the result shows that the final score of the student's competency test result was significantly improved. All the 'Discontinuity' model-based results showed in the 'very good' category. In addition, the survey results showed that the students feel more comfortable using the 'Discontinuity' competency test model than that 'Continuity' competency test model as well as the teachers satisfied with the proposed competency test model. The improvement in the competency test result is very important for the student who will be facing the labour market after graduated from vocational education. However, the industry considers students with a high competency score to join their company rather than the lower score one. In addition, a new competency test management is proposed in this study by allowing the students to take the competency test at any time since their first semester of study through an online platform that directly connected with vocational school management and DU-DI (World Business Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency test management. However, the proposed competency test management will ease the students and teachers to achieve an optimum final score of the competency test as well as improve the vocational school quality.

The decrease in concentration was not seen in the results or discussion. Reconsider?

The reasons are not basic?

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4 **Declarations**

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6 *Author contribution statement*

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9 Abdurrahman: Conceptualization; Methodology; Performed research; Analysed and  
10 interpreted the data; Wrote the paper.

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12 Parmin: Validation; Visualization; Supervision; Reviewed and edited the paper.

13  
14 S. Muryanto: reviewed the original manuscript; wrote the revision.

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17 *Funding statement*

18  
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20 748/UN37.3.1/LT/2016.

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24 *Competing interest statement*

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26 The authors declare no conflict of interest.

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28 *Additional information*

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30 No additional information is available for this paper.

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33 *Acknowledgments*

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36 Semarang for supporting and funding this research with the Grant no. 748/UN37.3.1/LT/2016.  
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11. Fourth Revision: Accepted with minor revision (7 Sept 2021)



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**Decision on submission HELIYON-D-20-08525R3 to Heliyon**

4 messages

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Tue, Sep 7, 2021 at 1:46 PM

Reply-To: Heliyon &lt;info@heliyon.com&gt;

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Manuscript. Number.: HELIYON-D-20-08525R3

Title: Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Journal: Heliyon

Dear Dr. Abdurrahman,

We have now received all of the reviewers' comments on your recent submission to Heliyon.

The reviewers have advised that your manuscript should become suitable for publication in our journal after appropriate revisions.

If you are able to address the reviewers' comments, which you can find below, I would like to invite you to revise and resubmit your manuscript. We ask that you respond to each reviewer comment by either outlining how the criticism was addressed in the revised manuscript or by providing a rebuttal to the criticism. This should be carried out in a point-by-point fashion as illustrated here: <https://www.cell.com/heliyon/guide-for-authors#Revisions>To allow the editors and reviewers to easily assess your revised manuscript, we also ask that you upload a version of your manuscript highlighting any revisions made. You may wish to use Microsoft Word's Track Changes tool or, for LaTeX files, the latexdiff Perl script (<https://ctan.org/pkg/latexdiff>).To submit your revised manuscript, please log in as an author at <https://www.editorialmanager.com/heliyon/>, and navigate to the "Submissions Needing Revision" folder under the Author Main Menu. Your revision due date is Oct 07, 2021.

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I look forward to receiving your revised manuscript.

Kind regards,

Jin Su Jeong, Ph.D. Ph.D.  
Associate Editor - Education  
Heliyon

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1. Even though the journal doesn't have a specific formatting for the manuscript, I would like to encourage you to at least format the manuscript with the consistent style, not having various formats in main text and references. For example, the citation should follow one specific regulation such as alphabetical or chronical order. Also, in the section of references, the authors should carefully format them based on a consistent style. Particularly, in the section of method, there is a mixed text format that should be changed carefully.
2. The authors used the methodology along with quantitative analysis. Regarding with quantitative analysis, I do not agree with the way to analyze the data, and it should be fortified to use more SPSS analyses since I can see only figures that actually not showed the significant difference of data comparison. Whilst not consenting the quantitative analysis, I have a doubt for the qualitative analysis that I can't see the proper examination.
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To: [sunaryaamud@gmail.com](mailto:sunaryaamud@gmail.com)

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**Abdurrahman Abdurrahman** <[abdurrahman@mail.unnes.ac.id](mailto:abdurrahman@mail.unnes.ac.id)>  
To: [sukestiyarno@mail.unnes.ac.id](mailto:sukestiyarno@mail.unnes.ac.id)

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12. Revision 4: Revised version received (7 Oct 2021)  
- Revised article



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1 message

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<b>Manuscript Number:</b>	HELIYON-D-20-08525
<b>Article Type:</b>	Original Research Article
<b>Section/Category:</b>	Education
<b>Keywords:</b>	Vocational education; automotive; competency; Discontinuity model; competency test management
<b>Abstract:</b>	<p>This article aimed to improve competency test results to increase the students' job opportunity in the labour market. Currently, the applied competency test model is the 'Continuity' model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students' fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the 'Discontinuity' competency test model was proposed aiming to overcome the issue on the 'Continuity' model. To research the effect of the 'Discontinuity' model implementation on the students' competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the 'Discontinuity' competency test model gives a significant improvement in the students' competency test scores. This reasonably happened due to the implementation of the 'Discontinuity' model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress level of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.</p>



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# Evaluation on The Automotive Skill Competency Test Through ‘Discontinuity’ Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>a</sup> *Mechanical Engineering Department, Faculty of Techniques, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>b</sup> *Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>c</sup> *Chemical Engineering Department, UNTAG University in Semarang, 50235 Gajah Mungkur, Semarang, Indonesia*

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## Abstract

This article provides an alternative competency test model for vocational education school in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students’ accomplishment during the competency test, aimed to improve competency test results to increase the students’ job opportunity in the labour market. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students’ fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test result. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue on the ‘Continuity’ model. To research the effect of the ‘Discontinuity’ model implementation on the students’ competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant improvement in the students’ competency test scores. This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress level of the students will significantly increase which adversely affect the students’ competency final score. In addition, the new management of the competency test was proposed in this research.

*Keywords: Vocational education; automotive; competency; Discontinuity model; competency test management*

## 1. Introduction

The presence of vocational education in this present circumstance brings a significant impact on the correlation between education and the labour market. Students are given two choices whether they will continue their studies to regular school or vocational education. Vocational education becomes a good choice for students who wants to directly look for a job after graduating from school and could be a shortcut to involved in the labour market directly. The percentage of practical knowledge of vocational education is higher than that in regular school. Thus, vocational education aims to prepare students one step forward for entering the labour market with a highly skilled in a specific field of jobs. In general, there are three types of vocational education systems, which are school-based vocational education, dual apprenticeship, and informal training (Guo & Wang, 2020). In a developing country, school-based vocational education is more applicable than the other systems considering manpower inequality. Students that enrol in a vocational education school exhibit outstanding practical skills supported by their early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). However, in some

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)

E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

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4 developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical  
5 issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a  
6 formal curriculum and standardized competency is very important to bring manpower equality which means  
7 the students are eligible for the industrial and business company requirements after graduated from  
8 vocational education. Moreover, vocational education also brings a significant impact on the economic  
9 sector for the country by reducing the youth unemployment population (Choi et al., 2019; Nilsson, 2010).  
10 Previous studies have investigated the effect of vocational education school-leavers on the labour market.  
11 The studies showed that the educational programs that were strongly oriented towards vocational skills and  
12 knowledge for the students have a positive influence and better integration into the labour market (Bol &  
13 van de Werfhorst, 2011; Muja et al., 2019).  
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### 16 *The Importance of Competency for Vocational Education*

17

18 However, in order to prepare the students' capability during the transition from high school to the labour  
19 market, the improvement of students' competency should be highly considered. Competency is a  
20 combination of skills, behaviour/attitude, and multiple knowledge that can be demonstrated by students  
21 where the skills, attitudes, and knowledge are obtained from the materials conceptualization that has been  
22 learned during the period of study. The level of vocational competency influences positively the chance of  
23 graduates of being matched to occupation with the specific educational domain. Furthermore, the  
24 application of on-the-job training will be much more efficient when implementing the generic competencies  
25 to adjust vocational competencies to the requirement of the job (Heijke et al., 2003). Due to the increase in  
26 the labour market qualification, the standard of student competence should be increased. This concern  
27 should be followed by the development of the students' assessment. Several points should be considered in  
28 order to improve the competency, which are authentic assessment, an improvement in quality lab sheet,  
29 student competency standard system, specific scoring rubric, and feedback from the students regarding their  
30 work. Therefore, a valid, reliable, fair, and consistent quality assessment could be achieved (Rahman et al.,  
31 2014).  
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33 In this industrial era, developing country such as Indonesia tends to force the economic sector by  
34 improving the industrial sector through massive production and export activity (Hidayatno et al., 2019;  
35 Neilson et al., 2020). In order to ensure that high demand in the industrial sector, vocational education  
36 contributes to human resources development and minimize the gap between the academic environment and  
37 industrial needs (Salleh et al., 2015). Therefore, it is critical to set up a good competency including skills  
38 and organizational knowledge for the graduates which means the graduates are ready for entering the  
39 workplace environment. To meet the industrial requirements, the graduates should be able to work  
40 effectively by combining the knowledge, skills, and other work-related capacities into specific competence  
41 needed (Loon & Bartram, 2007). This matter could be achieved by implementing the internship program  
42 during the period of study in a vocational education school which has a related industrial field (Ocampo et  
43 al., 2020).  
44

45 Competency test has been commonly used in most of the vocational education in Central Java,  
46 Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles  
47 repair or maintenance. The specific tasks are given to the students such as engine tune-up, clutch  
48 overhaul, gearbox transmission overhaul, electrical body system, and starter system. Currently, these five  
49 tasks are implemented to the students by using the 'Continuity' model which means that the students should  
50 finish all the tasks continuously within 5 hours. However, the 'Continuity' model tends to cause work  
51 fatigue during the competency test, while the work fatigue will decrease the student's concentration and  
52 focus which will significantly cause poor competency test results. Nurhayati et al. investigated the effect of  
53 the increase in the production time on the productivity achieved. During the investigation, the muscle  
54 fatigue has occurred at a very high level of production time and the results showed that the productivity  
55 achieved are below the productivity target (Nurhayati et al., 2016). Moreover, previous studies have  
56 investigated work fatigue as a long-term sickness absence. Hence, more potential diseases such as muscular  
57 soreness, cough, headache, and many more which can cause the worker absence. In addition, lack of focus  
58 and concentration in the workplace due to work fatigue means a lack of safety awareness which can cause  
59 fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for the 'Continuity'  
60 test model showed unsatisfied results where the students feel under pressure during the five hours  
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4 competency test and under the assessor supervision. Moreover, most of the students suffer from pressure  
5 which is not only physical but also mentally pressured. This condition caused the students' competency  
6 score results are not optimal. This will decrease the students' opportunity to get their best results in the  
7 competency test, while the competency test score determines their opportunity for competing in labour  
8 market. Therefore, further evaluation of the 'Continuity' competency test model in vocational education  
9 schools is highly necessary for this global industrial era.  
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### 11 *Management of The Competency Test*

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14 In vocational education, competency turns into an important aspect for the graduates as a benchmark  
15 that should be achieved by the students during their period of study to get a better job opportunity in labour  
16 market. Competency has two essential values which are first, authorities in carrying out the responsibility,  
17 license or right to decide, produce, serve, act, and perform, and second, the capability to implement the  
18 knowledge, skills, and experience (Mulder, 2007). Competency test in vocational education school should  
19 have a comprehensive and multi-dimensional construction. Generally, there are three different competency  
20 levels, those are conceptual competence, procedural competence, and interpretative competence (Winther  
21 & Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job assignments that  
22 match the specific needs of the world business industry. Competency test is essential for the students in  
23 terms of the final decision whether the students pass or fail during their study in vocational education as  
24 well as to avoid the incompetent graduates in labour market (Johnson, 2008). Alternatively, the substance  
25 of the competency test is not only for testing the students but also to seek the validation of the students. The  
26 validation process itself focuses on how students work on each assignment such as used tools accuracy,  
27 their work attitude, and adhere to SOP, instead of the final results-oriented only (pass or fail).

28 However, in this current vocational education school in Central Java, Indonesia, the implemented  
29 competency test is only focused on the final result without considering the process and performance of the  
30 students in detail during the competency test. The competency test is conducted only one time  
31 simultaneously at the end of the students' period of study according to the curriculum order. This  
32 management of the competency test is considered less effective due to the implementation of the  
33 competency test is limited at a certain time. The impact adversely students' performance during the  
34 competency test as well as the assessors' validation of the students' performance. In addition, owing to the  
35 last semester implementation of the competency test, the students tend to struggle to do retest if they fail  
36 during the competency test due to the limited schedule. Therefore, the innovation on the management of  
37 the competency test is highly necessary in order to significantly improve the quality of vocational education  
38 graduates. Proper management of the competency test is proposed in this research which aimed to give the  
39 students a bigger opportunity to perform better and get their best result during the competency test. The  
40 proper management of the competency test allows the students to take the assignments at any time as long  
41 as the quota meets the minimum requirements. The school will provide a minimum quota for each task to  
42 be carried out. Thus, the assessor could give detailed assessment and validation based on the requested  
43 ongoing assignment whether the students are passed or failed on their competency test. However, if the  
44 student failed, they will be given a chance to practice more in the workshop during their study, then they  
45 could take another competency test in the next semester. The proposed management of the competency test  
46 is involving teachers, internal assessors, and external assessors (field experts: mechanics or automotive  
47 experts).  
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### 49 *The Effect of Fatigue and Stress Level*

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53 The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels  
54 of the worker. This concept is also similar to the competency test particularly in automotive skills for  
55 vocational education students. During the automotive skill competency test, the students were forced to  
56 finish heavy duty within a limited time. However, this will significantly produce a poor competency result  
57 which will decrease the opportunity of the students entering the labour market due to the students' fatigue  
58 and stress level increase. The study about the effect of fatigue and stress levels on productivity has been  
59 investigated over the decades. The results prove that the environment and work pressure significantly affect  
60 the body temperature of the workers whereas significantly affecting the muscle fatigue and stress (Chad &  
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4 Brown, 1995). Qualitatively, fatigue, and stress level are attributed to extended working hours, working  
5 conditions, and high workloads. These aspects are significantly affecting low productivity and low job  
6 satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were  
7 observed such as reduced levels of awareness, low concentration and focus, reduced motivation and  
8 impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006).  
9 In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular  
10 tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick  
11 leave and reduce productivity (Åkerstedt et al., 2014). However, the recommendations such as time  
12 management, working time arrangement, rest and break time optimization, fitness, and sports program are  
13 highly necessary in order to avoid workers fatigue and stress level increases (Hsouna et al., 2019; Safitri &  
14 Rusdiana, 2010).

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16 Looking into the importance of rest and break time management and the time arrangement in the  
17 industrial sector, vocational education schools should implement a similar method due to the vocational  
18 education graduates are focus on the industrial labour market (Ahmed, 2016; Pema & Mehay, 2012). The  
19 implementation of the fatigue and stress level management could be assigned to the students' competency  
20 test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress  
21 management on their students during competency tests where poor competency results are inevitable  
22 (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is  
23 increasing with high criteria required. To overcome this problem, vocational education schools should  
24 increase their graduates' competency test scores, thus their graduates could easily compete in the labour  
25 market and improve job opportunities.  
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### 27 *The 'Discontinuity' Competency Test Model*

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30 Therefore, in this present study, the alternative model of competency test for vocational education called  
31 the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the  
32 'Discontinuity' model is by giving the student time to break and rest while shifting with another student to  
33 conduct the competency test. The five tasks of the competency test could be done within 10 hours with a  
34 break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could  
35 be done by 10 students per day by doing the competency test alternately. The break time is very important  
36 and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level  
37 of the workers (Gregson, 2020; Lim et al., 2020; O'Neill & Panuwatwanich, 2013). This current study aims  
38 to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model  
39 by analysing the competency test score of the vocational education students in Central Java, Indonesia. This  
40 study is a development from the previous study which was conducted in a narrower area and the taken  
41 sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al.,  
42 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving  
43 10 vocational education schools in Central Java, Indonesia, and provide a better result for educational  
44 improvement.  
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## 47 **2. Methods**

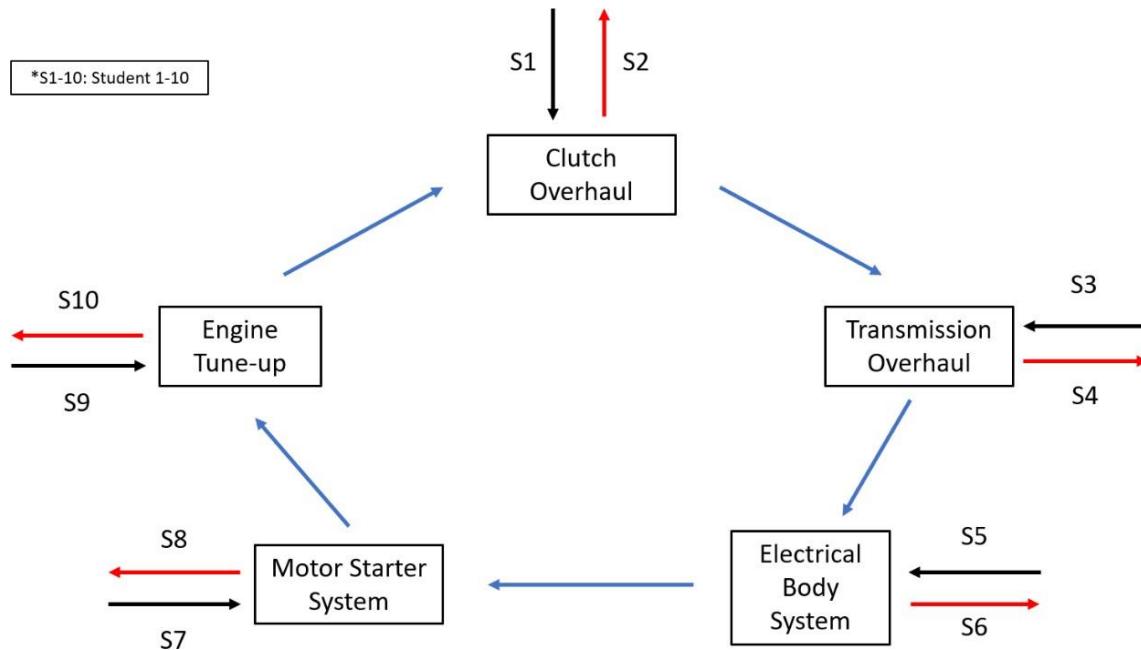
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49 This study was focused on a descriptive quantitative method with data collected through a questionnaire  
50 that describes the educational reality regarding the level of students' satisfaction with vocational education  
4 in Central Java, Indonesia (Sánchez Prieto et al., 2020). The level of satisfaction in vocational education is  
determined by the ability of teachers in learning. This study also uses a survey design because the number of  
research targets is spread over 10 different areas while the data collected is the same through competency tests  
and questionnaires. Two different models were implemented to collect the data which were 'Continuity'  
and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The  
'Continuity' model means the students must finish 5 competency tasks continuously within 5 hours with a  
very limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain  
time (1 hour) to break after finishing one task while shifting with the other student to do the same task.

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The schematic diagram of the ‘Discontinuity’ model is shown in Figure 1. The ‘Discontinuity’ model is considered to be more feasible and could significantly improve the students’ competency test final score.

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**Figure 1.** Schematic diagram of the ‘Discontinuity’ competency test model.

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This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyse the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students fatigue during the competence test, students score acquisition and competency test management.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The students’ evaluation of the proposed competency test management should consist of the following skills, those are; task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

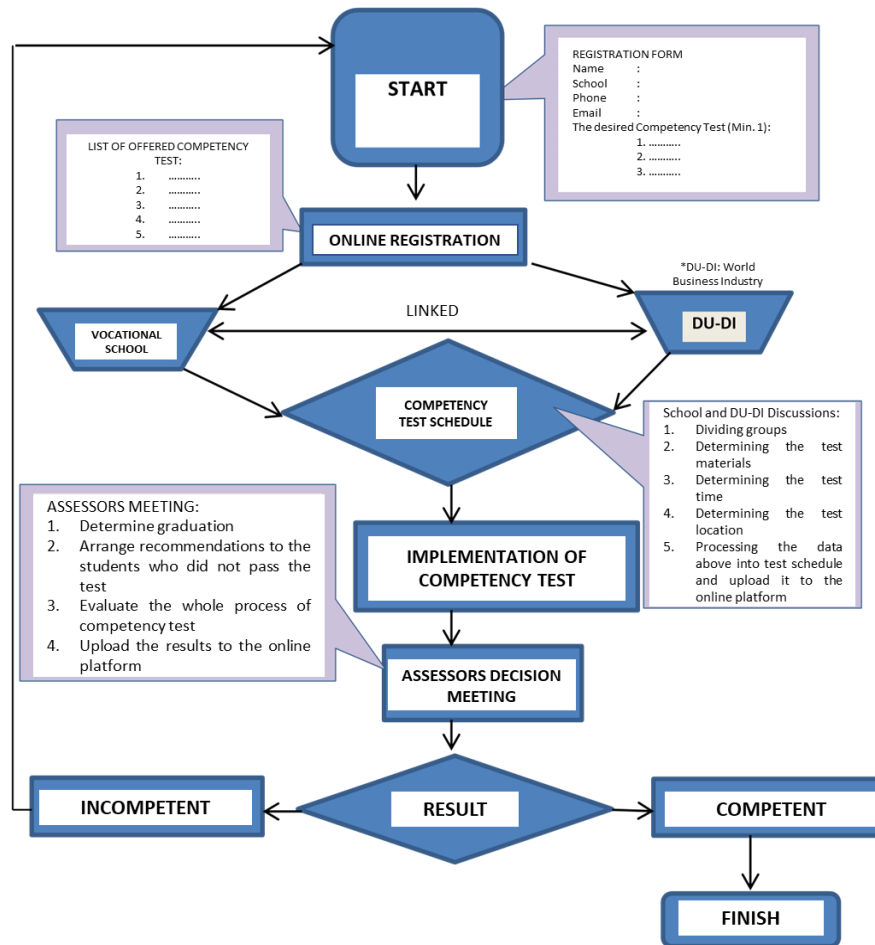
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The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. Before using the instruments, the validity of the items for the research instrument used in the form of a competence test for teachers was carried out first. The results of the validity of the items were as many as 40 items were declared valid from 30 questions. There are 30 valid questions that are continued as a matter of competence test. There are 5 competency tests for students with 12 points each for the transmission overhaul, 10 points for the electrical body system, 8 points for the motor starter system, 14 items for the engine tune-up, and 8 points for the clutch overhaul. The samples consisted of 5 teachers from each school which have a total of 50 teachers and 10 students from each school which have a total of 100 students. The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using continuity and discontinuity models. In this study, a comparative test was conducted between continuity and discontinuity groups through T-Test.

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Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyse the advantages and disadvantages of the proposed management given by the author. Additionally, the current study has been approved by the ethical committee of “Indonesian Ministry of Education and Culture, Universitas Negeri Semarang, Lembaga Penelitian dan Pengabdian Masyarakat” and confirmed that the study complies with all regulations and confirmation that informed consent was obtained.



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**Figure 2.** Schematic diagram of the proposed competency test management.

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### 3. Results and Discussion

This present study revealed the comparison between the ‘Continuity’ test model and the ‘Discontinuity’ test model that has been done in vocational schools in Central Java, Indonesia within the period of March to April 2020. Figure 3 and Figure 4 indicates the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model respectively.

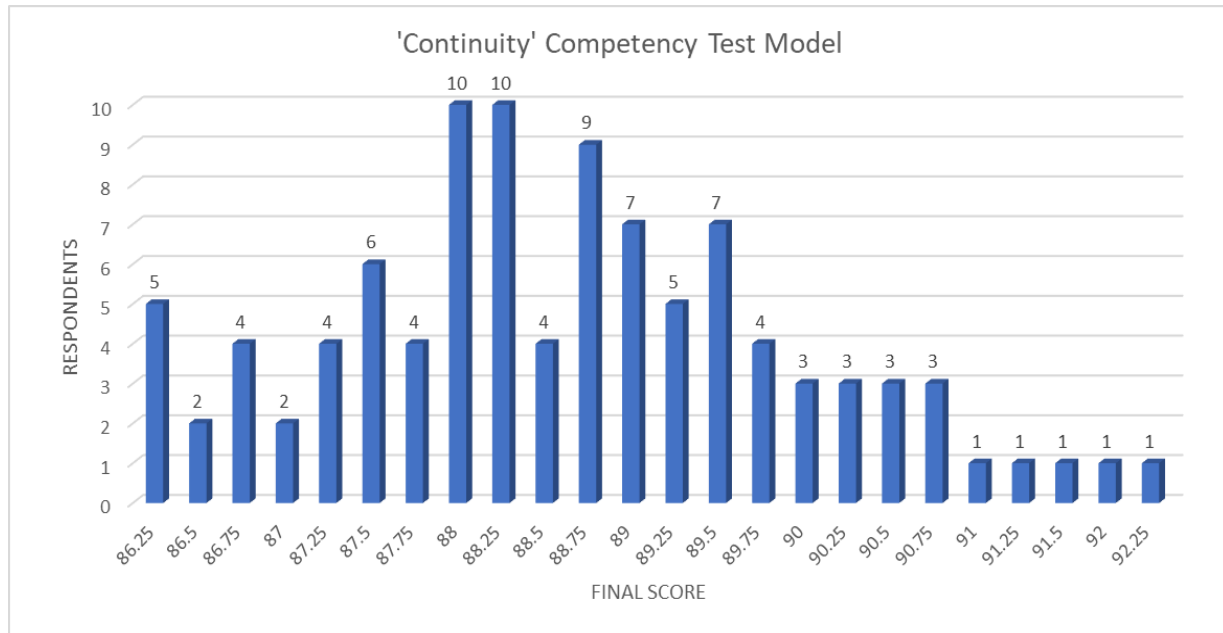


Figure 3. Schematic graph of the ‘Continuity’ competency test model results.

Criteria:

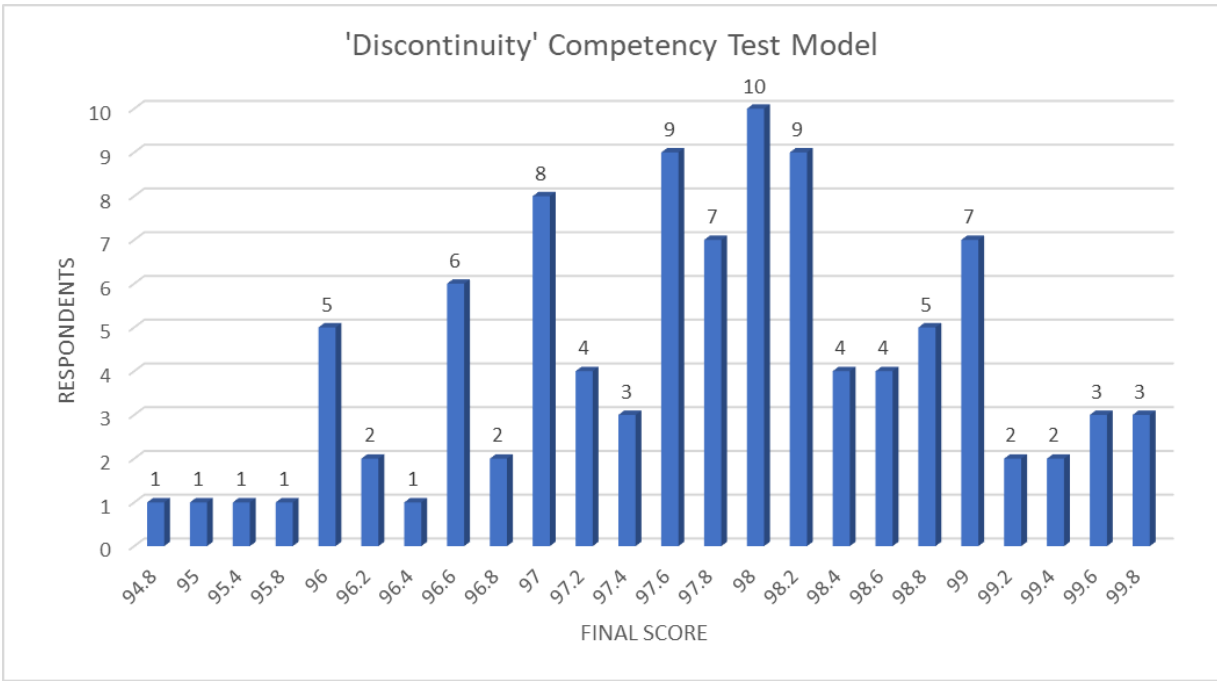
- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

Table 1. Students’ competency score based on criteria classification of the ‘Continuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the ‘Continuity’ competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the ‘Good’ level. The numbers of students with ‘Good’ level were 86 students. Meanwhile, the students with ‘Very good’ level were only 14 students which indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the ‘Continuity’ competency test model which was only achieved by one student. This score level indicates the students’ capability and convenience during the competency test. In this global industrial era, a ‘very good’ level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test results of the students should be carried out. Otherwise, the vocational education schools fail to become a bridge between the graduates and the labour market.





**Figure 4.** Schematic graph of the ‘Discontinuity’ competency test model results.

Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 2.** Students’ competency score based on criteria classification of the ‘Discontinuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

The results of the comparative test between the continuity and discontinuity groups through the T-Test are shown in Table 3.

**Table 3.** Results of T-Test in the Continuity and Discontinuity Groups

Group	N	Mean	Std.Deviation	Std. Error Mean
Continuity	100	88.6275	1.33593	0.13359
Discontinuity	100	97.7720	1.09877	0.10988

Sig = 0.000 = 0% < 5%, it means that Ho is rejected or H1 is accepted. The mean of continuity and discontinuity competency groups is different. Therefore, the mean of the discontinuity group is 97.77 > from the mean of the continuity group of 88.63. The results of the discontinuity competency group is better than the continuity competency group.

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Meanwhile, based on the 'Discontinuity' competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at 'Very good' level. The lowest score was 94.8, while the highest score for the 'Discontinuity' competency test model was 99.8. Although both 'Continuity' and 'Discontinuity' competency test model results were still acceptable, the 'Discontinuity' competency test model emphasize the optimum final score of the students. One hour of rest and break time that given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in labour market.

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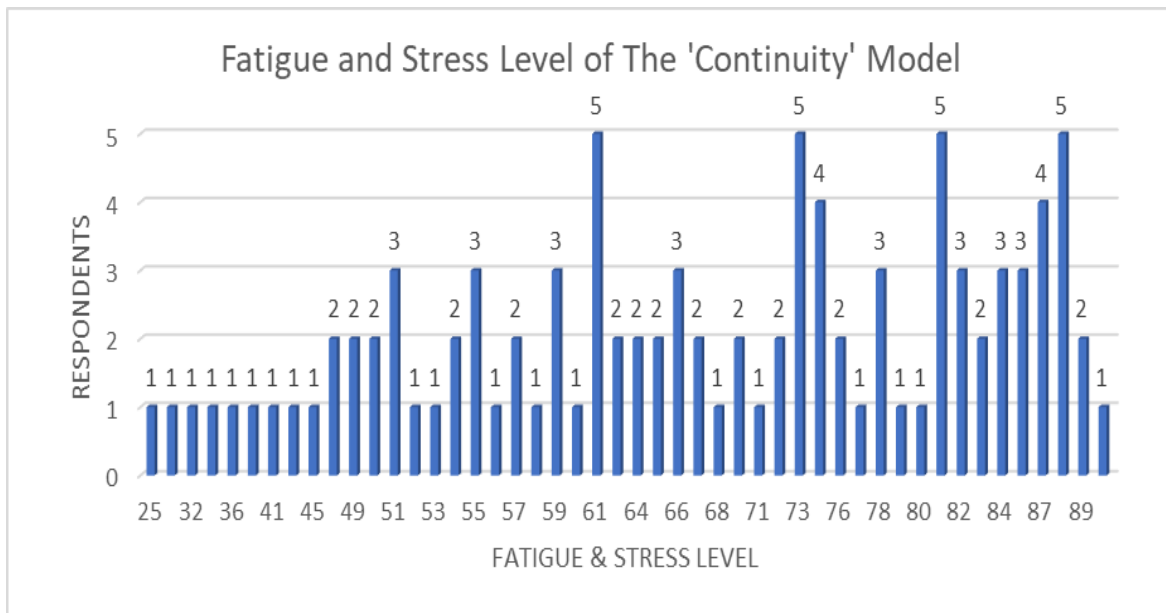


Figure 5. Schematic graph of the fatigue and stress level of the 'Continuity' competency test model.

- Criteria:  
 15 – 30 : Very not tiring  
 31 – 45 : Not tiring  
 46 – 60 : Enough  
 61 – 75 : Tiring  
 76 – 90 : Very tiring

Table 4. Students' fatigue level criteria classification of the 'Continuity' model.

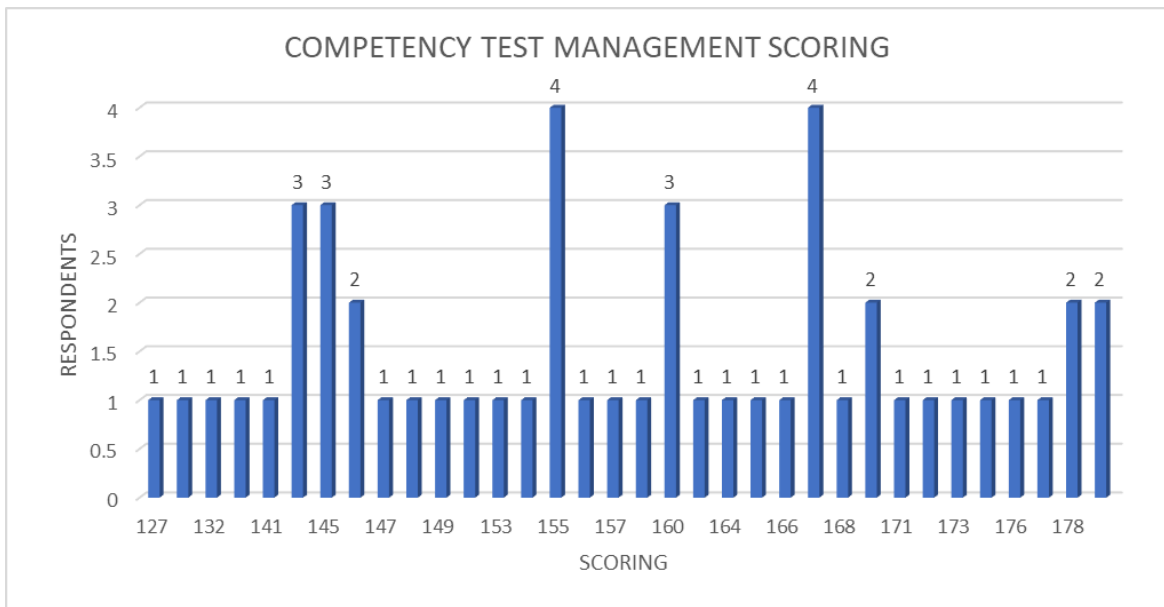
Criteria	Very Not Tiring	Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

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Figure 5 and Table 4 indicated the fatigue level survey that has been given to the respondents regarding the 'Continuity' competency test model. The results revealed that students tend to feel very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated at the 'very not tiring' category.

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Meanwhile, 24 students stated ‘enough’, 31 students stated ‘tiring’, and 36 students stated ‘very tiring’ category. These results were taken based on the students’ experience during the implementation of the ‘Continuity’ competency test model. This result proves that the ‘Continuity’ competency test model significantly affecting the students' fatigue. Figure 6 and Table 4 revealed the survey result that has been given to the students according to their opinion on the implication of the ‘Discontinuity’ model regarding their convenience during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the students are comfortable and very comfortable with the application of the ‘Discontinuity’ test model. It is in accordance with their final score of the competency test results which indicated significant improvement and better results during the competency test. 53 students stated at the ‘very comfortable’ category, 32 students stated at the ‘comfortable’ category, 12 students stated at ‘enough’ category, 1 student stated at the ‘uncomfortable’ category, and only 2 students stated at ‘very uncomfortable’ category. This result proves that the application of the ‘Discontinuity’ test model gives better comfortability to the students as well as reduce their fatigue and stress level. Therefore, the final score of the competency test could be increased significantly. The ‘Discontinuity’ model gives the students the opportunity to take a break for an hour in between the tasks in order to recover their focus and concentration to conduct the next following competency test. Therefore, they can refresh their mind to avoid high-stress level during competency test and take a break to relax their body due to the high intensity and pressure of the competency test. This ‘Discontinuity’ competency test model is established to fulfill the students’ desire to get the optimum competency test result to support their assets and increase their opportunity in labour market. In terms of quality, the vocational education school in which implementing this method could significantly gain massive improvement by graduating students with a high competency level.



61 **Figure 7.** Schematic graph of the proposed competency test management scoring

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Criteria :

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 5.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total Respondents	-	-	-	16	34

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41 The questionnaire of feasibility scoring was given to the respective vocational education teachers and  
42 staff who have been involved in this research to evaluate the proposed competency test management.  
43 According to the feasibility scoring result of the proposed competency test management, all of the  
44 vocational education teachers were agree with the proposed competency test management which is shown  
45 in Figure 7 and Table 5 where 34 teachers stated 'very agree' and 16 teachers stated 'agree'. This result  
46 proves that the benefits of the implication of the proposed competency test management are not only for  
47 the students but also for the teachers. Moreover, students' opportunities in the labour market improved  
64 owing to the students' competency final score improvement.  
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#### 52 **4. Conclusion**

53 Fatigue and stress levels of the vocational education students could adversely impact the competency  
54 test result. The current competency test model for vocational education in Central Java, Indonesia is a  
55 'Continuity' competency test model. This model tends to give low scores on students' competency test  
56 results due to the lack of time to break where the students must finish five tasks within 5 hours, thus, it  
57 causes the students' focus and concentration to decrease significantly. To overcome this problem, the  
58 implementation of the 'Discontinuity' model was proposed. By giving one-hour time to break for the  
59 student and the competency test could be done alternately, fatigue, and stress level of the students could  
60 significantly decrease. Consequently, the result shows that the final score of the student's competency test  
4 result was significantly improved. All the 'Discontinuity' model-based results showed in the 'very good'  
5 category. In addition, the survey results showed that the students feel more comfortable using the  
6 'Discontinuity' competency test model than that 'Continuity' competency test model as well as the teachers  
7 satisfied with the proposed competency test model. The improvement in the competency test result is very  
8 important for the student who will be facing the labour market after graduated from vocational education.  
9 However, the industry considers students with a high competency score to join their company rather than  
10 the lower score one. In addition, a new competency test management is proposed in this study by allowing  
11 the students to take the competency test at any time since their first semester of study through an online  
12 platform that directly connected with vocational school management and DU-DI (World Business  
13 Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff  
14 of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency  
15 test management. However, the proposed competency test management will ease the students and teachers  
16 to achieve an optimum final score of the competency test as well as improve the vocational school quality.  
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#### 19 **Declarations**

##### 20 *Author contribution statement*

21  
22 Abdurrahman: Conceptualization; Methodology; Performed research; Analysed and interpreted the data; Wrote  
23 the paper.

24 Parmin and S. Muryanto: Validation; Visualization; Supervision; Reviewed and edited the paper.  
25  
26

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##### *Competing interest statement*

32 The authors declare no conflict of interest.  
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##### 35 *Additional information*

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No additional information is available for this paper.

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Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

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# Evaluation on The Automotive Skill Competency Test Through ‘Discontinuity’ Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>a</sup> *Mechanical Engineering Department, Faculty of Techniques, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>b</sup> *Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia*

<sup>c</sup> *Chemical Engineering Department, UNTAG University in Semarang, 50235 Gajah Mungkur, Semarang, Indonesia*

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## Abstract

This article provides an alternative competency test model for vocational education schools in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author concerns about the students’ accomplishment during the competency test, aimed to improve competency test results to increase the students’ job opportunity in the labor market. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students’ fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test results. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue of the ‘Continuity’ model. To research the effect of the ‘Discontinuity’ model implementation on the students’ competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant improvement in the students’ competency test scores. This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress levels of the students will significantly increase which adversely affect the students’ competency final score. In addition, the new management of the competency test was proposed in this research.

*Keywords: Vocational education; automotive; competency; Discontinuity model; competency test management*

## 1. Introduction

The presence of vocational education in this present circumstance brings a significant impact on the correlation between education and the labor market. Students are given two choices whether they will continue their studies to regular school or vocational education. Vocational education becomes a good choice for students who wants to directly look for a job after graduating from school and could be a shortcut to being involved in the labor market directly. The percentage of practical knowledge of vocational education is higher than that in regular school. Thus, vocational education aims to prepare students one step forward for entering the labor market with a highly skilled in a specific field of jobs. In general, there are three types of vocational education systems, which are school-based vocational education, dual apprenticeship, and informal training (Guo & Wang, 2020). In a developing country, school-based vocational education is more applicable than the other systems considering manpower inequality. Students that enroll in a vocational education school exhibit outstanding practical skills supported by their early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019).

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)  
E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

However, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a formal curriculum and standardized competency is very important to bring manpower equality which means the students are eligible for the industrial and business company requirements after graduated from vocational education. Moreover, vocational education also brings a significant impact on the economic sector for the country by reducing the youth unemployment population (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational education school-leavers on the labor market. The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labor market (Bol & van de Werfhorst, 2011; Muja et al., 2019).

### *The Importance of Competency for Vocational Education*

However, in order to prepare the students' capability during the transition from high school to the labor market, the improvement of students' competency should be highly considered. Competency is a combination of skills, behavior/attitude, and multiple knowledge that can be demonstrated by students where the skills, attitudes, and knowledge are obtained from the materials conceptualization that has been learned during the period of study. The level of vocational competency influences positively the chance of graduates of being matched to occupation with the specific educational domain. Furthermore, the application of on-the-job training will be much more efficient when implementing the generic competencies to adjust vocational competencies to the requirement of the job (Heijke et al., 2003). Due to the increase in the labor market qualification, the standard of student competence should be increased. This concern should be followed by the development of the students' assessment. Several points should be considered in order to improve the competency, which are authentic assessment, an improvement in quality lab sheet, student competency standard system, specific scoring rubric, and feedback from the students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment could be achieved (Rahman et al., 2014).

In this industrial era, developing country such as Indonesia tends to force the economic sector by improving the industrial sector through massive production and export activity (Hidayatno et al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector, vocational education contributes to human resources development and minimizes the gap between the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set up a good competency including skills and organizational knowledge for the graduates which means the graduates are ready for entering the workplace environment. To meet the industrial requirements, the graduates should be able to work effectively by combining the knowledge, skills, and other work-related capacities into specific competence needed (Loon & Bartram, 2007). This matter could be achieved by implementing the internship program during the period of study in a vocational education school which has a related industrial field (Ocampo et al., 2020).

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles repair or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system. Currently, these five tasks are implemented to the students by using the 'Continuity' model which means that the students should finish all the tasks continuously within 5 hours. However, the 'Continuity' model tends to cause work fatigue during the competency test, while the work fatigue will decrease the student's concentration and focus which will significantly cause poor competency test results. Nurhayati et al. investigated the effect of the increase in the production time on the productivity achieved. During the investigation, muscle fatigue has occurred at a very high level of production time and the results showed that the productivity achieved are below the productivity target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough, headache, and many more can cause the worker absent. In addition, lack of focus and concentration in the workplace due to work fatigue means a lack of safety awareness which can cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for the 'Continuity' test model showed unsatisfied results, whereas the students feel under pressure during the five hours competency test and under the assessor's supervision. Moreover, most of the students suffer from pressure which is not only



physical but also mentally pressured. This condition caused the students' competency score results are not optimal. This will decrease the students' opportunity to get their best results in the competency test, while the competency test score determines their opportunity for competing in the labor market. Therefore, further evaluation of the 'Continuity' competency test model in vocational education schools is highly necessary for this global industrial era.

### *Management of The Competency Test*

In vocational education, competency turns into an important aspect for the graduates as a benchmark that should be achieved by the students during their period of study to get a better job opportunity in the labor market. Competency has two essential values which are first, authorities in carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and second, the capability to implement the knowledge, skills, and experience (Mulder, 2007). Competency tests in vocational education schools should have a comprehensive and multi-dimensional construction. Generally, there are three different competency levels, those are conceptual competence, procedural competence, and interpretative competence (Winther & Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job assignments that match the specific needs of the world business industry. Competency test is essential for the students in terms of the final decision whether the students pass or fail during their study in vocational education as well as to avoid the incompetent graduates in the labor market (Johnson, 2008). Alternatively, the substance of the competency test is not only for testing the students but also to seek the validation of the students. The validation process itself focuses on how students work on each assignment such as the used tools' accuracy, their work attitude, and adherence to SOP, instead of the final results-oriented only (pass or fail).

However, in this current vocational education school in Central Java, Indonesia, the implemented competency test is only focused on the final result without considering the process and performance of the students in detail during the competency test. The competency test is conducted only one time simultaneously at the end of the student's period of study according to the curriculum order. This management of the competency test is considered less effective due to the implementation of the competency test is limited at a certain time. The impact adversely students' performance during the competency test as well as the assessors' validation of the students' performance. In addition, owing to the last semester's implementation of the competency test, the students tend to struggle to do retests if they fail during the competency test due to the limited schedule. Therefore, innovation in the management of the competency test is highly necessary in order to significantly improve the quality of vocational education graduates. Proper management of the competency test is proposed in this research which aimed to give the students a bigger opportunity to perform better and get their best result during the competency test. The proper management of the competency test allows the students to take the assignments at any time as long as the quota meets the minimum requirements. The school will provide a minimum quota for each task to be carried out. Thus, the assessor could give detailed assessment and validation based on the requested ongoing assignment whether the students are passed or failed on their competency test. However, if the student failed, they will be given a chance to practice more in the workshop during their study, then they could take another competency test in the next semester. The proposed management of the competency test is involving teachers, internal assessors, and external assessors (field experts: mechanics or automotive experts).

### *The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labor market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting muscle fatigue and stress (Chad &

Brown, 1995). Qualitatively, fatigue and stress levels are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers' fatigue and stress level increases (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to vocational education graduates are focus on the industrial labor market (Ahmed, 2016; Pema & Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labor market and improve job opportunities.

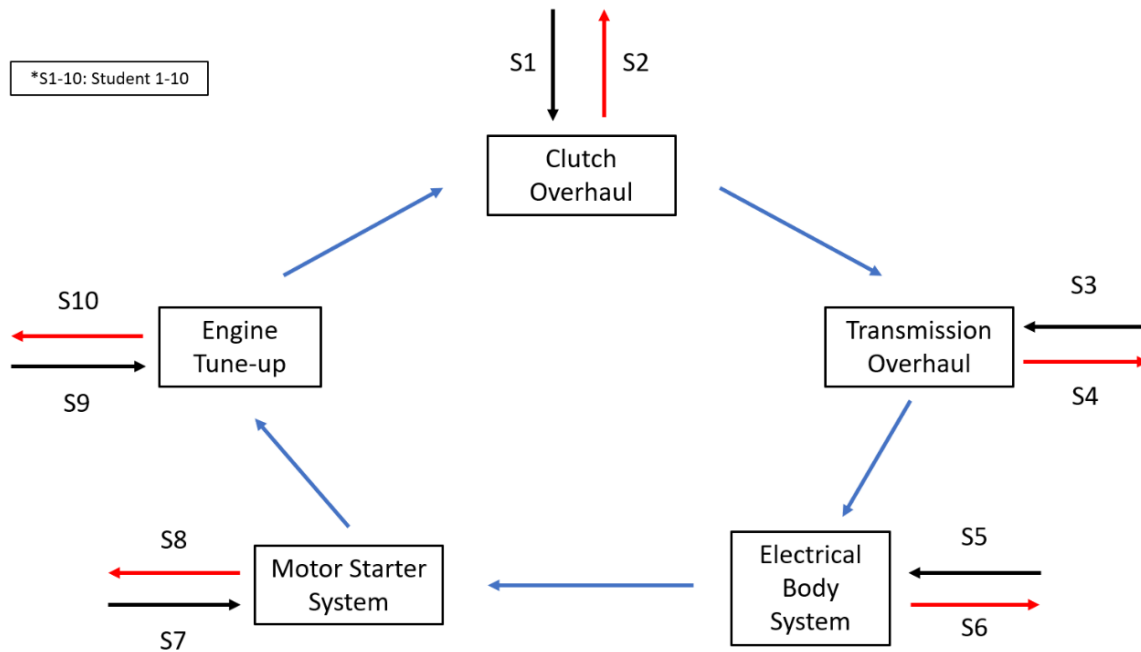
### *The 'Discontinuity' Competency Test Model*

Therefore, in this present study, the alternative model of competency test for vocational education called the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the 'Discontinuity' model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 hours with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O'Neill & Panuwatwanich, 2013). This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analyzing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provides a better result for educational improvement.

## **2. Methods**

This study was focused on a descriptive quantitative method with data collected through a questionnaire that describes the educational reality regarding the level of student's satisfaction with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). The level of satisfaction in vocational education is determined by the ability of teachers in learning. This study also used a survey design because the number of research targets is spread over 10 different areas while the collecting data method is the same through competency tests and questionnaires. Two different models were implemented to collect the data which were 'Continuity' and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The 'Continuity' model means the students must finish 5 competency tasks continuously within 5 hours with a very limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain time (1 hour) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the 'Discontinuity' model is shown in Figure 1. The 'Discontinuity'

model is considered to be more feasible and could significantly improve the students' competency test final score.



**Figure 1.** Schematic diagram of the 'Discontinuity' competency test model.

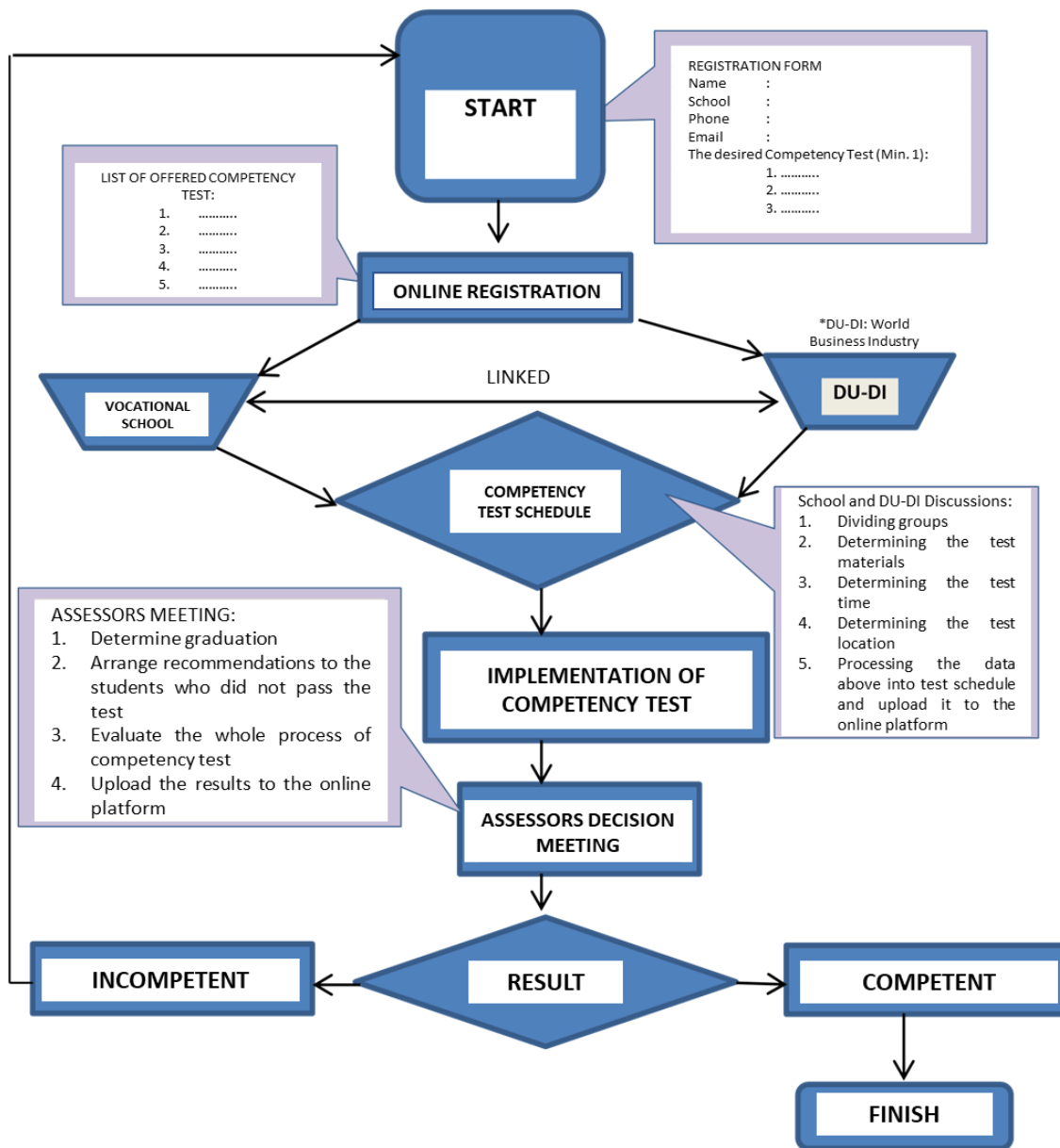
This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyze the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students' fatigue during the competence test, students' score acquisition, and competency test management.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The student's evaluation of the proposed competency test management should consist of the following skills, those are task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. Before using the instruments, the validity of the items for the research instrument was carried out by using the competency test for the teachers. The results of the validity of the item from 40 items were declared valid from 30 questions. There are 30 valid questions that are continued as a matter of competence test. There are 5 competency tests for students with 12 points each for the transmission

overhaul, 10 points for the electrical body system, 8 points for the motor starter system, 14 items for the engine tune-up, and 8 points for the clutch overhaul. The samples consisted of 5 teachers from each school which has a total of 50 teachers and 10 students from each school which has a total of 100 students. The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. In this study, a comparative test was conducted between continuity and discontinuity groups through T-Test analysis.

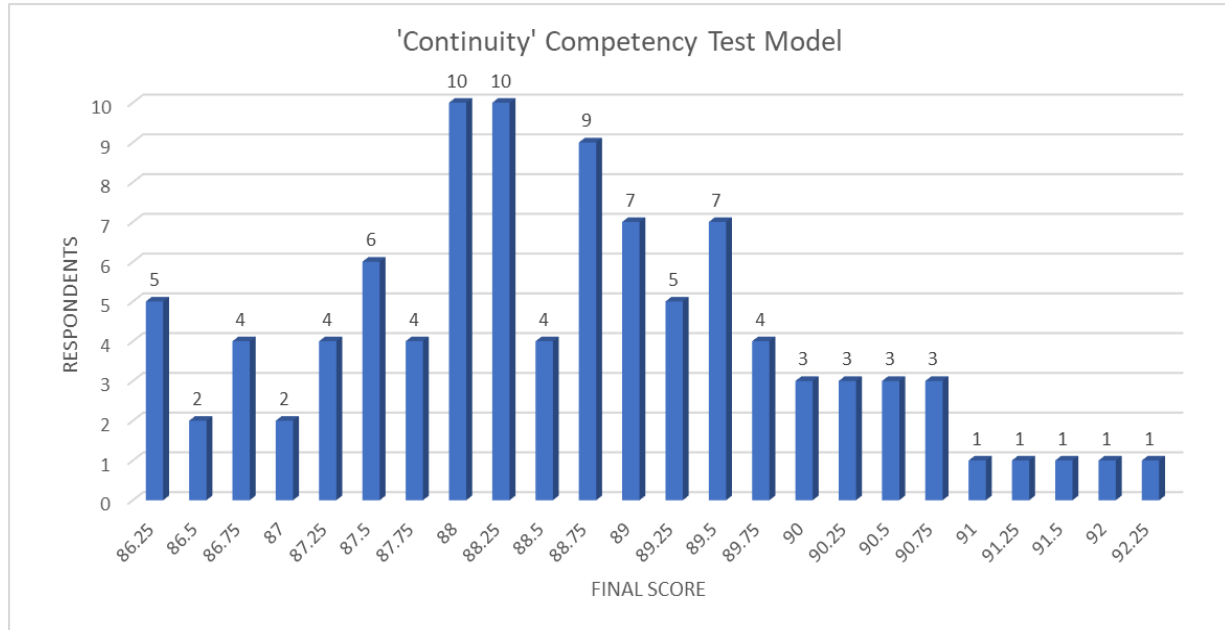
Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyze the advantages and disadvantages of the proposed management given by the author. Additionally, the current study has been approved by the ethical committee of the “Indonesian Ministry of Education and Culture, Universitas Negeri Semarang, Lembaga Penelitian dan Pengabdian Masyarakat” and confirmed that the study complies with all regulations and confirmation that informed consent was obtained.



**Figure 2.** Schematic diagram of the proposed competency test management.

### 3. Results and Discussion

This present study revealed the comparison between the ‘Continuity’ test model and the ‘Discontinuity’ test model that has been done in vocational schools in Central Java, Indonesia within the period of March to April 2020. Figure 3 and Figure 4 indicate the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model, respectively.



**Figure 3.** Schematic graph of the ‘Continuity’ competency test model results.

Criteria:

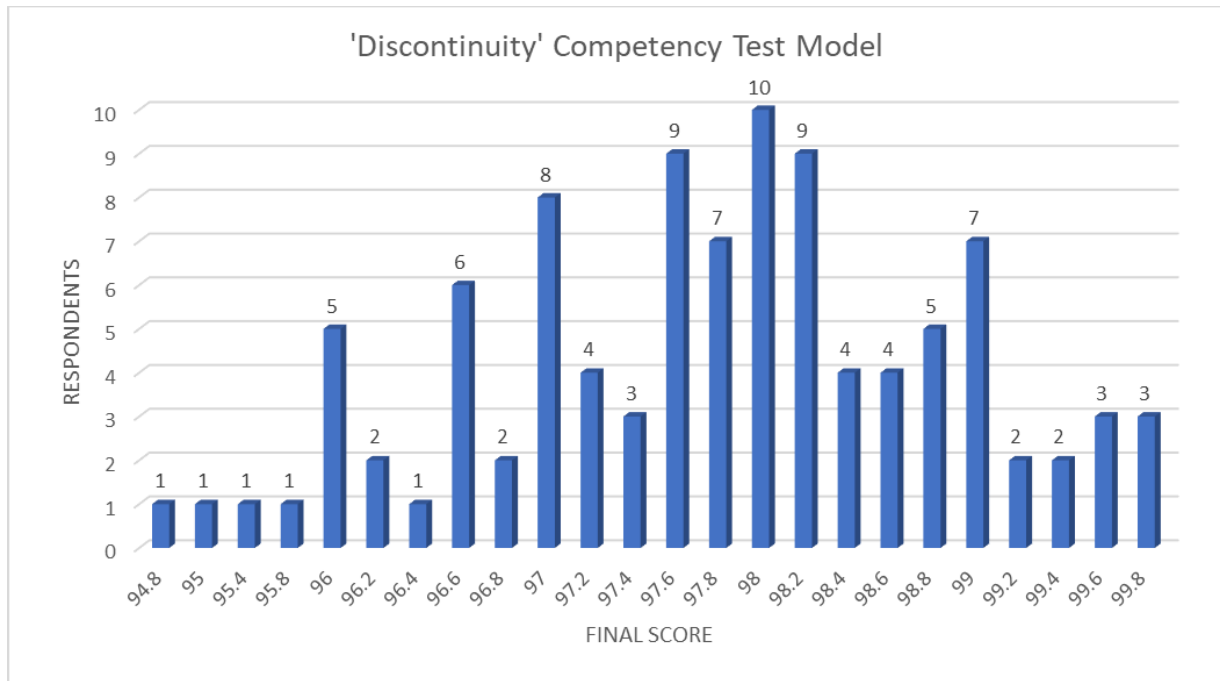
- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 1.** Students’ competency score based on criteria classification of the ‘Continuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the ‘Continuity’ competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the ‘Good’ level. The numbers of students with a ‘Good’ level were 86 students. Meanwhile, the students with ‘Very good’ level were only 14 students which are indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the ‘Continuity’ competency test model which was only achieved by one student. This score level indicates the students’ capability and convenience during the competency test. In this global industrial era, a ‘very good’ level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test

results of the students should be carried out. Otherwise, vocational education schools fail to become a bridge between the graduates and the labor market.



**Figure 4.** Schematic graph of the ‘Discontinuity’ competency test model results.

Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 2.** Students’ competency score based on criteria classification of the ‘Discontinuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

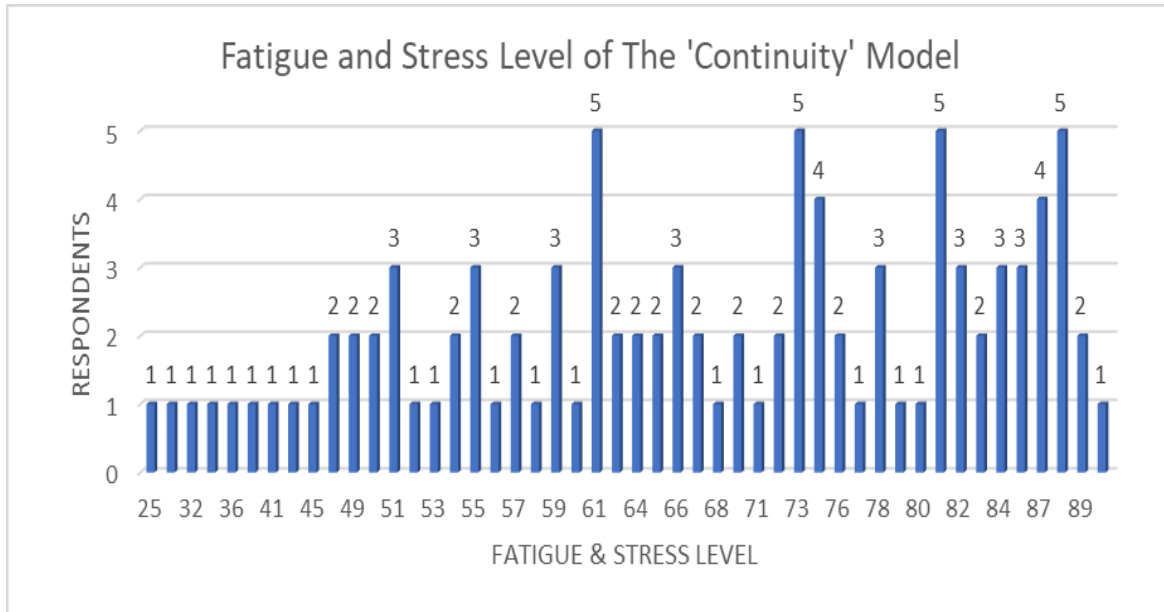
Meanwhile, based on the ‘Discontinuity’ competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at ‘Very good’ level. The lowest score was 94.8, while the highest score for the ‘Discontinuity’ competency test model was 99.8. Although both ‘Continuity’ and ‘Discontinuity’ competency test model results were still acceptable, the ‘Discontinuity’ competency test model emphasize the optimum final score of the students. One hour of rest and break time that is given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in the labor market. The result in Table 2 has also become evidence that the students could achieve a “very good” result in their students’ competency score using the discontinuity model.

**Table 3.** Results of the T-Test in the Continuity and Discontinuity Groups

Group	N	Mean	Std. Deviation	Std. Error Mean
Continuity	100	88.6275	1.33593	0.133559

Discontinuity	100	97.7720	1.09877	0.10988
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Sig = 0.000 = 0% < 5%, it means that Ho is rejected or H1 is accepted. The mean of continuity and discontinuity competency groups is different. Therefore, the mean of the discontinuity group is 97.77 which has a higher amount compared with the continuity group of 88.63 which is shown in Table 3. The results of the discontinuity competency group are better than the continuity competency group.



**Figure 5.** Schematic graph of the fatigue and stress level of the 'Continuity' competency test model.

Criteria:

15 – 30 : Very not tiring

31 – 45 : Not tiring

46 – 60 : Enough

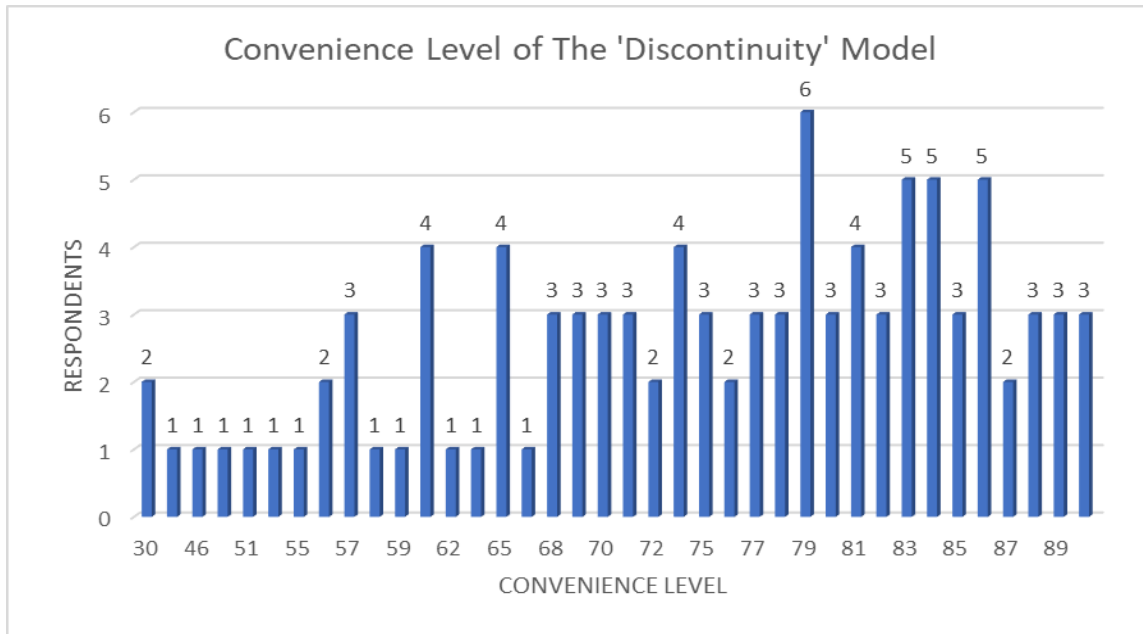
61 – 75 : Tiring

76 – 90 : Very tiring

**Table 4.** Students' fatigue level criteria classification of the 'Continuity' model.

Criteria	Very Not Tiring	Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

Figure 5 and Table 4 indicated the fatigue level survey that has been given to the respondents regarding the 'Continuity' competency test model. The results revealed that students tend to feel very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated at the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affecting the students' fatigue and stress level.



**Figure 6.** Schematic graph of the fatigue and stress level of the ‘Discontinuity’ competency test model.

Criteria:

15 – 30 : Very uncomfortable

31 – 45 : Uncomfortable

46 – 60 : Enough

61 – 75 : Comfortable

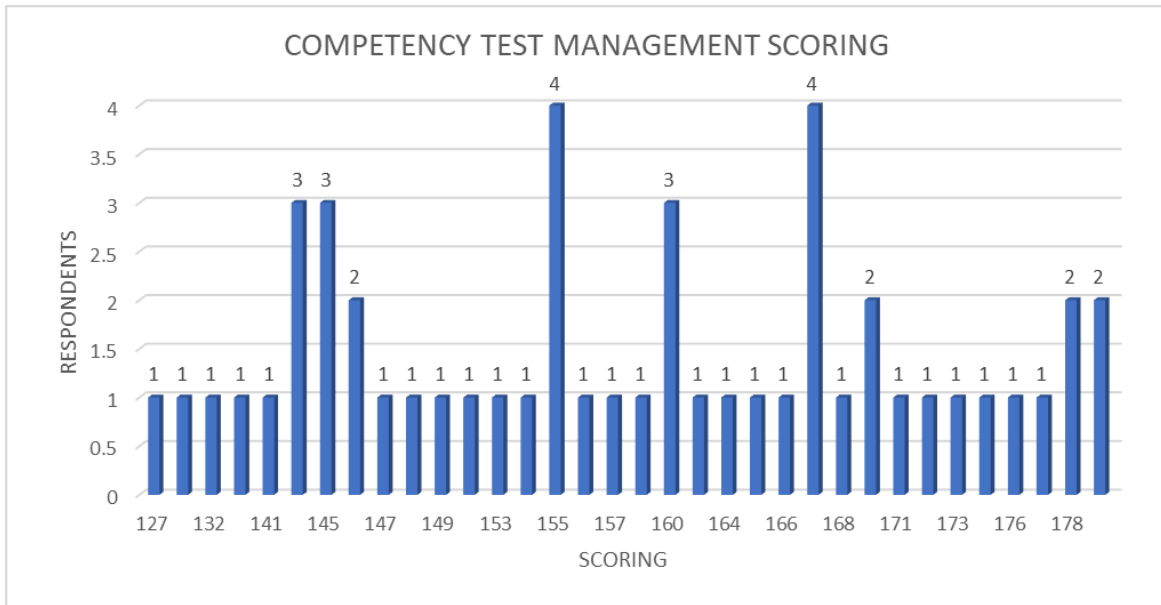
76 – 90 : Very comfortable

**Table 5.** Students’ convenience level criteria classification of the ‘Discontinuity’ model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

Figure 6 and Table 5 revealed the survey result that has been given to the students according to their opinion on the implication of the ‘Discontinuity’ model regarding their convenience during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the students are comfortable and very comfortable with the application of the ‘Discontinuity’ test model. It is in accordance with their final score of the competency test results which indicated significant improvement and better results during the competency test. 53 students stated in the ‘very comfortable’ category, 32 students stated in the ‘comfortable’ category, 12 students stated in the ‘enough’ category, 1 student stated in the ‘uncomfortable’ category, and only 2 students stated at ‘very uncomfortable’ category. This result proves that the application of the ‘Discontinuity’ test model gives better comfortability to the students as well as reduces their fatigue and stress level. Therefore, the final score of the competency test could be increased significantly. The ‘Discontinuity’ model gives the students the opportunity to take a break for an hour in between the tasks in order to recover their focus and concentration to conduct the next following competency test. Therefore, they can refresh their mind to avoid high-stress levels during competency tests and take a break to relax their body due to the high intensity and pressure of the competency test. This ‘Discontinuity’ competency test model is established to fulfill the students’ desire to get the optimum competency test result to support their assets and increase their opportunities in the labor market. In terms of quality, the vocational education school in which implementing this method could significantly gain massive improvement by graduating students with a high competency level.





**Figure 7.** Schematic graph of the proposed competency test management scoring.

Criteria:

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 6.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total	-	-	-	16	34
Respondents					

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 7 and Table 6 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labor market improved owing to the students’ competency final score improvement.

#### 4. Conclusion

Fatigue and stress levels of the vocational education students could adversely impact the competency test result. The current competency test model for vocational education in Central Java, Indonesia is a ‘Continuity’ competency test model. This model tends to give low scores on students’ competency test results due to the lack of time to break where the students must finish five tasks within 5 hours, thus, it causes the students’ focus and concentration to decrease significantly. To overcome this problem, the implementation of the ‘Discontinuity’ model was proposed. By giving one-hour time to break for the student and the competency test could be done alternately, fatigue, and stress level of the students could significantly decrease. Consequently, the result shows that the final score of the student’s competency test

result was significantly improved. All the ‘Discontinuity’ model-based results showed in the ‘very good’ category. In addition, the survey results showed that the students feel more comfortable using the ‘Discontinuity’ competency test model than that ‘Continuity’ competency test model as well as the teachers satisfied with the proposed competency test model. The improvement in the competency test result is very important for the student who will be facing the labor market after graduated from vocational education. However, the industry considers students with a high competency score to join their company rather than the lower score one. In addition, a new competency test management is proposed in this study by allowing the students to take the competency test at any time since their first semester of study through an online platform that is directly connected with vocational school management and DU-DI (World Business Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency test management. However, the proposed competency test management will ease the students and teachers to achieve an optimum final score of the competency test as well as improve the vocational school quality.

## **Declarations**

### ***Author contribution statement***

Abdurrahman: Conceptualization; Methodology; Performed research; Analysed and interpreted the data; Wrote the paper.

Parmin and S. Muryanto: Validation; Visualization; Supervision; Reviewed and edited the paper.

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### ***Competing interest statement***

The authors declare no conflict of interest.

### ***Additional information***

No additional information is available for this paper.

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15. Sixth Revision: Article ACCEPTED with Minor Revision (18 Jan 2022)



Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

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16. Revision 6: Revised version received (24 Jan 2022)  
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# Evaluation on The Automotive Skill Competency Test Through ‘Discontinuity’ Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Abdurrahman <sup>a\*</sup>, Parmin <sup>b</sup>, and Stefanus Muryanto <sup>c</sup>

<sup>a</sup> Mechanical Engineering Department, Faculty of Techniques, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia

<sup>b</sup> Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia

<sup>c</sup> Chemical Engineering Department, UNTAG University in Semarang, 50235 Gajah Mungkur, Semarang, Indonesia

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## Abstract

This article provides an alternative competency test model for vocational education schools in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author’s concern about the students’ accomplishment during the competency test, aimed to improve competency test results to increase the students’ job opportunity in the labor market. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students’ fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test results. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue of the ‘Continuity’ model. To research the effect of the ‘Discontinuity’ model implementation on the students’ competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant improvement in the students’ competency test scores. This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress levels of the students will significantly increase which adversely affect the students’ competency final score. In addition, the new management of the competency test was proposed in this research.

*Keywords: Vocational education; automotive; competency; Discontinuity model; competency test management*

## 1. Introduction

The presence of vocational education in this present circumstance brings a significant impact on the correlation between education and the labor market. Students are given two choices whether they will continue their studies to regular school or vocational education. Vocational education becomes a good choice for students who wants to directly look for a job after graduating from school and could be a shortcut to being involved in the labor market directly. The percentage of practical knowledge of vocational education is higher than that in regular school. Thus, vocational education aims to prepare students one step forward for entering the labor market with a highly skilled in a specific field of jobs. In general, there are three types of vocational education systems, which are school-based vocational education, dual apprenticeship, and informal training (Guo & Wang, 2020). In a developing country, school-based vocational education is more applicable than the other systems considering manpower inequality. Students that enroll in a vocational education school exhibit outstanding practical skills supported by their early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019).

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\* Corresponding authors. Tel.: +6285866125757 (Abdurrahman)  
E-mail address: abdurrahman@mail.unnes.ac.id (Abdurrahman)

However, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster & Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a formal curriculum and standardized competency is very important to bring manpower equality which means the students are eligible for the industrial and business company requirements after graduating from vocational education. Moreover, vocational education also brings a significant impact on the economic sector for the country by reducing the youth unemployment population (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational education school-leavers on the labor market. The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labor market (Bol & van de Werfhorst, 2011; Muja et al., 2019).

### *The Importance of Competency for Vocational Education*

However, in order to prepare the students' capability during the transition from high school to the labor market, the improvement of students' competency should be highly considered. Competency is a combination of skills, behavior/attitude, and multiple knowledge that can be demonstrated by students where the skills, attitudes, and knowledge are obtained from the materials conceptualization that has been learned during the period of study. The level of vocational competency influences positively the chance of graduates of being matched to occupation with the specific educational domain. Furthermore, the application of on-the-job training will be much more efficient when implementing the generic competencies to adjust vocational competencies to the requirement of the job (Heijke et al., 2003). Due to the increase in the labor market qualification, the standard of student competence should be increased. This concern should be followed by the development of the students' assessment. Several points should be considered in order to improve the competency, which are authentic assessment, an improvement in quality lab sheet, student competency standard system, specific scoring rubric, and feedback from the students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment could be achieved (Rahman et al., 2014).

In this industrial era, developing country such as Indonesia tends to force the economic sector by improving the industrial sector through massive production and export activity (Hidayatno et al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector, vocational education contributes to human resources development and minimizes the gap between the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set up a good competency including skills and organizational knowledge for the graduates which means the graduates are ready for entering the workplace environment. To meet the industrial requirements, the graduates should be able to work effectively by combining the knowledge, skills, and other work-related capacities into specific competence needed (Loon & Bartram, 2007). This matter could be achieved by implementing the internship program during the period of study in a vocational education school that has a related industrial field (Ocampo et al., 2020).

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles repair or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system. Currently, these five tasks are implemented to the students by using the 'Continuity' model which means that the students should finish all the tasks continuously within 5 hours. However, the 'Continuity' model tends to cause work fatigue during the competency test, while the work fatigue will decrease the student's concentration and focus which will significantly cause poor competency test results. Nurhayati et al. investigated the effect of the increase in the production time on the productivity achieved. During the investigation, muscle fatigue has occurred at a very high level of production time and the results showed that the productivity achieved are below the productivity target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough, headache, and many more can cause the worker unfit. In addition, lack of focus and concentration in the workplace due to work fatigue means a lack of safety awareness which can cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for the 'Continuity' test model showed unsatisfied results, whereas the students feel under pressure during the five hours competency test and under the assessor's supervision. Moreover, most of the students suffer from pressure which is not only

physical but also mentally pressured. This condition caused the students' competency score results are not optimal. This will decrease the students' opportunity to get their best results in the competency test, while the competency test score determines their opportunity for competing in the labor market. Therefore, further evaluation of the 'Continuity' competency test model in vocational education schools is highly necessary for this global industrial era.

### *Management of The Competency Test*

In vocational education, competency turns into an important aspect for the graduates as a benchmark that should be achieved by the students during their period of study to get a better job opportunity in the labor market. Competency has two essential values which are first, authorities in carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and second, the capability to implement the knowledge, skills, and experience (Mulder, 2007). Competency tests in vocational education schools should have a comprehensive and multi-dimensional construction. Generally, there are three different competency levels, those are conceptual competence, procedural competence, and interpretative competence (Winther & Achtenhagen, 2009; Winther & Klotz, 2013). All these competency levels lead to job assignments that match the specific needs of the world business industry. Competency test is essential for the students in terms of the final decision whether the students pass or fail during their study in vocational education as well as to avoid the incompetent graduates in the labor market (Johnson, 2008). Alternatively, the substance of the competency test is not only for testing the students but also to seek the validation of the students. The validation process itself focuses on how students work on each assignment such as the used tools' accuracy, their work attitude, and adherence to SOP, instead of the final results-oriented only (pass or fail).

However, in this current vocational education school in Central Java, Indonesia, the implemented competency test is only focused on the final result without considering the process and performance of the students in detail during the competency test. The competency test is conducted only one time simultaneously at the end of the student's period of study according to the curriculum order. This management of the competency test is considered less effective because the implementation of the competency test is limited at a certain time. The impact adversely students' performance during the competency test as well as the assessors' validation of the students' performance. In addition, owing to the last semester's implementation of the competency test, the students tend to struggle to do retests if they fail during the competency test due to the limited schedule. Therefore, innovation in the management of the competency test is highly necessary in order to significantly improve the quality of vocational education graduates. Proper management of the competency test is proposed in this research which aimed to give the students a bigger opportunity to perform better and get their best result during the competency test. The proper management of the competency test allows the students to take the assignments at any time as long as the quota meets the minimum requirements. The school will provide a minimum quota for each task to be carried out. Thus, the assessor could give detailed assessment and validation based on the requested ongoing assignment whether the students are passed or failed on their competency test. However, if the student failed, they will be given a chance to practice more in the workshop during their study, then they could take another competency test in the next semester. The proposed management of the competency test is involving teachers, internal assessors, and external assessors (field experts: mechanics or automotive experts).

### *The Effect of Fatigue and Stress Level*

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labor market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting muscle fatigue and stress (Chad &

Brown, 1995). Qualitatively, fatigue and stress levels are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders & Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers' fatigue and stress level increases (Hsouna et al., 2019; Safitri & Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to vocational education graduates are focused on the industrial labor market (Ahmed, 2016; Pema & Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labor market and improve job opportunities.

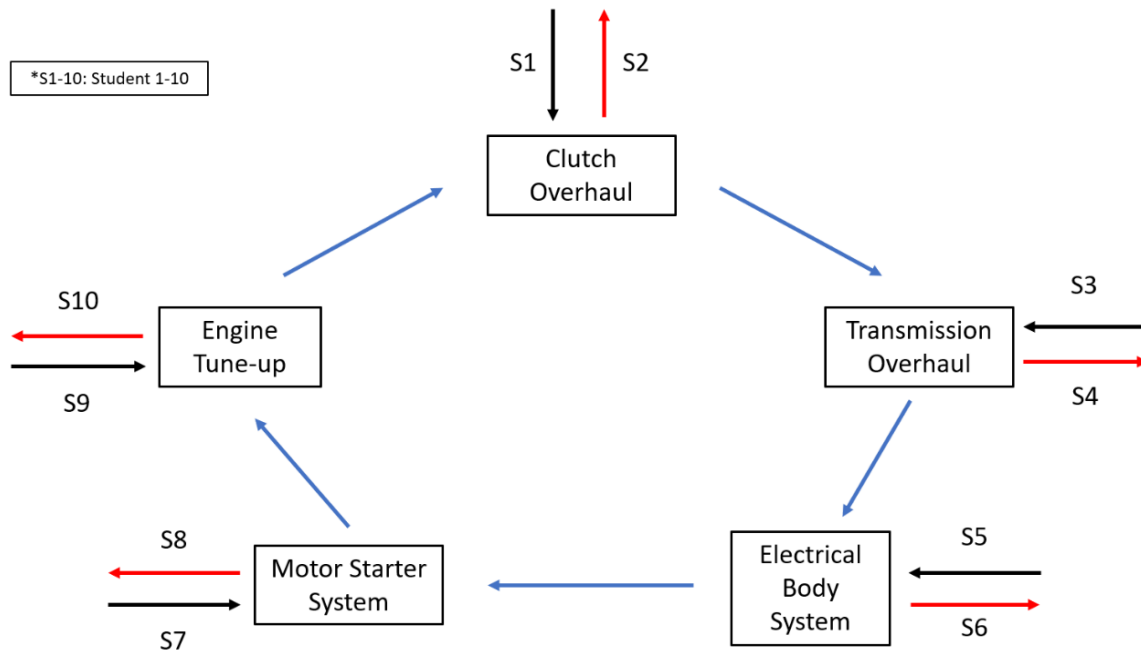
### *The 'Discontinuity' Competency Test Model*

Therefore, in this present study, the alternative model of competency test for vocational education called the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the 'Discontinuity' model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 hours with a break time of 1 hour in between each task. By giving the break time of 1 hour, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O'Neill & Panuwatwanich, 2013). This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analyzing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are involving 10 vocational education schools in Central Java, Indonesia, and provides a better result for educational improvement.

## **2. Methods**

This study was focused on a descriptive quantitative method with data collected through a questionnaire that describes the educational reality regarding the level of student's satisfaction with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). The level of satisfaction in vocational education is determined by the ability of teachers in learning. This study also used a survey design because the number of research targets is spread over 10 different areas while the collecting data method is the same through competency tests and questionnaires. Two different models were implemented to collect the data which were 'Continuity' and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The 'Continuity' model means the students must finish 5 competency tasks continuously within 5 hours with a very limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain time (1 hour) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the 'Discontinuity' model is shown in Figure 1. The 'Discontinuity'

model is considered to be more feasible and could significantly improve the students' competency test final score.



**Figure 1.** Schematic diagram of the 'Discontinuity' competency test model.

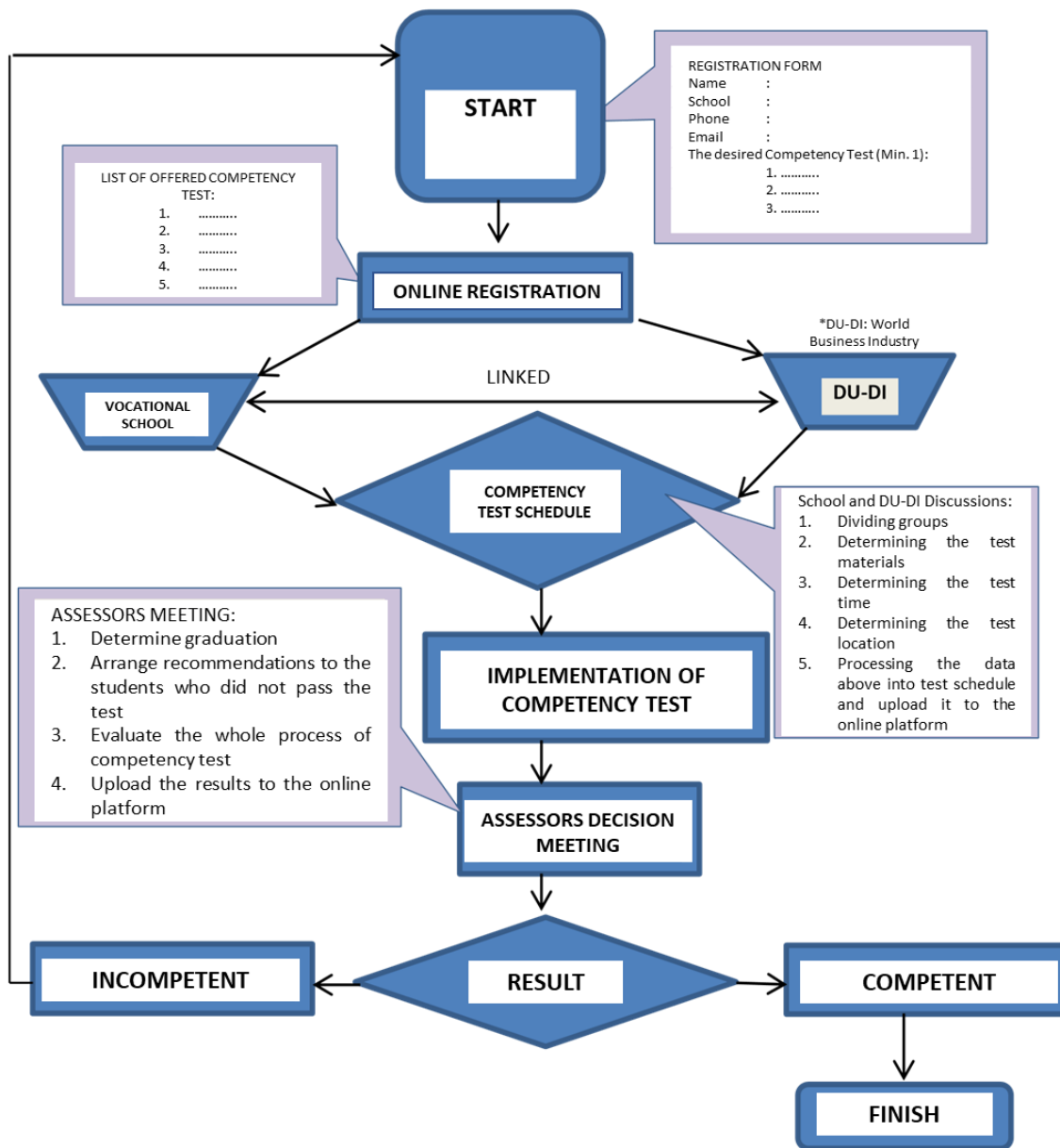
This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyze the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students' fatigue during the competence test, students' score acquisition, and competency test management.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The student's evaluation of the proposed competency test management should consist of the following skills, those are task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. Before using the instruments, the validity of the items for the research instrument was carried out by using the competency test for the teachers. The results of the validity of the item from 40 items were declared valid from 30 questions. There are 30 valid questions that are continued as a matter of competence test. There are 5 competency tests for students with 12 points each for the transmission

overhaul, 10 points for the electrical body system, 8 points for the motor starter system, 14 items for the engine tune-up, and 8 points for the clutch overhaul. The samples consisted of 5 teachers from each school which has a total of 50 teachers and 10 students from each school which has a total of 100 students. The research data were collected through the application of the “Continuity” and “Discontinuity” competency test model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. In this study, a comparative test was conducted between continuity and discontinuity groups through T-Test analysis.

Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyze the advantages and disadvantages of the proposed management given by the author. Additionally, the current study has been approved by the ethical committee of the “Indonesian Ministry of Education and Culture, Universitas Negeri Semarang, Lembaga Penelitian dan Pengabdian Masyarakat” and confirmed that the study complies with all regulations and confirmation that informed consent was obtained.

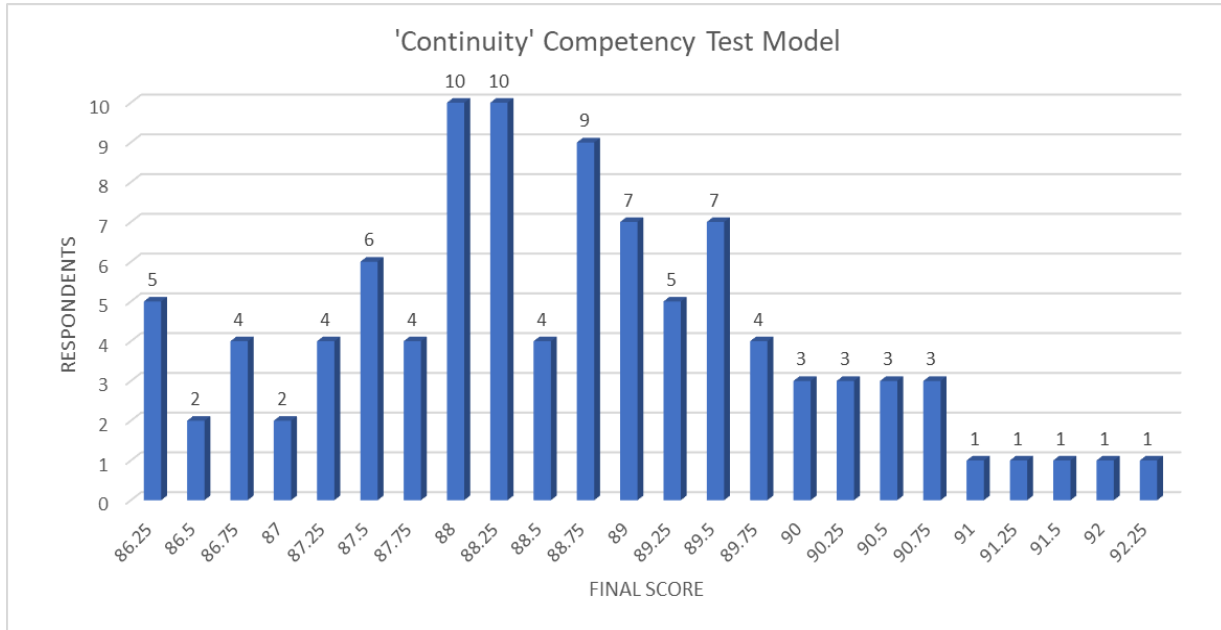


**Figure 2.** Schematic diagram of the proposed competency test management.



### 3. Results and Discussion

This present study revealed the comparison between the ‘Continuity’ test model and the ‘Discontinuity’ test model that has been done in vocational schools in Central Java, Indonesia within the period of March to April 2020. Figure 3 and Figure 4 indicate the correlation between the number of respondents and the final score of the competency test using the ‘Continuity’ and the ‘Discontinuity’ model, respectively.



**Figure 3.** Schematic graph of the ‘Continuity’ competency test model results.

Criteria:

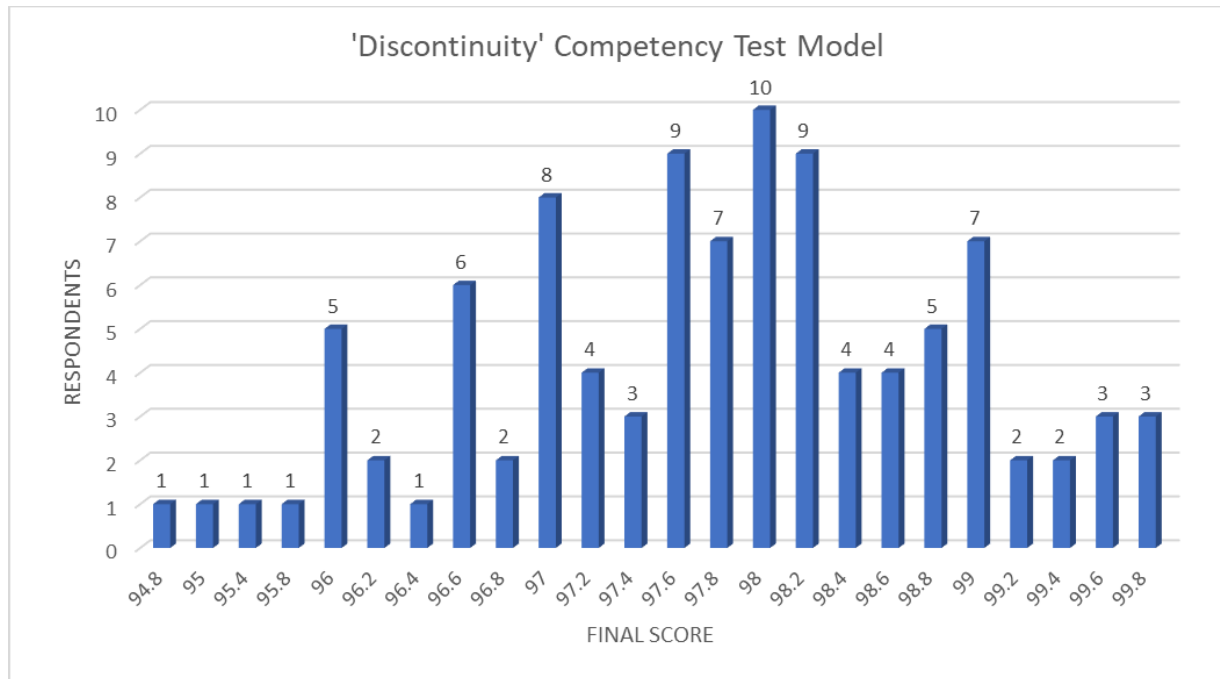
- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 1.** Students’ competency score based on criteria classification of the ‘Continuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Based on the ‘Continuity’ competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the ‘Good’ level. The numbers of students with a ‘Good’ level were 86 students. Meanwhile, the students with ‘Very good’ level were only 14 students which are indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the ‘Continuity’ competency test model which was only achieved by one student. This score level indicates the students’ capability and convenience during the competency test. In this global industrial era, a ‘very good’ level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test

results of the students should be carried out. Otherwise, vocational education schools fail to become a bridge between the graduates and the labor market.



**Figure 4.** Schematic graph of the ‘Discontinuity’ competency test model results.

Criteria:

- 50 – 60 : Very low
- 61 – 70 : Low
- 71 – 80 : Enough
- 81 – 90 : Good
- 91 – 100 : Very good

**Table 2.** Students’ competency score based on criteria classification of the ‘Discontinuity’ model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

Meanwhile, based on the ‘Discontinuity’ competency test model result which is shown in Figure 4 revealed that all of the final competency scores were at ‘Very good’ level. The lowest score was 94.8, while the highest score for the ‘Discontinuity’ competency test model was 99.8. Although both ‘Continuity’ and ‘Discontinuity’ competency test model results were still acceptable, the ‘Discontinuity’ competency test model emphasizes the optimum final score of the students. One hour of rest and break time that is given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in the labor market. The result in Table 2 has also become evident that the students could achieve a “very good” result in their students’ competency score using the discontinuity model.

**Method**

$\mu_1$ : mean of Continuity  
 $\mu_2$ : mean of Discontinuity  
 Difference:  $\mu_1 - \mu_2$

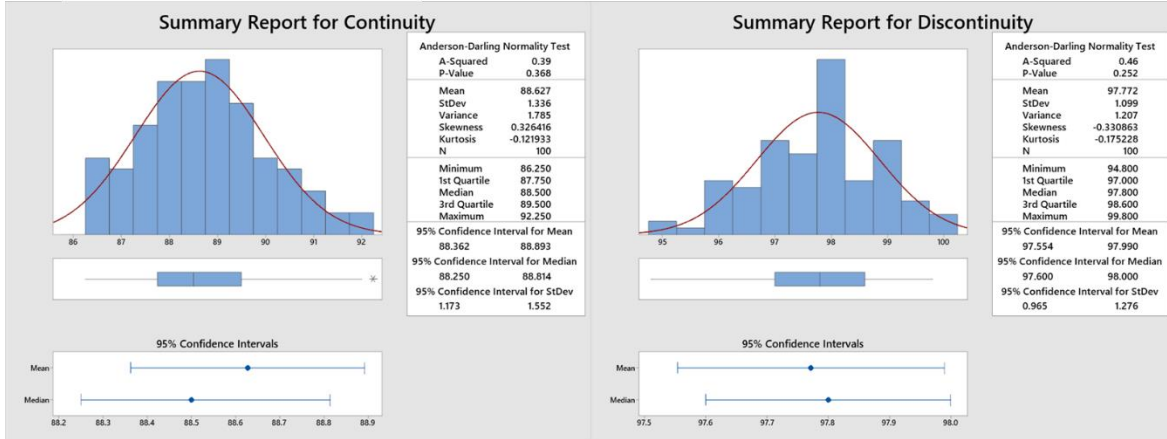
*Equal variances are assumed for this analysis.*

**Estimation for Difference**

Pooled 95% CI for  
Difference StDev Difference  
 -9.145 1.223 (-9.486, -8.803)

**Test**

Null hypothesis  $H_0: \mu_1 - \mu_2 = 0$   
 Alternative hypothesis  $H_1: \mu_1 - \mu_2 \neq 0$   
T-Value DF P-Value  
 -52.87 198 0.000

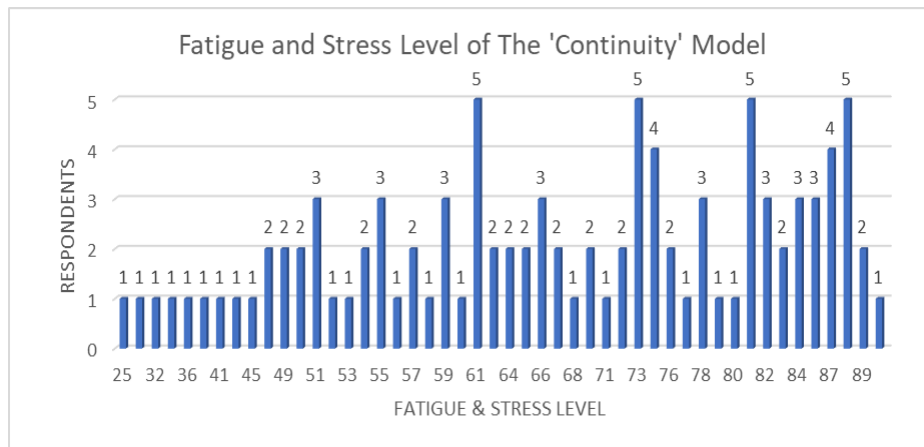


**Figure 5.** T-Test analysis result for the Continuity and Discontinuity model.

**Table 3.** Results of the T-Test in the Continuity and Discontinuity Groups

Group	N	Mean	Std. Deviation	Std. Error Mean
Continuity	100	88.6275	1.33593	0.133559
Discontinuity	100	97.7720	1.09877	0.10988

Sig = 0.000 = 0% < 5%, it means that  $H_0$  is rejected or  $H_1$  is accepted. The mean of continuity and discontinuity competency groups is different. Therefore, the mean of the discontinuity group is 97.77 which has a higher amount compared with the continuity group of 88.63 which is shown in Table 3. The results of the discontinuity competency group are better than the continuity competency group. Figure 5 also shows the summary report from the T-Test analysis of both the continuity and discontinuity model. The P-Value of discontinuity was 0.252 and the continuity was 0.368. It means that the lower P-value is better. According to the T-Test analysis, the discontinuity model has a better statistical model compared to the continuity model.



**Figure 6.** Schematic graph of the fatigue and stress level of the 'Continuity' competency test model.

Criteria:

15 – 30 : Very not tiring

31 – 45 : Not tiring

46 – 60 : Enough

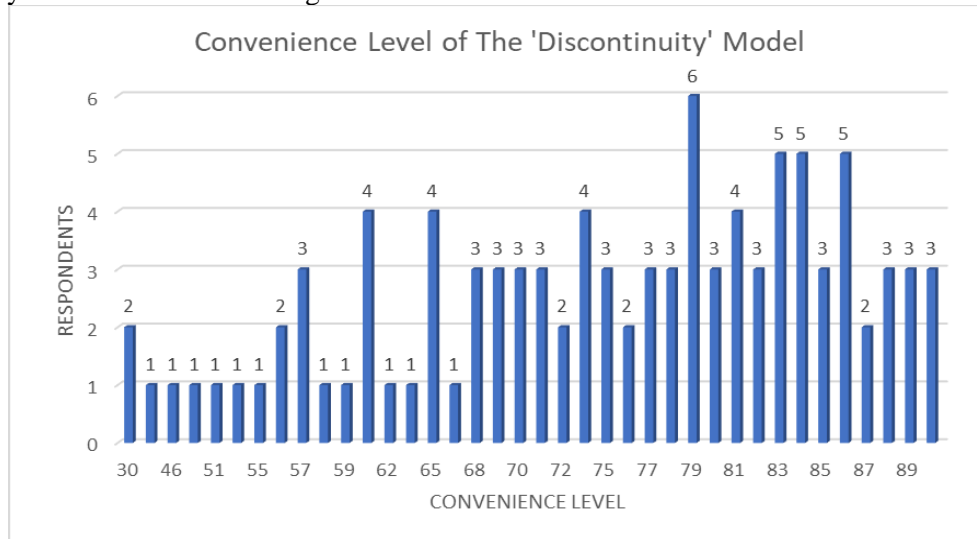
61 – 75 : Tiring

76 – 90 : Very tiring

**Table 4.** Students' fatigue level criteria classification of the 'Continuity' model.

Criteria	Very Not Tiring	Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

Figure 6 and Table 4 indicated the fatigue level survey that has been given to the respondents regarding the 'Continuity' competency test model. The results revealed that students tend to feel very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated in the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affects the students' fatigue and stress levels.



**Figure 7.** Schematic graph of the fatigue and stress level of the 'Discontinuity' competency test model.

Criteria:

15 – 30 : Very uncomfortable

31 – 45 : Uncomfortable

46 – 60 : Enough

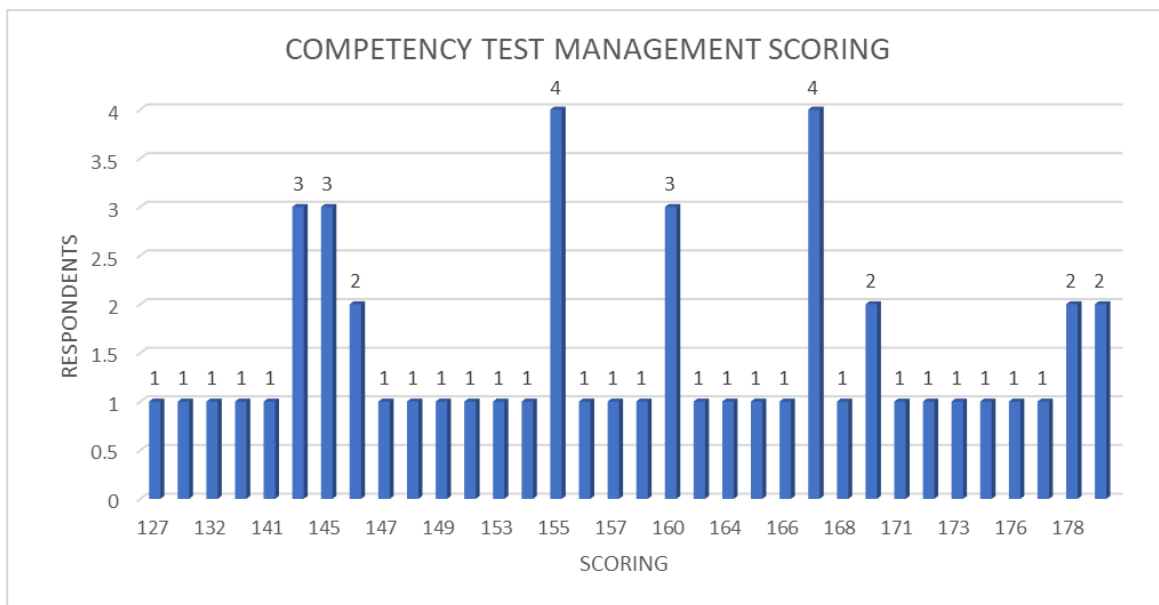
61 – 75 : Comfortable

76 – 90 : Very comfortable

**Table 5.** Students' convenience level criteria classification of the 'Discontinuity' model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

Figure 7 and Table 5 revealed the survey result that has been given to the students according to their opinion on the implication of the ‘Discontinuity’ model regarding their convenience during the competency test. Based on the graph in Figure 6, it is clearly stated that most of the students are comfortable and very comfortable with the application of the ‘Discontinuity’ test model. It is in accordance with their final score of the competency test results which indicated significant improvement and better results during the competency test. 53 students stated in the ‘very comfortable’ category, 32 students stated in the ‘comfortable’ category, 12 students stated in the ‘enough’ category, 1 student stated in the ‘uncomfortable’ category, and only 2 students stated at ‘very uncomfortable’ category. This result proves that the application of the ‘Discontinuity’ test model gives better comfortability to the students as well as reduces their fatigue and stress level. Therefore, the final score of the competency test could be increased significantly. The ‘Discontinuity’ model gives the students the opportunity to take a break for an hour in between the tasks in order to recover their focus and concentration to conduct the next following competency test. Therefore, they can refresh their mind to avoid high-stress levels during competency tests and take a break to relax their body due to the high intensity and pressure of the competency test. This ‘Discontinuity’ competency test model is established to fulfill the students’ desire to get the optimum competency test result to support their assets and increase their opportunities in the labor market. In terms of quality, the vocational education school in which implementing this method could significantly gain massive improvement by graduating students with a high competency level.



**Figure 8.** Schematic graph of the proposed competency test management scoring.

Criteria:

- 30 – 60 : Very disagree
- 61 – 90 : Disagree
- 91 – 120 : Enough
- 121 – 150 : Agree
- 151 – 180 : Very agree

**Table 6.** Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total Respondents	-	-	-	16	34

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 8 and Table 6 where 34 teachers stated 'very agree' and 16 teachers stated 'agree'. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students' opportunities in the labor market improved owing to the students' competency final score improvement.

#### 4. Conclusion

Fatigue and stress levels of the vocational education students could adversely impact the competency test result. The current competency test model for vocational education in Central Java, Indonesia is a 'Continuity' competency test model. This model tends to give low scores on students' competency test results due to the lack of time to break where the students must finish five tasks within 5 hours, thus, it causes the students' focus and concentration to decrease significantly. To overcome this problem, the implementation of the 'Discontinuity' model was proposed. By giving one-hour time to break for the student and the competency test could be done alternately, fatigue, and stress level of the students could significantly decrease. Consequently, the result shows that the final score of the student's competency test result was significantly improved. All the 'Discontinuity' model-based results showed in the 'very good' category. In addition, the survey results showed that the students feel more comfortable using the 'Discontinuity' competency test model than that 'Continuity' competency test model as well as the teachers satisfied with the proposed competency test model. The improvement in the competency test result is very important for the student who will be facing the labor market after graduating from vocational education. However, the industry considers students with a high competency score to join their company rather than the lower score one. In addition, a new competency test management is proposed in this study by allowing the students to take the competency test at any time since their first semester of study through an online platform that is directly connected with vocational school management and DU-DI (World Business Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency test management. However, the proposed competency test management will ease the students and teachers to achieve an optimum final score of the competency test as well as improve the vocational school quality.

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17. PAPER ACCEPTED IN HELIYON  
(27 Jan 2022)



Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

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## Decision on submission to Heliyon

1 message

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**Heliyon** <em@editorialmanager.com>

Thu, Jan 27, 2022 at 4:31 PM

Reply-To: Heliyon &lt;info@heliyon.com&gt;

To: Abdurrahman Abdurrahman &lt;abdurrahman@mail.unnes.ac.id&gt;

Manuscript Number: HELIYON-D-20-08525R5

Title: Evaluation on The Automotive Skill Competency Test Through 'Discontinuity' Model and The Competency Test Management of Vocational Education School in Central Java, Indonesia

Journal: Heliyon

Dear Dr. Abdurrahman,

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## Research article

## Evaluation on the automotive skill competency test through ‘discontinuity’ model and the competency test management of vocational education school in Central Java, Indonesia

Abdurrahman<sup>a,\*</sup>, Parmin<sup>b</sup>, Stefanus Muryanto<sup>c</sup><sup>a</sup> Mechanical Engineering Department, Faculty of Techniques, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia<sup>b</sup> Science Education Studies Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, 50229 Gunungpati, Semarang, Indonesia<sup>c</sup> Chemical Engineering Department, UNTAG University in Semarang, 50235 Gajah Mungkur, Semarang, Indonesia

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## ABSTRACT

This article provides an alternative competency test model for vocational education schools in Central Java, Indonesia which particularly for automotive skill competency in order to replace the current competency test model that has been implemented for several decades which the author's concern about the students' accomplishment during the competency test, aimed to improve competency test results to increase the students' job opportunity in the labor market. Currently, the applied competency test model is the ‘Continuity’ model, where the students are given five tasks and should be finished within five hours with limited break time. This model tends to increase students' fatigue and stress levels. Consequently, the students lose their focus and concentration which adversely impacts their competency test results. In this study, the new competency test model namely the ‘Discontinuity’ competency test model was proposed aiming to overcome the issue of the ‘Continuity’ model. To research the effect of the ‘Discontinuity’ model implementation on the students' competency test results and vocational school competency test management, a study was done among 100 students and 50 teachers in 10 vocational education schools around Central Java, Indonesia. The results show that the ‘Discontinuity’ competency test model gives a significant improvement in the students' competency test scores. This reasonably happened due to the implementation of the ‘Discontinuity’ model gives the students time to break for an hour of each competency task. Without this break time, fatigue and stress levels of the students will significantly increase which adversely affect the students' competency final score. In addition, the new management of the competency test was proposed in this research.

## 1. Introduction

The presence of vocational education in this present circumstance brings a significant impact on the correlation between education and the labor market. Students are given two choices whether they will continue their studies to regular school or vocational education. Vocational education becomes a good choice for students who wants to directly look for a job after graduating from school and could be a shortcut to being involved in the labor market directly. The percentage of practical knowledge of vocational education is higher than that in regular school. Thus, vocational education aims to prepare students one step forward for entering the labor market with a highly skilled in a specific field of jobs. In general, there are three types of vocational education systems, which are school-based vocational education, dual apprenticeship, and informal

training (Guo and Wang, 2020). In a developing country, school-based vocational education is more applicable than the other systems considering manpower inequality. Students that enroll in a vocational education school exhibit outstanding practical skills supported by their early interest in the profession (Quiroga-Garza et al., 2020). The vocational education school carried out the high-intensity practical study with a specific industrial-based curriculum and competency (Muja et al., 2019). However, in some developing countries, manpower inequality in terms of practical skills and knowledge becomes a critical issue (Forster and Bol, 2018; Maragkou, 2020; Mohapatra et al., 1992; Xie et al., 2020). Thus, the role of a formal curriculum and standardized competency is very important to bring manpower equality which means the students are eligible for the industrial and business company requirements after graduating from vocational education. Moreover, vocational education

\* Corresponding author.

E-mail address: [abdurrahman@mail.unnes.ac.id](mailto:abdurrahman@mail.unnes.ac.id) (Abdurrahman).

also brings a significant impact on the economic sector for the country by reducing the youth unemployment population (Choi et al., 2019; Nilsson, 2010). Previous studies have investigated the effect of vocational education school-leavers on the labor market. The studies showed that the educational programs that were strongly oriented towards vocational skills and knowledge for the students have a positive influence and better integration into the labor market (Bol and van de Werfhorst, 2011; Muja et al., 2019).

### 1.1. The importance of competency for vocational education

However, in order to prepare the students' capability during the transition from high school to the labor market, the improvement of students' competency should be highly considered. Competency is a combination of skills, behavior/attitude, and multiple knowledge that can be demonstrated by students where the skills, attitudes, and knowledge are obtained from the materials conceptualization that has been learned during the period of study. The level of vocational competency influences positively the chance of graduates of being matched to occupation with the specific educational domain. Furthermore, the application of on-the-job training will be much more efficient when implementing the generic competencies to adjust vocational competencies to the requirement of the job (Heijke et al., 2003). Due to the increase in the labor market qualification, the standard of student competence should be increased. This concern should be followed by the development of the students' assessment. Several points should be considered in order to improve the competency, which are authentic assessment, an improvement in quality lab sheet, student competency standard system, specific scoring rubric, and feedback from the students regarding their work. Therefore, a valid, reliable, fair, and consistent quality assessment could be achieved (Rahman et al., 2014).

In this industrial era, developing country such as Indonesia tends to force the economic sector by improving the industrial sector through massive production and export activity (Hidayatno et al., 2019; Neilson et al., 2020). In order to ensure that high demand in the industrial sector, vocational education contributes to human resources development and minimizes the gap between the academic environment and industrial needs (Salleh et al., 2015). Therefore, it is critical to set up a good competency including skills and organizational knowledge for the graduates which means the graduates are ready for entering the workplace environment. To meet the industrial requirements, the graduates should be able to work effectively by combining the knowledge, skills, and other work-related capacities into specific competence needed (Loon and Bartram, 2007). This matter could be achieved by implementing the internship program during the period of study in a vocational education school that has a related industrial field (Ocampo et al., 2020).

Competency test has been commonly used in most of the vocational education in Central Java, Indonesia, especially in the automotive field to ensure the capability of the students to conduct vehicles repair or maintenance. The specific tasks are given to the students such as engine tune-up, clutch overhaul, gearbox transmission overhaul, electrical body system, and starter system. Currently, these five tasks are implemented to the students by using the 'Continuity' model which means that the students should finish all the tasks continuously within 5 h. However, the 'Continuity' model tends to cause work fatigue during the competency test, while the work fatigue will decrease the student's concentration and focus which will significantly cause poor competency test results. Nurhayati et al. investigated the effect of the increase in the production time on the productivity achieved. During the investigation, muscle fatigue has occurred at a very high level of production time and the results showed that the productivity achieved are below the productivity target (Nurhayati et al., 2016). Moreover, previous studies have investigated work fatigue as a long-term sickness absence. Hence, more potential diseases such as muscular soreness, cough, headache, and many more can cause the worker unfit. In addition, lack of focus and concentration in the

workplace due to work fatigue means a lack of safety awareness which can cause fatal injury and death (Banks et al., 2019; Janssen, 2003). Based on the previous survey for the 'Continuity' test model showed unsatisfied results, whereas the students feel under pressure during the five hours competency test and under the assessor's supervision. Moreover, most of the students suffer from pressure which is not only physical but also mentally pressured. This condition caused the students' competency score results are not optimal. This will decrease the students' opportunity to get their best results in the competency test, while the competency test score determines their opportunity for competing in the labor market. Therefore, further evaluation of the 'Continuity' competency test model in vocational education schools is highly necessary for this global industrial era.

### 1.2. Management of the competency test

In vocational education, competency turns into an important aspect for the graduates as a benchmark that should be achieved by the students during their period of study to get a better job opportunity in the labor market. Competency has two essential values which are first, authorities in carrying out the responsibility, license or right to decide, produce, serve, act, and perform, and second, the capability to implement the knowledge, skills, and experience (Mulder, 2007). Competency tests in vocational education schools should have a comprehensive and multi-dimensional construction. Generally, there are three different competency levels, those are conceptual competence, procedural competence, and interpretative competence (Winther and Achtenhagen, 2009; Winther and Klotz, 2013). All these competency levels lead to job assignments that match the specific needs of the world business industry. Competency test is essential for the students in terms of the final decision whether the students pass or fail during their study in vocational education as well as to avoid the incompetent graduates in the labor market (Johnson, 2008). Alternatively, the substance of the competency test is not only for testing the students but also to seek the validation of the students. The validation process itself focuses on how students work on each assignment such as the used tools' accuracy, their work attitude, and adherence to SOP, instead of the final results-oriented only (pass or fail).

However, in this current vocational education school in Central Java, Indonesia, the implemented competency test is only focused on the final result without considering the process and performance of the students in detail during the competency test. The competency test is conducted only one time simultaneously at the end of the student's period of study according to the curriculum order. This management of the competency test is considered less effective because the implementation of the competency test is limited at a certain time. The impact adversely students' performance during the competency test as well as the assessors' validation of the students' performance. In addition, owing to the last semester's implementation of the competency test, the students tend to struggle to do retests if they fail during the competency test due to the limited schedule. Therefore, innovation in the management of the competency test is highly necessary in order to significantly improve the quality of vocational education graduates. Proper management of the competency test is proposed in this research which aimed to give the students a bigger opportunity to perform better and get their best result during the competency test. The proper management of the competency test allows the students to take the assignments at any time as long as the quota meets the minimum requirements. The school will provide a minimum quota for each task to be carried out. Thus, the assessor could give detailed assessment and validation based on the requested ongoing assignment whether the students are passed or failed on their competency test. However, if the student failed, they will be given a chance to practice more in the workshop during their study, then they could take another competency test in the next semester. The proposed management of the competency test is involving teachers, internal assessors, and external assessors (field experts: mechanics or automotive experts).

### 1.3. The effect of fatigue and stress level

The high intensity of the workload in the industrial sector tends to produce high fatigue and stress levels of the worker. This concept is also similar to the competency test particularly in automotive skills for vocational education students. During the automotive skill competency test, the students were forced to finish heavy duty within a limited time. However, this will significantly produce a poor competency result which will decrease the opportunity of the students entering the labor market due to the students' fatigue and stress level increase. The study about the effect of fatigue and stress levels on productivity has been investigated over the decades. The results prove that the environment and work pressure significantly affect the body temperature of the workers whereas significantly affecting muscle fatigue and stress (Chad and Brown, 1995). Qualitatively, fatigue and stress levels are attributed to extended working hours, working conditions, and high workloads. These aspects are significantly affecting low productivity and low job satisfaction (Pelders and Nelson, 2019). Several impacts on the fatigue and stress level increased were observed such as reduced levels of awareness, low concentration and focus, reduced motivation and impaired mood as well as low job satisfaction (Lerman et al., 2012; Phillips et al., 2017; Shen et al., 2006). In terms of health, fatigue, and stress level can also lead to long-term health problems such as muscular tension, musculoskeletal disorders, heart disease, and mental illness which the workers tend to use sick leave and reduce productivity (Åkerstedt et al., 2014). However, recommendations such as time management, working time arrangement, rest and break time optimization, fitness, and sports program are highly necessary in order to avoid workers' fatigue and stress level increases (Hsouna et al., 2019; Safitri and Rusdiana, 2010).

Looking into the importance of rest and break time management and the time arrangement in the industrial sector, vocational education schools should implement a similar method due to vocational education graduates are focused on the industrial labor market (Ahmed, 2016; Pema and Mehay, 2012). The implementation of the fatigue and stress level management could be assigned to the students' competency test model. However, most vocational education schools in Indonesia are facing poor fatigue and stress management on their students during competency tests where poor competency results are inevitable (Abdurrahman et al., 2019). Meanwhile, the demand for the industrial sector on human resources is increasing with high criteria required. To overcome this problem, vocational education schools should increase their graduates' competency test scores, thus their graduates could easily compete in the labor market and improve job opportunities.

### 1.4. The 'discontinuity' competency test model

Therefore, in this present study, the alternative model of competency test for vocational education called the 'Discontinuity' test model has been proposed and investigated in detail. The concept of the 'Discontinuity' model is by giving the student time to break and rest while shifting with another student to conduct the competency test. The five tasks of the competency test could be done within 10 h with a break time of 1 h in between each task. By giving the break time of 1 h, the competency test could be done by 10 students per day by doing the competency test alternately. The break time is very important and has been commonly used in the industrial sector to improve productivity and reduce the fatigue level of the workers (Gregson, 2020; Lim et al., 2020; O'Neill and Panuwatwanich, 2013). This current study aims to observe the student's convenience on the application of the 'Continuity' and 'Discontinuity' test model by analyzing the competency test score of the vocational education students in Central Java, Indonesia. This study is a development from the previous study which was conducted in a narrower area and the taken sample was only from one vocational education school in Semarang city, Indonesia (Abdurrahman et al., 2019). However, the developed 'Discontinuity' model in this study covers larger areas which are

involving 10 vocational education schools in Central Java, Indonesia, and provides a better result for educational improvement.

## 2. Methods

This study was focused on a descriptive quantitative method with data collected through a questionnaire that describes the educational reality regarding the level of student's satisfaction with vocational education in Central Java, Indonesia (Sánchez Prieto et al., 2020). The level of satisfaction in vocational education is determined by the ability of teachers in learning. This study also used a survey design because the number of research targets is spread over 10 different areas while the collecting data method is the same through competency tests and questionnaires. Two different models were implemented to collect the data which were 'Continuity' and 'Discontinuity' model competency tests of automotive skills in vocational education schools. The 'Continuity' model means the students must finish 5 competency tasks continuously within 5 h with a very limited time to break. Meanwhile, the 'Discontinuity' model means the students will be given a certain time (1 h) to break after finishing one task while shifting with the other student to do the same task. The schematic diagram of the 'Discontinuity' model is shown in Figure 1. The 'Discontinuity' model is considered to be more feasible and could significantly improve the students' competency test final score.

This study was conducted in Central Java, Indonesia which collecting data from 10 different Vocational High Schools (SMK) with the competence of the Automotive Light Vehicle Techniques which are; SMK Negeri 2 Surakarta, SMK Negeri 2 Salatiga, SMK Negeri 1 Magelang, SMK Negeri 1 SEDAN Rembang, SMK Negeri 4 Semarang, SMK Negeri 1 Kedungwuni, SMK Negeri 1 Ampelgading, SMK Negeri 2 Pati, SMK Negeri 2 Kudus, dan SMK Negeri 1 Adiwerna Tegal. Several stages have been carried out in this research. The following stages were explained as follows; determine the problem, determine the goal, make an instrument, determine the sample, collect data, analyze the data, conclude, and follow up the findings. In order to answer the aim of this study, three variables were implemented which are students' fatigue during the competence test, students' score acquisition, and competency test management.

In terms of the proposed management of the competency test, the questionnaire was given to the respective teachers, head of the department, and head of the laboratory of each vocational school regarding their judgment of the proposed management to be implemented. The student's evaluation of the proposed competency test management should consist of the following skills, those are task skill, task management skill, contingency management skill, environment skill, and transfer skill. This proposed management will ease the students to get the optimum result of their competency test. The students are allowed to take the competency test at any time since the first semester of their study as long as meet the minimum requirements. The proposed competency test management could be accessed by the students through an online platform which is provided by the collaboration between the vocational schools and the world business industry. The schematic diagram of the proposed management of the competency test is shown in Figure 2.

The study uses descriptive research with a *sample at one point in time* model, which is a descriptive study that aims to report the characteristics of the object studied whose research data is obtained from one-time measurement only. Before using the instruments, the validity of the items for the research instrument was carried out by using the competency test for the teachers. The results of the validity of the item from 40 items were declared valid from 30 questions. There are 30 valid questions that are continued as a matter of competence test. There are 5 competency tests for students with 12 points each for the transmission overhaul, 10 points for the electrical body system, 8 points for the motor starter system, 14 items for the engine tune-up, and 8 points for the clutch overhaul. The samples consisted of 5 teachers from each school which has a total of 50 teachers and 10 students from each school which has a total of 100 students. The research data were collected through the application of the "Continuity" and "Discontinuity" competency test

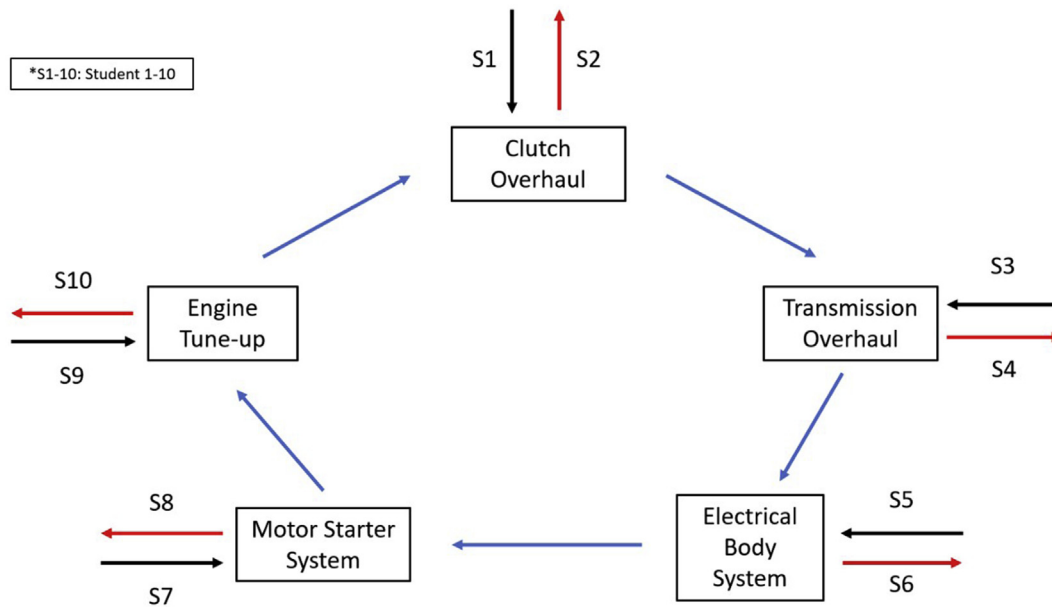


Figure 1. Schematic diagram of the 'Discontinuity' competency test model.

model. After the competency test, the questionnaires were given to the students to reveal the satisfactory level of using Continuity and Discontinuity models. In this study, a comparative test was conducted between continuity and discontinuity groups through T-Test analysis.

Moreover, related to the competency test management, the head of the department, head of the laboratory technician, and teachers were involved to observe and analyze the advantages and disadvantages of the proposed management given by the author. Additionally, the current study has been approved by the ethical committee of the "Indonesian Ministry of Education and Culture, Universitas Negeri Semarang, Lembaga Penelitian dan Pengabdian Masyarakat" and confirmed that the study complies with all regulations and confirmation that informed consent was obtained.

### 3. Results and discussion

This present study revealed the comparison between the 'Continuity' test model and the 'Discontinuity' test model that has been done in vocational schools in Central Java, Indonesia within the period of March to April 2020. Figure 3 and Figure 4 indicate the correlation between the number of respondents and the final score of the competency test using the 'Continuity' and the 'Discontinuity' model, respectively.

Based on the 'Continuity' competency test model result which is shown in Figure 3 revealed that the final competency scores were mostly at the 'Good' level. The numbers of students with a 'Good' level were 86 students. Meanwhile, the students with 'Very good' level were only 14 students which are indicated in Table 1. The lowest score obtained by 5 students was 86.25 and 92.25 was the highest score for the 'Continuity' competency test model which was only achieved by one student. This score level indicates the students' capability and convenience during the competency test. In this global industrial era, a 'very good' level is highly necessary to be obtained by the students due to the high requirements of the manpower in these current industrial companies (Suharno et al., 2020). Thus, the improvement in the competency test results of the students should be carried out. Otherwise, vocational education schools fail to become a bridge between the graduates and the labor market.

Meanwhile, based on the 'Discontinuity' competency test model result which is shown in Figure 4 revealed that all of the final competency

scores were at 'Very good' level. The lowest score was 94.8, while the highest score for the 'Discontinuity' competency test model was 99.8. Although both 'Continuity' and 'Discontinuity' competency test model results were still acceptable, the 'Discontinuity' competency test model emphasizes the optimum final score of the students. One hour of rest and break time that is given to the students during the competency test exhibit the optimum potential of the students. Thus, they could perform better during the competency test and deliver higher competency final scores that could be beneficial for their opportunity in the labor market. The result in Table 2 has also become evident that the students could achieve a "very good" result in their students' competency score using the discontinuity model.

$\text{Sig} = 0.000 = 0\% < 5\%$ , it means that  $H_0$  is rejected or  $H_1$  is accepted. The mean of continuity and discontinuity competency groups is different. Therefore, the mean of the discontinuity group is 97.77 which has a higher amount compared with the continuity group of 88.63 which is shown in Table 3. The results of the discontinuity competency group are better than the continuity competency group. Figure 5 also shows the summary report from the T-Test analysis of both the continuity and discontinuity model. The P-Value of discontinuity was 0.252 and the continuity was 0.368. It means that the lower P-value is better. According to the T-Test analysis, the discontinuity model has a better statistical model compared to the continuity model.

Figure 6 and Table 4 indicated the fatigue level survey that has been given to the respondents regarding the 'Continuity' competency test model. The results revealed that students tend to feel very tiring when implementing this method. These results were in accordance with the final score of the competency test results which dominantly at the 'Good' level. Only one student stated in the 'very not tiring' category. Meanwhile, 24 students stated 'enough', 31 students stated 'tiring', and 36 students stated 'very tiring' category. These results were taken based on the students' experience during the implementation of the 'Continuity' competency test model. This result proves that the 'Continuity' competency test model significantly affects the students' fatigue and stress levels.

Figure 7 and Table 5 revealed the survey result that has been given to the students according to their opinion on the implication of the 'Discontinuity' model regarding their convenience during the



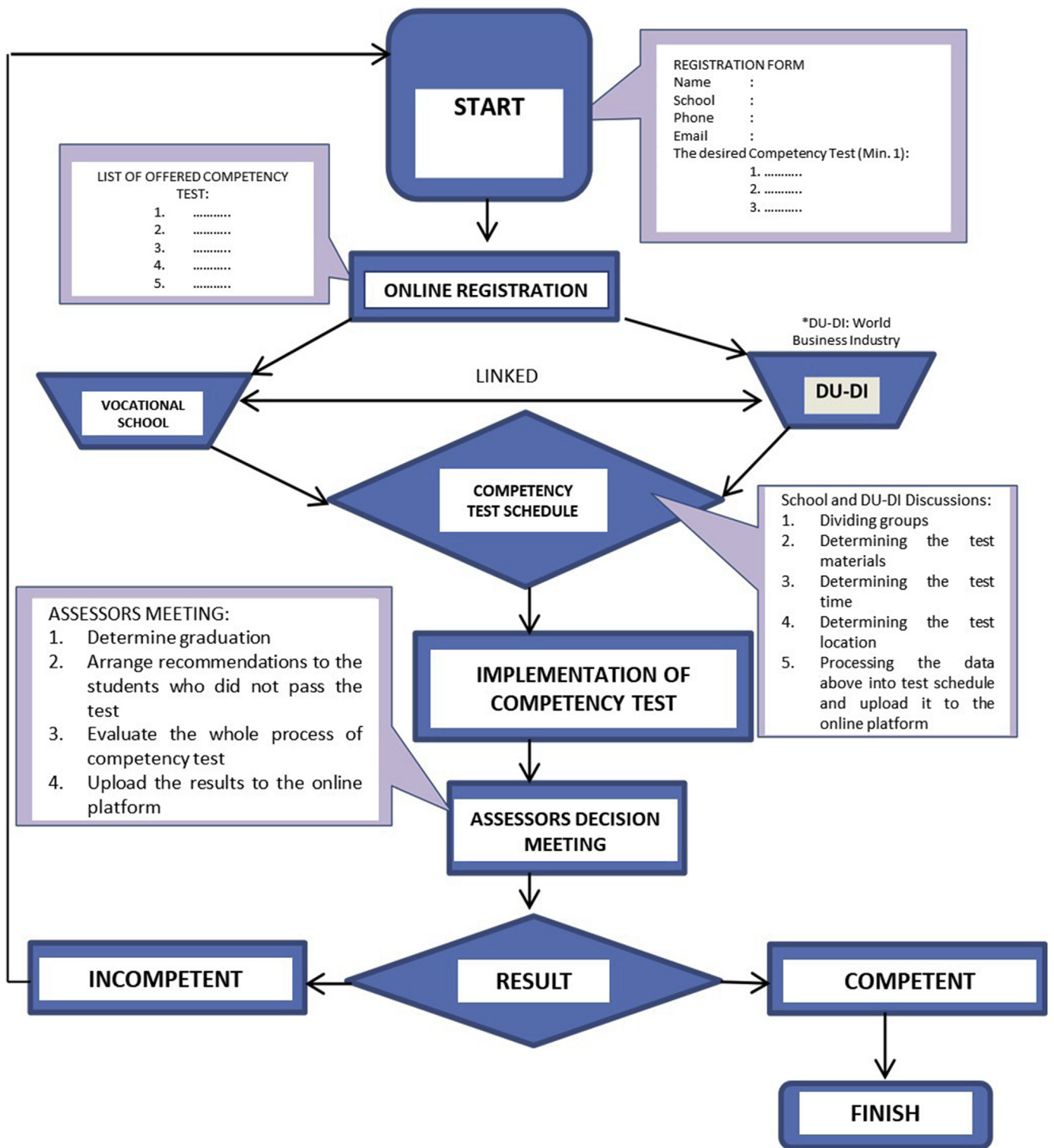


Figure 2. Schematic diagram of the proposed competency test management.

competency test. Based on the graph in Figure 6, it is clearly stated that most of the students are comfortable and very comfortable with the application of the 'Discontinuity' test model. It is in accordance with their final score of the competency test results which indicated significant improvement and better results during the competency test. 53 students stated in the 'very comfortable' category, 32 students stated in the 'comfortable' category, 12 students stated in the 'enough' category, 1

student stated in the 'uncomfortable' category, and only 2 students stated at 'very uncomfortable' category. This result proves that the application of the 'Discontinuity' test model gives better comfortability to the students as well as reduces their fatigue and stress level. Therefore, the final score of the competency test could be increased significantly. The 'Discontinuity' model gives the students the opportunity to take a break for an hour in between the tasks in order to recover their focus and



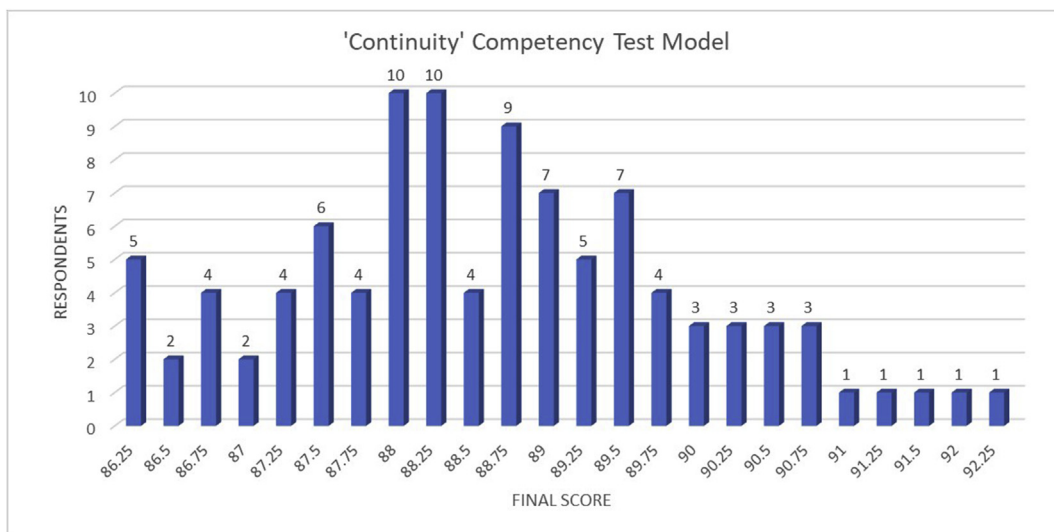


Figure 3. Schematic graph of the 'Continuity' competency test model results.

Criteria:

50–60: Very low

61–70: Low

71–80: Enough

81–90: Good

91–100: Very good.

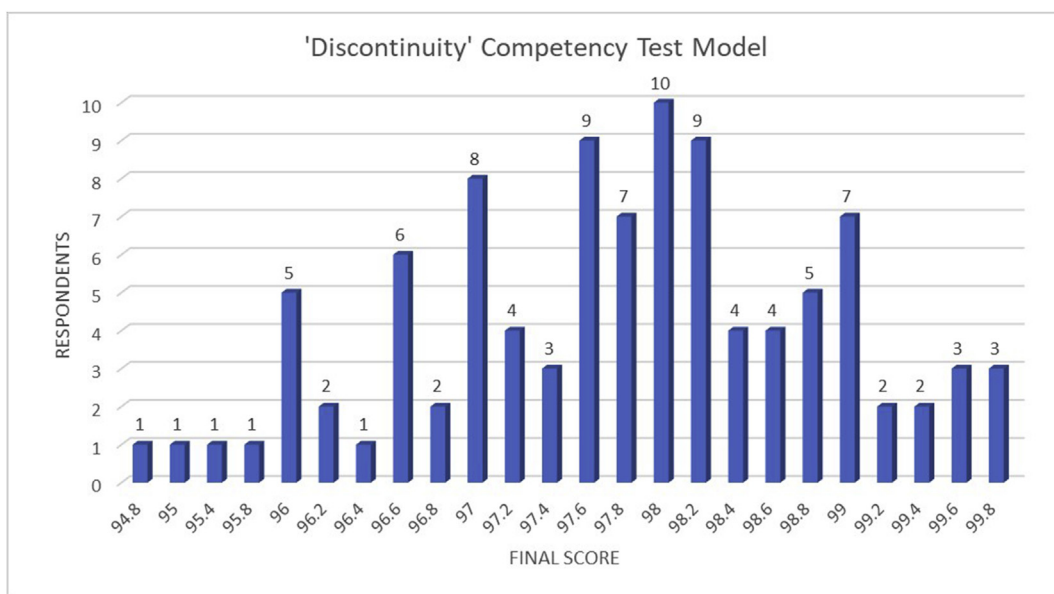


Figure 4. Schematic graph of the 'Discontinuity' competency test model results.

Criteria:

50–60: Very low

61–70: Low

71–80: Enough

81–90: Good

91–100: Very good.

Table 1. Students' competency score based on criteria classification of the 'Continuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	86	14

Table 2. Students' competency score based on criteria classification of the 'Discontinuity' model.

Criteria	Very Low	Low	Enough	Good	Very Good
Total Students	-	-	-	-	100

**Table 3.** Results of the T-Test in the continuity and discontinuity groups.

Group	N	Mean	Std. Deviation	Std. Error Mean
Continuity	100	88.6275	1.33593	0.133559
Discontinuity	100	97.7720	1.09877	0.10988

concentration to conduct the next following competency test. Therefore, they can refresh their mind to avoid high-stress levels during competency tests and take a break to relax their body due to the high intensity and pressure of the competency test. This ‘Discontinuity’ competency test model is established to fulfill the students’ desire to get the optimum competency test result to support their assets and increase their opportunities in the labor market. In terms of quality, the vocational education school in which implementing this method could significantly gain massive improvement by graduating students with a high competency level.

**Table 4.** Students’ fatigue level criteria classification of the ‘Continuity’ model.

Criteria	Very Not Tiring	Not Tiring	Enough	Tiring	Very Tiring
Total Students	1	8	24	31	36

The questionnaire of feasibility scoring was given to the respective vocational education teachers and staff who have been involved in this research to evaluate the proposed competency test management. According to the feasibility scoring result of the proposed competency test management, all of the vocational education teachers were agree with the proposed competency test management which is shown in Figure 8 and Table 6 where 34 teachers stated ‘very agree’ and 16 teachers stated ‘agree’. This result proves that the benefits of the implication of the proposed competency test management are not only for the students but also for the teachers. Moreover, students’ opportunities in the labor market improved owing to the students’ competency final score improvement.

**Method**

$\mu_1$ : mean of Continuity  
 $\mu_2$ : mean of Discontinuity  
 Difference:  $\mu_1 - \mu_2$

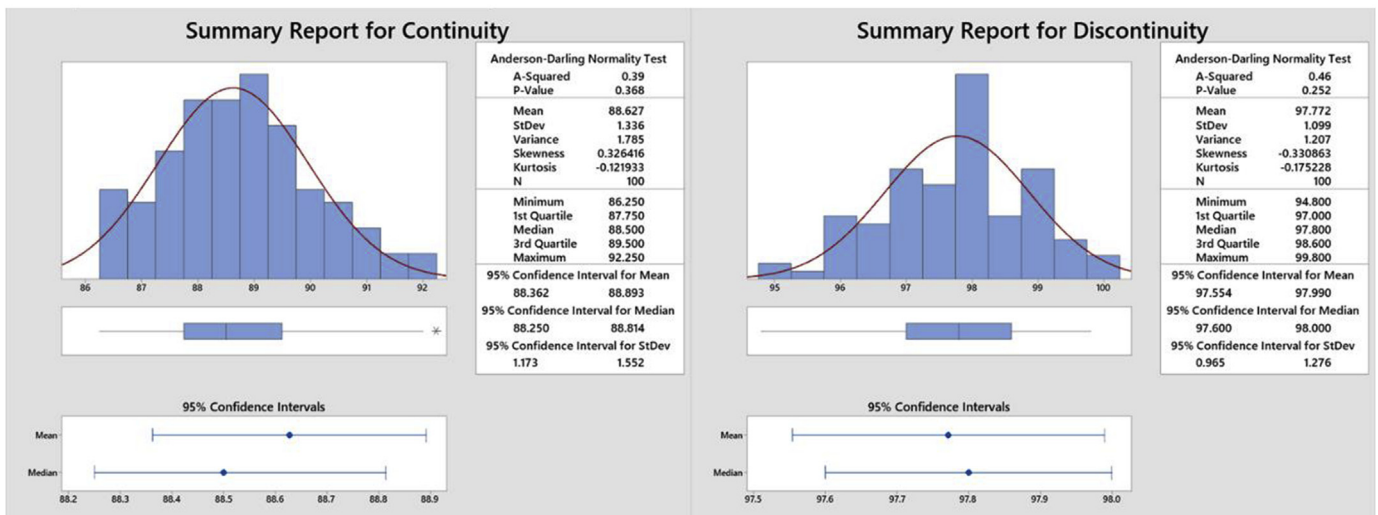
*Equal variances are assumed for this analysis.*

**Estimation for Difference**

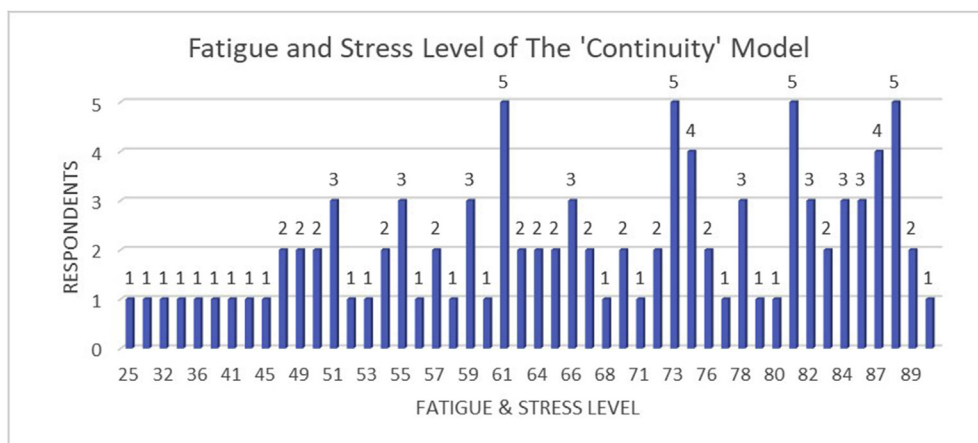
	Pooled Difference	95% CI for StDev Difference
	-9.145	1.223 (-9.486, -8.803)

**Test**

Null hypothesis	$H_0: \mu_1 - \mu_2 = 0$	
Alternative hypothesis	$H_1: \mu_1 - \mu_2 \neq 0$	
<b>T-Value</b>	<b>DF</b>	<b>P-Value</b>
-52.87	198	0.000



**Figure 5.** T-Test analysis result for the Continuity and Discontinuity model.



**Figure 6.** Schematic graph of the fatigue and stress level of the ‘Continuity’ competency test model.

Criteria:  
 15–30: Very not tiring  
 31–45: Not tiring  
 46–60: Enough  
 61–75: Tiring  
 76–90: Very tiring.

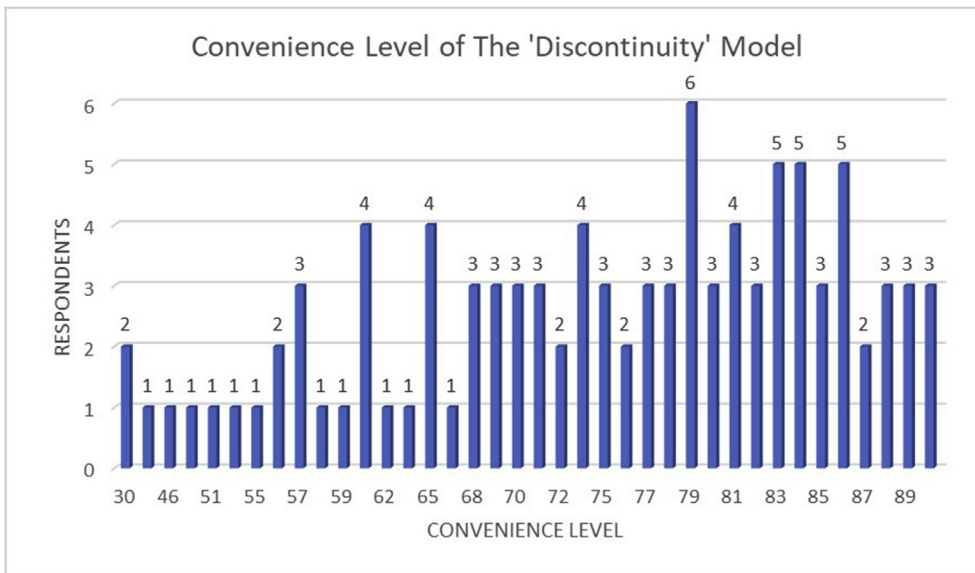


Figure 7. Schematic graph of the fatigue and stress level of the 'Discontinuity' competency test model.

Criteria:  
 15–30: Very uncomfortable  
 31–45: Uncomfortable  
 46–60: Enough  
 61–75: Comfortable  
 76–90: Very comfortable.

Table 5. Students' convenience level criteria classification of the 'Discontinuity' model.

Criteria	Very Uncomfortable	Uncomfortable	Enough	Comfortable	Very Comfortable
Total Students	2	1	12	32	53

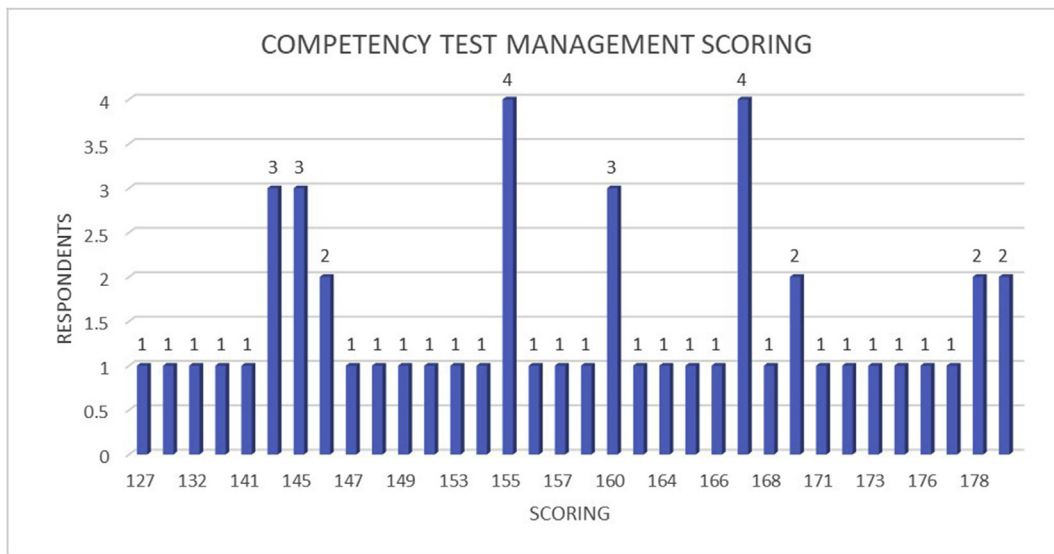


Figure 8. Schematic graph of the proposed competency test management scoring.

Criteria:  
 30–60: Very disagree  
 61–90: Disagree  
 91–120: Enough  
 121–150: Agree  
 151–180: Very agree.

Table 6. Feasibility test result graph of the proposed competency test management.

Criteria	Very Disagree	Disagree	Enough	Agree	Very Agree
Total Respondents	-	-	-	16	34

#### 4. Conclusion

Fatigue and stress levels of the vocational education students could adversely impact the competency test result. The current competency test model for vocational education in Central Java, Indonesia is a

'Continuity' competency test model. This model tends to give low scores on students' competency test results due to the lack of time to break where the students must finish five tasks within 5 h, thus, it causes the students' focus and concentration to decrease significantly. To overcome this problem, the implementation of the 'Discontinuity' model was proposed. By giving one-hour time to break for the student and the competency test could be done alternately, fatigue, and stress level of the students could significantly decrease. Consequently, the result shows that the final score of the student's competency test result was significantly improved. All the 'Discontinuity' model-based results showed in the 'very good' category. In addition, the survey results showed that the students feel more comfortable using the 'Discontinuity' competency test model than that 'Continuity' competency test model as well as the teachers satisfied with the proposed competency test model. The improvement in the competency test result is very important for the student who will be facing the labor market after graduating from vocational education. However, the industry considers students with a high competency score to join their company rather than the lower score one. In addition, a new competency test management is proposed in this study by allowing the students to take the competency test at any time since their first semester of study through an online platform that is directly connected with vocational school management and DU-DI (World Business Industry). The feasibility scoring survey of the proposed management revealed that both teachers and staff of the respective vocational schools in Central Java, Indonesia agree to implement the proposed competency test management. However, the proposed competency test management will ease the students and teachers to achieve an optimum final score of the competency test as well as improve the vocational school quality.

## Declarations

### Author contribution statement

Abdurrahman: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Parmin&Stefanus Muryanto: Contributed reagents, materials, analysis tools or data.

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### Data availability statement

Data included in article/supplementary material/referenced in article.

### Declaration of interests statement

The authors declare no conflict of interest.

### Additional information

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