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ASSESSMENT OF TEACHING MATERIAL IN MECHANICAL ENGINEERING DRAWINGS

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ABSTRACT

This study aims at assessing the various educational materials used in teaching mechanical engineering drawing to students of the Department of Mechanical Engineering Education, Semarang State University, and Vocational High School. Data were obtained from 71 university students, 75 public vocational high school 1 students and 37 students of Texmaco Semarang vocational high school using the questionnaire method. Furthermore, descriptive statistics and one-way analysis of variance tests were used to analyze data. The results of the descriptive analysis show that the materials used in teaching mechanical engineering students are in the "very necessary" category, while that of students of vocational high school is in the "necessary" category. The difference in assessment is evidenced from the results of a one-way analysis of variance test, which found differences in the results of the assessment among university students, students of State Vocational High School 1 and Texmaco Vocational High School Semarang.

Keywords: assessment, material, teaching materials, subjects, mechanical engineering drawings.

INTRODUCTION

Regulation of the General Director of Primary and Secondary Education of the Education and Culture Ministry Number: 07 / D.D5 / KK / 2018 concerning Curriculum Structure of Vocational High Schools, Sekolah Menengah Kejuruan (SMK) or Madrasah Aliyah Kejuruan (MAK), where Mechanical Engineering competency skills include subjects of creative product and entrepreneurship with a total of 524 lesson hours. The addition of these subjects has the aim that Vocational High School graduates of the Mechanical Engineering competency skills after graduating can become entrepreneurs to create creative products. This includes creating useful technological products.

If the implementation of creative and entrepreneurship product subject is successful, there will be more and more students graduating from the Mechanical Engineering competency who succeed in being entrepreneurs in the technology field. In the long term, this will reduce the dependence of vocational graduates on Mechanical Engineering competency skills to look for jobs, but instead create their jobs and influence other SMK graduates to work.

To be able to create their own jobs, SMK students of Mechanical Engineering skills need to have not only adequate skills but also a strong willingness to create and produce workable products that can be sold well. Useful work-piece products are products needed by the society in the form of spare parts and production machines for processing such as rice threshing machines, soybean peeling machines, chip cutting machines, coconut grater machines, meat grinding machines, and so on.

Based on this case, SMK students of Mechanical Engineering competency need to master teaching materials (basic competencies) in mechanical engineering drawing subjects. By mastering these competencies, students will be able to design and make industrial products, so after graduating, the students will be able to apply mechanical engineering drawing competency that has been mastered to make industrial products needed by people. Basic competency in mechanical engineering drawing subject is allocated 144 hours of study time. It is also the basic skill subject given to class X in the first semester, 4 hours of study, and in the second semester, also 4 hours of study.

According to Sato and Hartanto (1994: 1), mechanical engineering drawing is a tool for expressing a person's intention, and then the mechanical technique is often called "technical language". Based on this reason, it can be said that mechanical engineering drawing is a communication tool among people in the industry. If students' competences in mechanical engineering drawing are low, it can be said that students will not be able to design in the manufacture of machinery products. For this reason, it is

needed to have efforts to improve student competence in mechanical engineering drawings.

There have already been several kinds of research on the development of teaching materials, but there are still no technical materials for drawing teaching materials. The research conducted by Chang, Sung, and Hou (2006: 139) explains that based on the experts' assessment of web-based using a more coherent and systematic system English speaking skills teaching materials, they provide deeper and wider information for learning, and can apply more adequate teaching strategies.

As those who will teach and who have studied mechanical engineering subjects, Mechanical Engineering Education (Pendidikan Teknik Mesin/PTM) students, and SMK students in Mechanical Engineering skills who have received mechanical engineering drawing materials, it is important to know their assessment in accepting engineering drawing materials. This is so important that the teaching-learning process of mechanical engineering drawings can be maximized with the fulfilment of mechanical engineering drawing materials in accordance with the wishes of prospective teachers and students who study mechanical engineering drawings.

Republic of Indonesia Minister of Education and Culture Regulation Number: 70 in the year of 2013 concerning Vocational High School (SMK) / Madrasah Aliyah Kejuruan (MAK) in Basic Competence of Mechanical engineering drawings, it is explained that mechanical engineering drawing material consists of equipment and completeness of engineering drawings, drawing lines of shapes and functions, letters, numbers and image etiquette, geometric construction drawings, projection images, cut out images, and image sizes. To get the teaching material of mechanical engineering subjects, an analysis of basic competencies is carried out and matched one by one with the teaching materials in the mechanical engineering textbook. The results of the analysis on the subject of mechanical engineering drawings are making drawing lines, making letters and numbers, designing geometric construction drawings (lines, facets and ellipses), making etiquette, giving pictures, making 3D objects (Pictorial / perspective drawing projection, making 2 D images according to orthogonal quadrant I projections (European projections), making 2 D images according to orthogonal quadrant III projections (American projections), designing cutout images, making symbols (work marks) in the image, making tolerance in the image, drawing a picture of the nut, drawing a picture of the bolt, drawing a picture of the bolt nut, drawing a picture of the opening (stretch), making a detailed drawing (part) and drawing a picture of the arrangement. The teaching materials contained in the subject of mechanical

engineering drawings are then compiled into questionnaires totalling 21 items.

RESEARCH METHOD

The study uses a descriptive survey method, which is a survey for accurate measurement of certain phenomena (Singarimbun and Effendi, 1989: 4). In this case, it is the phenomenon of the assessment of PTM students and SMK students on teaching materials in mechanical engineering subjects. The population of this study is all PTM students and students of Public and Private Vocational Schools in Semarang. The sampling method is proportional random sampling by drawing. In the first stage, drawing for the sample of the State Vocational High School was obtained in the State Vocational High School 1 as a sample. Then, drawing a sample to represent the Private Vocational School was obtained by Texmaco Vocational High School. For samples of PTM students were drawn from the population. Determination of the number of samples uses the Krecjie Table (Sugiyono, 1997: 67) with details as follows in Table 1.

Table 1. Determination of Research Samples.

Resource of Data	Population	Sample Minimum	Sample which was taken
Students of PTM	85	70	71
Students of SMK Negeri 1 Semarang	90	73	75
Students of SMK Texmaco Semarang	40	36	37
Total			183

Taking data uses questionnaire instrument Likert scale regarding teaching materials needed for mechanical engineering drawing subjects totalling 21 items. Then, the questionnaire was given to a sample of PTM students, students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang of Mechanical Engineering skill competency to assess whether the teaching material of Mechanical Engineering drawings is very necessary or not. Assessment is done by giving a checkmark (V) in accordance by what is felt by the choice: 'very unnecessary', 'not necessary', 'quite necessary', 'necessary', and 'very necessary'. Before being used to take 21 items of the instrument, the questionnaire instrument was validated and tested on 33 respondents. To test its validity, it is used the moment product correlation formula, where for each criterion item $r_{xy} \geq 0.30$ (Azwar, 2012: 95), while for reliability, it is calculated by the Cronbach Alpha formula, the criterion is $\alpha \geq 0.70$ (Litwin, 1995: 31). The result is that all items are valid, with the lowest item validity is number 5 = 0.319 and the highest is number 19 = 0.756. For the test results of the instrument reliability, it is obtained $\alpha = 0.91$ which shows the instrument is very consistent.

Data analysis used descriptive statistics and analysis of one-way variant. To find out the mechanical engineering drawing teaching material needed by descriptive statistics, it uses the SPSS program (Statistical Package for Social Science). In the assessment criteria,

it is made a range of scores from 1 to 105 which are then divided into 5 categories in Table 2.

Tabel 2. Assessment Criteria for Teaching Materials

No.	Score range	Category
1	1 – 21	Very unnecessary
2	22 – 42	unnecessary
3	43 – 63	Sufficient necessary
4	64 – 84	Necessary
5	85 – 105	Very necessary

Before a one-way variant analysis test is carried out, the requirement analysis is done first. This includes the normality test and homogeneity test. All calculations are performed using SPSS. The Normality test uses the Kolmogorov-Smirnov formula with criteria if p> 0.05 normal data (Triton PB, 2005: 79) and the homogeneity test uses the Lavene Statistic formula with the criteria if the value of Based on Mean, Based on Median, Based on Median and with adjusted df and Based on trimmed mean at p> 0.05 then homogeneous data (Triton, PB 2005: 87). Furthermore, for the one-way variance analysis test, the criteria are if the significance level is p ≥ 5 0.05, then Ho is accepted and Ha is rejected. Conversely, if p <0.05, then Ho is rejected and Ha is accepted (Triton PB, 2005: 197). If Ha is accepted, it means that there are differences in assessment between PTM students, students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang, whereas if Ho is accepted then there is no difference in assessment between PTM students, SMK Negeri 1 Semarang students and SMK Texmaco Semarang students in assessing teaching materials on mechanical engineering drawing subject.

FINDINGS AND DISCUSSION

Descriptive analysis of the data obtained regarding the assessment of PTM students, students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang towards teaching materials in mechanical engineering drawing subject is by looking at the average value. The results can be seen in Table 3.

Tabel 3. Assessment Average of Teaching Materials

Sample	Average	Assessment Category
Students of PTM	91,99	Very necessary
Students of SMK N 1 Semarang	82,64	Necessary
Students of SMK Texmaco Semarang	77,27	Necessary

Based on Table 3, the average score of PTM students' evaluation on teaching materials of mechanical engineering drawing subject is 91.99, the average score of SMK Negeri 1 Semarang students' evaluation is 82.64 and the average score of SMK Texmaco Semarang students'evaluation is 77.27. When consulted with the Criteria in Table 2, the assessment of PTM students on teaching materials in mechanical engineering drawing subject is in the very necessary category, while the assessment of students of SMK Negeri 1 Semarang and SMK Texmaco Semarang is in the necessary category.

The assessment of PTM students on the teaching materials in mechanical engineering drawing subject in detail for each category is by looking at the number of students or the percentage in each category. The results of the assessment of PTM students for each category can be seen in Table 4.

Tabel4. Categories of PTM Students' Assessment Results

No.	Score Range	Category	Number of Students (%)
1	1 – 21	Very unnecessary	0 (0%)
2	22 – 42	Unnecessary	0 (0%)
3	43 – 63	Sufficient unnecessary	0 (0%)
4	64 – 84	Necessary	9 (12,68%)
5	85-105	Very necessary	62 (87,32%)
Total			71 (100%)

Based on the results in Table 4, it appears that PTM students who assessed teaching material in the necessary category amounted to 9 students (12.68%), while those who assessed the very necessary category amounted to 62 students (87.32%). There were no PTM students who assessed that in a very unnecessary, unnecessary and sufficient necessary category.

The assessment of the students of SMK Negeri 1 Semarang on the teaching materials in the subject of mechanical engineering drawings in detail for each category is by looking at the number of students or the percentage in each category. The results of the assessment of SMK Negeri 1 Semarang students for each category can be seen in Table 5.

Tabel 5. Assessment Results Categories of SMK Negeri 1 Semarang students

No.	Score Range	Category	Number of Students (%)
1	1 – 21	Very unnecessary	0 (0%)
2	22 – 42	Unnecessary	0 (0%)
3	43 – 63	Sufficient unnecessary	0 (0%)
4	64 – 84	Necessary	46 (61,33%)
5	84 – 105	Very necessary	29 (38,67%)
Total			75 (100%)

Based on the results in Table 5, it appears that students of SMK Negeri 1 Semarang who assessed teaching materials in the necessary categories amounted to 46 students (61.33%), while those who assessed very necessary were 29 students (38.67%). There were not students of SMK Negeri 1 Semarang who assessed that in a very unnecessary, unnecessary and sufficient necessary category.

The assessment of the SMK Texmaco Semarang students on the teaching material of mechanical engineering drawing subject in detail for each category is by looking at the number of students or the percentage in each category. The results of the assessment of SMK Texmaco Semarang students for each category can be seen in Table 6.

Tabel 6. Assessment Results Categories of SMK Texmaco Semarang Students

No.	Score Range	Category	Number of Students (%)
1	1 – 21	Very unnecessary	0 (0%)
2	22 – 42	Unnecessary	0 (0%)
3	43 – 63	Sufficient necessary	1 (2,70%)
4	64 – 84	Necessary	28 (75,68%)
5	84 – 105	Very necessary	8 (21,62%)
Total			37 (100%)

Based on the results in Table 6, it appears that the students of SMK Texmaco Semarang who assessed teaching material in the necessary categories amounted to 1 student (2.70%), the necessary category was 28 students (75.68%), while those who assessed very necessary category amounted to 8 students (21.62%). There were not students who assessed that in the very unnecessary and unnecessary category.

The results of the analysis requirements test for the of the evaluation data normality of mechanical engineering drawing teaching material for PTM students, SMK Negeri 1 Semarang students and students of SMK Texmaco Semarang use the Kolmogorov-Smirnov test. The results of the normality test are in Table 7.

Tabel 7. Data Normality Test Results

Data	Origin	*Kolmogorov-Smirnov*			Note
		Statistic	*df*	*Sig.*	
mechanical engineering drawing teaching materials	Students of PTM	.067	71	.200	Normal
	Students of SMK N 1	.097	75	.077	Normal
	Students of SMK Texmaco	.135	37	.089	Normal

Based on the results in Table 7, it can be concluded that the assessment data on mechanical engineering drawing teaching materials for PTM students, students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang are normal. This is because all prices are sig> 0.05.

The calculation of the variance homogeneity test of the assessment data on the mechanical engineering drawing materials was carried out by using the Levene Statistics test. The results of the homogeneity test are in Table 8.

Tabel 8. Variant Homogeneity Test Results

Data	Value	*Levene Statistic*	df1	df2	*Sig.*
Mechanical Engineering Drawing Teaching Materials	*Based on Mean*	.359	2	180	.699
	Based on Median	.293	2	180	.747
	Based on Median and with adjusted df	.293	2	176.09	.747
	Based on trimmed mean	.403	2	180	.669

Based on the results of homogeneity test in Table 8, because the value on Based on Mean, Based on Media, Based on Median and with adjusted df, and Based on trimmed means all values of sig> 0.05, it can be concluded that the data on teaching material in mechanical engineering drawing subject are homogeneous.

The next test is a different test with one-way variant analysis (one-way ANOVA). The test results are in Table 9.

Tabel 9. Test Results of One Way Variant Analysis

Variant Resource	MK	Fh	*Sig*	Note
Among In Total	3043.74 71.23	42.73	.00	Ha is accepted

Based on Table 9, it takes the price of Fh = 42.73 and sig = 0.00 <0.05. Thus, Ha is accepted. It means that there is a difference between PTM students, students of SMK Negeri 1 Semarang and Students of SMK Texmaco Semarang in assessing teaching material in mechanical engineering drawing

the subject. These results reinforce the results of the descriptive analysis which shows PTM students assess that the teaching material in mechanical engineering drawing subject is in the very necessary category, and students of SMK Negeri 1 and SMK Texmaco Semarang assess in the necessary category.

The existence of different variations in the assessment of teaching material in the mechanical engineering drawing subject is not accidental, but it is because of the origin of the sample (respondent). This is reinforced from the results of one-way variant analysis tests which found that there are differences in the assessment of mechanical engineering drawing teaching material. It means that the different variations of the assessment on the results of the descriptive analysis are due to the evaluation of the sample origin (respondents) from PTM students, SMK Negeri 1 Semarang students and SMK Texmaco Semarang students.

Although the assessment of PTM students, SMK Negeri 1 Semarang students and SMK Texmaco Semarang students on mechanical engineering drawing teaching material are different, overall the assessment of PTM students, SMK Negeri 1 Semarang and SMK Texmaco Semarang in evaluating for mechanical engineering drawing teaching materials are very necessary and necessary. These results support previous similar studies conducted by Niswa (2012: 1) that students' responses to the development of based-flash interactive video listening teaching material are very good and Ampa, Basri and Andriani research (2013: 1) in developing contextual learning teaching material for material of English speaking skills based on expert assessment with psychological, pedagogical and methodological aspects, the results are very valid.

The participation of students in each preparation of learning material as indicated by an assessment of the learning material to be received is needed for each subject. The results of the assessment of PTM students, students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang as a whole have assessed the teaching materials in the very necessary and necessary category is a satisfactory assessment response. This result is in accordance with previous research conducted by Zaneldin (2011: 599) who found that students were satisfied with the direct and rapid notification each time there was a change in teaching material. Based on this case, the participation of PTM students and students of SMK in the Mechanical Engineering competency in assessing teaching material in mechanical engineering drawing subject in a very necessary and necessary category will be able to ward off concerns about the development of frequently overlooked teaching materials (HU, WANG, ZHANG and CHEN , 2013).

PTM students who assessed the mechanical engineering drawing teaching material better than the assessment of

students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang were an exciting start in the face of the regulations of the General Director of Primary and Secondary Education of the Education and Culture Ministry Number: 07 / D.D5 / KK / 2018 regarding changes in the curriculum structure of Vocational High School (Sekolah Menengah Kejuruan / SMK) / Madrasah Aliyah Kejuruan (MAK) where there is an additional Creative Products and Entrepreneurship subject for the Mechanical Engineering skills competency which reaches 524 lesson hours. On the basis of the results of PTM students' assessment stating that mechanical engineering drawing teaching material is very necessary are needed later, when PTM students have graduated and become teachers at the Vocational High School of Mechanical Engineering skills competency, they will emphasize drawing teaching materials on the design of useful technological products on Creative Products and Entrepreneurship subjects, so that graduates of SMK students of Mechanical Engineering Skills competency have the mindset of entrepreneurship creating their work rather than looking for jobs like today. On this basis, it is possible in the long term to reduce unemployment for graduates of Vocational High Schools.

CONCLUSION

Based on the results and discussion, it is clear that according to the Assessment of PTM students on mechanical engineering drawing subject teaching material is in the very necessary category, whereas according to the assessment of students of SMK Negeri 1 Semarang and students of SMK Texmaco Semarang, the category is necessary. The different results of the one-way variant analysis test indicate that the differences in the assessment of teaching material in mechanical engineering drawing subjects are due to the assessment of the origin of the sample/respondent. They are PTM students, SMK Negeri 1 Semarang students and SMK Texmaco Semarang students. Suggestions that can be given is it is supposed that PTM students and vocational students can master all teaching materials of mechanical engineering drawing subject in accordance by the assessment that has been done, so it is not only theoretical but they can draw mechanical engineering well.

BIBLIOGRAPHY

Ampa, Endi Tanri, Basri D, Muhammad, Andriani, Andi Ari (2013). The Development of Contextual Learning Materials for English Speaking Skills. *International Journal of Education and Research. Vol. 1 No. 9*, September 2013. p. 1-10.

Azwar, Saifuddin (2012) *Penyusunan Skala Psdikologi* Edisi II Pustaka Pelajar, Yogyakarta

Chang, Kuo-En, Sung, Yaoting and Hou, Huei-Tse (2006). Web-based Tools for Designing and Developing Teaching Materials for Integration of Information Technology into Instruction. *Educational Technology & Society 9 (4)*. p. 139-149.

HU, Tai, David WS. Yang Chih, WANG, Ray, ZHANG, Ren-Cheng, and CHEN, Jia- Ling (2013). The Visual Presentation Model Improving High School Student Learning Outcomes. *https://www.researchgate.net/publication/287321779.*

Litwin, Mark S. (1995) *How to Measure Survey Reliability and Validity*. London: Sage Publications,

Niswa, Auliyah. (2012). Pengembangan Bahan Ajar Mendengarkan Berbasis Video Interaktif Bermedia Flash Kelas VIID SMP Negeri 1 Kedamean. *Jurnal Bahasa dan Sastra Indonesia* Volume 01 Nomor 01 Tahun 2012

Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 70 Tahun 2013 tentang *Kerangka Dasar dan Struktur Kurikulum Sekolah Menengah Kejuruan/Madrasah Aliyah Kejuruan*.

Peraturan Direktur Jenderal Pendidikan Dasar dan Menengah Kementerian Pendidikan dan Kebudayaan Nomor: 07/D.D5/KK/2018 tentang Struktur kurikulum Sekolah Menengah Kejuruan (SMK)/Madrasah Aliyah Kejuruan (MAK)

Sato, G. Takeshi dan Hartarto, Sugiarto, N. (1994). *Mechanical Drawing According To ISO Standards (Menggambar Mesin Menurut Standar ISO)*. Cetakan Keenam. Jakarta: P.T. Pradnya Paramita.

Singarimbun, Masri dan Effendi, Sofian (Editor). (1989). *Metode Penelitian Survei*. Jakarta: LP3S

Sugiono. (1997). *Statistika Untuk Penelitian.* Bandung: Alfabeta

Triton PB (2005). *SPSS 13,0 Terapan Riset Statistik Parametrik*. Yogyakarta: Penerbit Andi.

Zaneldi, Essam K (2011), "A dynamic system to manage changes in course material", *International Journal of Educational Management, Vol. 25 Iss 5 pp. 509 – 527* Permanent link to this document: http://dx.doi.org/10.1108/09513541111146396.