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Training in Fundamentals of Standard Technical Drawing at SMK Muhammadiyah Tirtayasa

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Abstract

A training program is conducted to address the need for fundamental skills in Engineering Drawing. The partner school for this program is SMK Muhammadiyah Tirtayasa, located in the Serang Regency. The training focuses on basic technical drawing techniques. A total of 14 participants, including students and teachers, take part in the training. The training began with an explanation of the theoretical foundations of technical drawing, followed by three practical exercises. The participants' progress was evaluated based on the quality of their technical drawings. The results indicated that the participants had a good overall understanding and ability to apply the fundamental principles of line drawing, object projections, and dimensioning. The average scores across the three exercises were relatively high. Furthermore, the analysis revealed that male participants achieved higher scores compared to their female counterparts. To enhance the professionalism of the participants, it is recommended to incorporate computer-aided drawing tools to enhance their knowledge and skills in applying technical drawing concepts. In conclusion, the training program successfully provides participants with essential skills in Engineering Drawing. The findings highlight the potential benefits of integrating computer-based applications to further enhance their proficiency in this field.

Keywords: drafter; technical drawing; class action research.

Introduction

The demand for skilled workers in Technical Drawing or Drafting is continuously increasing in line with the growth rate of the manufacturing industry and infrastructure development in Indonesia. Although there is currently no accurate statistical data on the drafting profession in Indonesia, an overview of its importance can be seen from statistics on the drafting profession in the United States. There are over 81,759 individuals currently engaged in the drafting profession in the United States, with a composition of 25.3% females and 74.7% males (Zippia.com, 2019). The need for drafters in Indonesia can be observed through online job search platforms like Jobstreet, where 767 job openings are found using the keyword "drafter" across various industries (Jobstreet.com, 2022).

The requirement for drafters can be fulfilled by graduates from vocational schools. Vocational education plays a crucial role in preparing individuals with the necessary skills required by specific industries, as mandated in Article 15 of Law Number 20 of 2003. Therefore, Vocational High Schools (SMK) play a significant role in producing skilled drafters. Several studies have shown that the Technical Drawing skills taught in Vocational High Schools are highly relevant to the needs of relevant industries, as demonstrated in research conducted by Arifin and Ristadi (2017) and Puruasdi (2016). Both studies concluded that the Technical Drawing curriculum has strong relevance to the needs of drafters in relevant industries. However, the current reality depicts a lack of professional drafting skills, with graduates' quality in the industry being concerning and having low standards due to the absence of strict educational standards from educational institutions (McLaren, 2008). The issue of insufficient Technical Drawing skills can be identified in studies by Nawangsasi (2016), Nugroho *et al*. (2016), and Pradani *et al*. (2021).

The teaching method for Technical Drawing may present some challenges due to the limited number of teachers with specific expertise (Dewi *et al*., 2021). Additionally, the appropriate method for teaching Technical Drawing must be carefully considered, given the current technological advancements where Technical Drawing skills can be executed using Computer-Aided Design (CAD). However, the existence of CAD cannot replace the ability to understand the applicable standards in Technical Drawing, such as line types and thicknesses, specific symbols for technical treatments in drawings, and more. Hence, manual drawing instruction is still relevant and necessary for introducing the prevailing standards in Technical Drawing to prepare graduates for professional careers (Meyers, 2000). Skills in reading and interpreting technical drawings and understanding the underlying engineering technology are crucial (Abdullah *et al*., 2011).

This article describes the community service activity conducted to teach the basics of Technical Drawing manually at a Vocational High School. The training focuses on four essential topics in Technical Drawing standards, namely: (1) line types and thicknesses, (2) dimensioning and scaling, (3) special symbols in welding, special treatments, and fittings, and (4) projections. Based on observations and interviews with the community service partners, the limited number of teachers with technical backgrounds makes it challenging to transfer the required knowledge to students, especially in the field of Technical Drawing. The lack of teachers with expertise in Technical Drawing hinders students from acquiring the necessary skills. Therefore, training sessions that start with the fundamentals and rules of Technical Drawing are necessary to assist schools in addressing these deficiencies. Several issues can be identified, including (1) a shortage of instructors with technical skills in Technical Drawing, (2) a lack of dedicated teaching methods for understanding Technical Drawing, and (3) a shortage of graduates with Technical Drawing abilities, despite high industry demand.

Based on the explanations provided in the background, the general objective of this community service activity is to enhance the knowledge and skills of teachers and students in the fundamentals of Technical Drawing to align with industry standards. By involving teachers and students from the target schools, it is expected to facilitate the maximum transfer of knowledge through a comprehensive approach combining theory and practice in manual Technical Drawing instruction. This approach aims to enable participants to accurately read and comprehend technical drawings in accordance with applicable standards.

Research Method

The community service activity at SMK Muhammadiyah Tirtayasa consists of several stages, as shown in the illustration provided in Figure 1.

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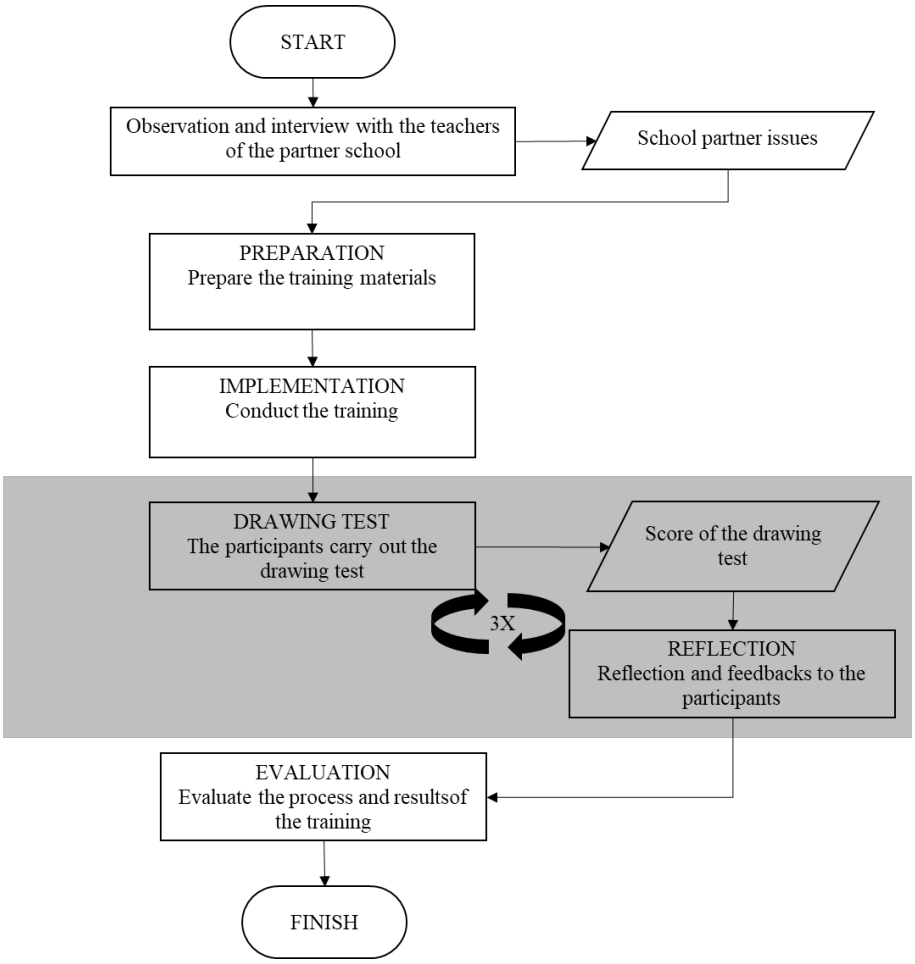

Figure 1. The flowchart of the training

Prior to commencing activities at the partner school, the engagement team conducted direct observations of the school and held interviews with several teachers and the principal to gather information about the curriculum, school facilities, and infrastructure. Additionally, information regarding the career development of graduates from the partner school was obtained to gain insight into the impact of graduates on industry. Through these observations and interviews, the issues faced by the partner school were identified.

Among the various challenges faced by the partner school, the engagement team focused on improving Technical Drawing skills. After coordinating with the partner school for the training plan, the engagement team prepared training materials, including theoretical content on Technical Drawing and the necessary training tools. The Technical Drawing training at the partner school was conducted conventionally, without using the computers, even though Computer-Aided Design (CAD) has become common in the industry. This decision was made considering the importance of firmly establishing a solid foundation of Technical Drawing knowledge, as it is a theoretical subject that needs to be thoroughly understood. Conducting manual exercises is expected to facilitate better retention of the theoretical lessons, using paper and other drawing tools.

The training content focused on four skills: (1) line types and thickness, (2) dimensions and scale of drawings, (3) special symbols for welding, special treatments, and fittings, and (4) projections. The target participants for this activity were both teachers and students. The inclusion of both target participants in the training aimed to enable teachers to transfer their Technical Drawing knowledge and

skills, with the assistance of trained students. This approach was expected to maximize the adoption of Technical Drawing knowledge and skills through intensive guidance.

During the implementation phase, the engagement team's facilitators conducted face-to-face training sessions, covering the fundamentals of Technical Drawing based on industry standards. The facilitators provided examples and demonstrations relevant to each training focus. In this phase, participants underwent three cycles of ability tests, with different sets of questions in each cycle. Initially, participants were given simple objects to draw according to the American projection rules. This activity aimed to familiarize participants with drawing object projections using the specified rules. Throughout the training, the engagement team presented various objects to each participant, expanding their imagination of spatial forms in drawing objects. The engagement team observed, reflected, and evaluated the scores obtained by each participant during these tests, following the principles of Classroom Action Research. The assessment of drawing outcomes was conducted using a 0 to 100 grading scale. Classroom action research-based instruction is a teaching and learning approach that places emphasis on the research process and its outcomes. It recognizes that the research process consists of two interconnected components: the actual research process and the resulting findings. As a result, classroom action research-based instruction involves the utilization of both the research process and its outcomes in the teaching and learning process. This approach entails conducting classroom action research alongside learning management in a systematic manner to foster the development of both teachers and students (Meesuk *et al*., 2020).

Upon completion of the Technical Drawing test, the engagement team proceeded to the next stage, which involved evaluating the participants' achievements and the training process. Based on these evaluations, the team drew conclusions regarding the level of success achieved and identified opportunities for improvement in future training sessions. Subsequently, the completion of the community engagement activity and the production of the activity report marked the end of the entire engagement process.

Results & Discussion

School Partner Issues

SMK Muhammadiyah Tirtayasa is a private vocational school funded by community self-help, particularly by members and sympathizers of Muhammadiyah organization through endowments. Additionally, the school receives support and assistance from the government to enhance its facilities and infrastructure. Since its establishment in 2011, the school has six study groups specializing in Motorcycle Engineering and Business. According to the school authorities, the current challenges faced by the school include a limited number of teachers with technical skills qualifications, particularly in Technical Drawing skills. Although Technical Drawing is included in the school curriculum, the lack of teachers proficient in Technical Drawing skills results in basic instruction, hindering the optimal transfer of knowledge and skills necessary for vocational school graduates to be job-ready in the business and industrial sectors. The second challenge pertains to the incomplete laboratory facilities. The current mechanical lab is a grant from PT Astra Honda Motor, a partner of the school. However, the computer lab still lacks an adequate number of computers and falls short in terms of technical specifications. Some computers are also non-functional as they have exceeded their productive lifespan of five years. Therefore, it can be concluded that there is a need for both fundamental and advanced Technical Drawing skills, including proficiency in computer applications. In this activity, we focus on enhancing fundamental Technical Drawing skills as a foundation and preparation for the development of more advanced drawing abilities.

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Preparation

In the preparation phase, training materials, both directly related to the training content and those associated with the training worksheets, are prepared and reviewed by the service team to ensure a smooth training process without any hindrances. We utilize a checklist to examine the readiness of the required materials and training worksheets that will be used during the training.

Figure 2. The Preparation of The Training Materials

The training materials and equipment requirements consist of training modules and the necessary tools for manual Technical Drawing practice, as indicated in Table 1.

Table 1
Training Materials

No.	Material	Quantity	Unit
1	Paper A4 70 g	1	rim
2	Pencil B2	10	pieces
3	Eraser	10	pieces
4	Ruler	5	pieces
5	Modul	5	pieces

This training was attended by a total of 14 participants, consisting of teachers and students from SMK Muhammadiyah Tirtayasa. The complete profile of the participants in this basic standard Technical Drawing training is presented in Table 2. From the participant profile data, it can be observed that the participation of teachers and students is balanced. However, in terms of gender, there were more female participants (F) than male participants (M). Similarly, among the group of teacher participants, female teachers still dominated with a total of five individuals, while male teachers amounted to two individuals.

Table 2
Participants of The Training

Participant	Gender (M/F)	Description
1	F	Teacher
2	F	Teacher
3	F	Teacher
4	F	Teacher
5	F	Teacher
6	M	Teacher
7	M	Teacher
8	M	Student
9	M	Student
10	F	Student
11	M	Student
12	F	Student
13	F	Student
14	F	Student

Implementation

The basic Technical Drawing training was conducted from June 15th to June 17th, 2022. All participants in the training were given an explanation of the essential theoretical knowledge in Technical Drawing, which includes: (1) types and thickness of lines, (2) dimensions and scale of drawings, (3) special symbols in welding, special treatments, and fittings, (4) projections. These four core topics constitute the fundamental knowledge required in the field of Technical Drawing. During the explanation, participants were given the opportunity to ask questions if any material was unclear. This session ran smoothly and interactively between the presenter and the participants, making the training atmosphere engaging and facilitating the development of training materials.

During the training, the Head of School from SMK Muhammadiyah Tirtayasa was also present at the location to observe the level of interest and attention of the participants. This training program is still rarely offered in certain Community Service activities due to the scarcity of Technical Drawing experts. The same applies to the target school, where Technical Drawing lessons are still relatively new, despite being included in the school curriculum. Considering the enthusiasm of the training participants, both the school principal and teachers from SMK Muhammadiyah Tirtayasa suggested continuing this training program with advanced training sessions that will enhance the students' competence in the field of Technical Drawing.

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Figure 3. The Training Process

Drawing Test

After the basic theory of Technical Drawing was provided, the training continued with a drawing exercise where participants were given objects to draw by the presenter. In this session, several repetitions were conducted to ensure that participants understood the concepts well and were able to read technical drawings correctly. The final stage of this training involved providing questions related to technical drawings, including topics such as projections, the use of lines, and special symbols. At the end of the question practice session, the presenter evaluated the participants' worksheets to measure their level of success in understanding the material. Additionally, the evaluation of these practice questions helped identify the parts of the material that were still challenging for the participants to comprehend.

One interesting aspect of this training was the improvement in participants' ability to imagine the spatial shape of observed objects. The topic of projections is fundamental for participants to understand since it serves as the basis for creating subsequent drawings, whether they are part drawings or assembly drawings. According to Iswanda *et al*. (2020), it can be concluded that there is a significant relationship between Technical Drawing ability and the ability to read technical drawings. Therefore, this training plays a crucial role in helping participants build the foundational skills in Technical Drawing.

Evaluation Phase

In this evaluation phase, the training facilitator assessed the participants' performance and assigned scores. These scores provided an indication of the participants' level of knowledge absorption from the training. The drawn objects from the training session were then evaluated for accuracy and conformity to the original objects, ensuring that participants gained a comprehensive understanding of the actual version of the objects through their drawings. One of the evaluation activities is illustrated in Figure 4.

Figure 4. Evaluation of the training

Overall, all participants in the training demonstrated good drawing results, with an average score of 86.07 out of 100. However, there were some deficiencies or errors in the detailed execution of the exercise questions. The training facilitation team addressed these issues by providing feedback on the mistakes made by the participants. This allowed the participants to review the relevant materials and identify the errors in their exercise answers provided by the facilitators. The evaluation of the participants' drawings was conducted in three separate sessions. The obtained scores are presented in Figure 5 and Figure 6 after completing the exercise questions.

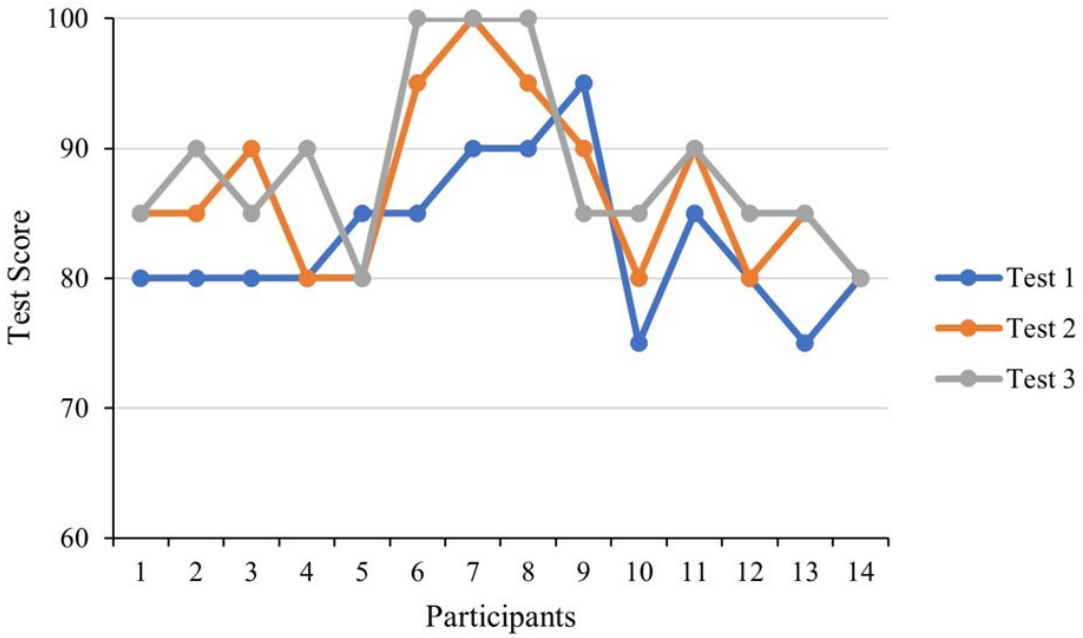

Figure 5. Scores in three test cycles

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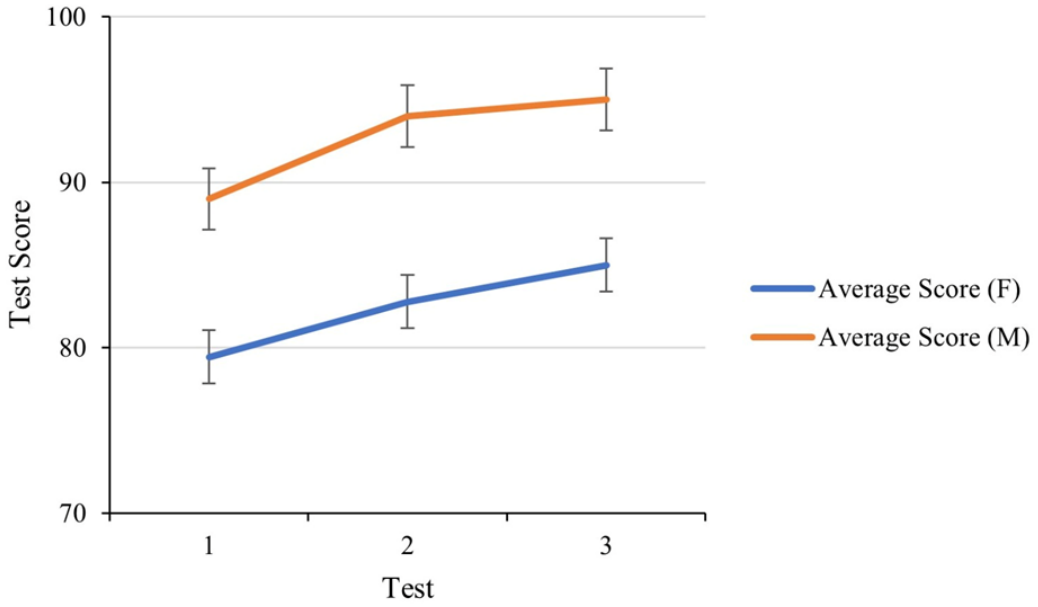

Figure 6. The average score in 3 cycles by sex

Figure 5 illustrates the improvement in scores among all participants who attended the training. Significant score improvements can be observed for participants 6, 7, 8, and 9, reaching their peak scores in the third exercise. Based on the participant profile, it is noted that there are two male teachers and two male students. Participants 1 to 5 are female teachers, while participants 10 to 14 consist of one male student and four female students. Figure 6 presents the score differences between female and male participants. It is also evident from Figure 6 that male participants achieved higher scores compared to female participants. Similar findings were obtained in a study conducted by Metraglia *et al*. (2013), which demonstrated that male participants were able to achieve better Technical Drawing ability scores compared to female participants.

Conclusions

Based on the outcomes of the community engagement activities with SMK Muhammadiyah, the following conclusions can be drawn: (1) The training materials provided were still unfamiliar to both the students and teachers, as there had not been similar skills taught by the teachers before. (2) The participating students were generally able to follow the training and demonstrated good performance based on the evaluation of technical drawing exercises. (3) According to the evaluation results, the students expressed that they gained new knowledge and desired to enhance their skills to achieve an advanced level in Technical Drawing. (4) Regarding the interest in further training to sharpen their skills in Technical Drawing, it is recommended to conduct advanced training activities using computers, as ultimately a drafter is expected to be proficient in using computers as a drawing medium.

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References

Abdullah, Z., Field, B. W., & Burvill, C. R. (2011). Measuring Malaysian undergraduate skills in reading and interpreting engineering drawing. *ICED 11 - 18th International Conference on Engineering Design - Impacting Society Through Engineering Design*, *8*(August), 13–22.

Arifin, A. N., & Ristadi, F. A. (2017). Relevansi Kompetensi Teknik Gambar Manufaktur di SMK Terhadap Kebutuhan Industri. *Jurnal Dinamika Vokasional Teknik Mesin*, *2*(2), 105. https://doi.org/10.21831/dinamika.v2i2.15997

Dewi, A. P., Casban, C., Marfuah, U., & Sunardi, D. (2021). Pelatihan Membaca Gambar Teknik Untuk Tim Sales Dan Produksi Pada PT. ISTW Jakarta. *Jurnal Pengabdian Masyarakat Indonesia*, *1*(5), 249–257. https://doi.org/10.52436/1.jpmi.44

Iswanda, A., Aziz, A., & Sari, D. Y. (2020). Correlatioan Between the Ability To Read Mechanical Engineering Images and the Ability of Machining on Class X Students At Smk Negeri 2 Sawahlunto Study Year 2019/2020. *Jurnal Vokasi Mekanika*, *2*(4), 100–105.

Jobstreet.com. (2022). *Lowongan Drafter*. https://www.jobstreet.co.id/id/job-search/drafter-jobs/

McLaren, S. V. (2008). Exploring perceptions and attitudes towards teaching and learning manual technical drawing in a digital age. *International Journal of Technology and Design Education*, *18*(2), 167–188. https://doi.org/10.1007/s10798-006-9020-2

Meesuk, P., Sramoon, B., & Wongrugsa, A. (2020). Classroom Action Research-based Instruction: The Sustainable Teacher Professional Development Strategy. *Journal of Teacher Education for Sustainability*, *22*(1), 98–110. https://doi.org/10.2478/jtes-2020-0008

Metraglia, R., Baronio, G., Villa, V., & Adamini, R. (2013). Development of a Self-assessment Questionnaire for basic Technical Drawing Skills: A Preliminary Study. *Procedia - Social and Behavioral Sciences*, *106*, 848–859. https://doi.org/10.1016/j.sbspro.2013.12.097

Meyers, F. D. (2000). First Year Engineering Graphics Curricula in Major Engineering Colleges. *Engineering Design Graphics Journal*, *64*(2), 23–28.

Nawangsasi, S. H. (2016). Upaya Meningkatkan Keterampilan Menggambar Teknik Dengan Bantuan Audio Visual Pada Siswa Kelas X Teknik Gambar Bangunan Smk Negeri 2 Probolinggo. *Jurnal Ilmiah Pro Guru*, *2*, 510–518.

Nugroho, B. S., Djunaidi, & Rusilowati, A. (2016). Pengembangan Penilaian Kinerja Menggambar Teknik Potongan Di Smk Pada Kurikulum 2013. *Journal of Educational Research Evaluation*, *5*(1), 01–07.

Pradani, Y. F., Rohman, M., & Saepuddin, A. (2021). *Efektivitas model PjBL STEM dalam meningkatkan keterampilan menggambar teknik mahasiswa The effectiveness of the PjBL STEM model in improving students ' engineering drawing skills*. *9*(2), 101–109.

Puruasdi, R. J. (2016). Relevansi Mata Pelajaran Teknik Gambar Manufaktur di SMK Negeri 2 Pengasih Terhadap Kebutuhan Kompetensi di Industri. *Jurnal Pendidikan Vokasional Teknik Mesin*, *4*(6), 535–540.

Zippia.com. (2019). *Drafter Demographics and Statistics in The US*. https://www.zippia.com/design-drafter-jobs/demographics/

 DOI: https://doi.org/10.29313/ethos.v11i2.10924