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ASSESSING TEACHING FACTORY READINESS IN MECHANICAL ENGINEERING EDUCATION USING GOOGLE FORMS TO IMPROVE 21ST CENTURY SKILLS

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ABSTRACT

Teaching Factory (TEFA) is a production-based learning model that aims to align student skills with industry needs. This study analyzes the readiness and implementation of TEFA in the Mechanical Engineering Education Study Program at Surabaya State University to improve 21st-century skills in the digital era. Using a simple random sampling method with 44 respondents, the data were analyzed using Rasch modeling because of its accurate measurement in identifying the level of response suitability. The results show that the educational aspect of TEFA received a very positive response, reflecting the contribution of this program in supporting the development of 21st-century competencies, including critical thinking, communication, collaboration, creativity, character, and civic engagement. Students are trained to think critically and solve real problems so that they are ready to face industry challenges. However, the marketing aspect needs to be improved so that information about TEFA is better known and this program gets more comprehensive support from the community. With a more effective promotion strategy, opportunities for collaboration with external parties can increase, and more students can be involved, strengthening the collaboration and communication aspects of 21st-century competencies. Overall, TEFA not only helps students master technical skills but also strengthens 21st-century competencies that are relevant and applicable in the professional world.

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I. INTRODUCTION

Teaching Factory (TEFA) is a production and service-based learning model designed for universities, following applicable industry standards and procedures [1]. Its implementation creates a learning atmosphere that resembles actual conditions in the industry, aiming to bridge the competency gap between the knowledge provided on campus and the demands of the industrial world [2]. However, previous research has not adequately addressed the specific challenges faced by students in adapting to these industry standards, particularly in the context of rapidly evolving technologies and market needs. This study aims to fill this gap by providing a comprehensive analysis of TEFA's effectiveness in enhancing student competencies in line with current industrial demands. TEFA not only focuses on theoretical learning but also combines actual practices oriented towards production and business so that students can hone skills through current and future industrial developments [3]. TEFA development begins with existing university production units, where the partner industry system is integrated into the practice [4]. Through the implementation of TEFA, students are invited to master skills by implementing work procedures and standards as in the industry. Products produced during the learning process can even be marketed to the public, and the proceeds from the sales are used to support the operational costs of universities [5].

The purpose of implementing TEFA includes various vital aspects designed to prepare university graduates to become competent professionals and entrepreneurs. TEFA helps students choose a field of work that aligns with their competencies and fosters creativity through a direct learning approach (learning by doing) [6]. Moreover, TEFA plays a significant role in equipping students with practical skills that are much needed in the world of work. This industry-based learning process allows students to prepare themselves optimally as workers while opening

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opportunities to establish relationships with relevant industries. In addition, TEFA provides opportunities for students to practice career-related decision-making skills to make the right choices based on real experiences. Overall, implementing TEFA aims to produce graduates with not only qualified technical expertise but also critical soft skills, such as cooperation, responsibility, work ethic, discipline, and honesty, all crucial qualities in a modern industrial environment [7]–[9]. Furthermore, the implications of this research extend beyond academic settings; it is expected to provide practical insights for universities and industries alike. By enhancing the quality of education through TEFA, universities can better prepare graduates who are not only technically proficient but also possess the soft skills necessary to thrive in the job market. This alignment between educational outcomes and industry needs is crucial for improving the employability of graduates and ensuring that they meet the evolving demands of employers in a competitive landscape.

In the digital era, integrating TEFA with technology is very important [10]. Computer simulations, 3D modeling, and virtual reality technology can enrich students' learning experiences, allowing them to understand technical concepts and manufacturing processes in more depth. The Internet of Things (IoT) application can also be used in TEFA to monitor and optimize production processes in real-time, where data generated by sensors can be analyzed to improve efficiency, quality, and safety [11]. E-learning platforms can expand students' access to learning materials, collaborative projects, and additional resources supporting TEFA learning [12]. The synergy between TEFA and digital technology opens up new opportunities to develop students' skills and prepare them to become adaptive and competitive professionals in the ever-evolving job market. Universities' Mechanical Engineering Education Study Program has adopted the TEFA concept in its learning process. However, the success of TEFA requires a thorough analysis of its readiness and implementation. Therefore, a research entitled "Analysis of the Readiness of the PTM Study Program Teaching Factory to Improve 21st Century Skills in the Digital Era" was prepared to evaluate and improve the effectiveness of TEFA in equipping students with skills that are by the demands of the digital era.

II. METHOD

The sampling method in this questionnaire used a simple random sampling method [13], [14], which was chosen due to its ability to provide each member of the population an equal chance of being selected, thereby minimizing selection bias. This method is particularly advantageous in the context of the Teaching Factory research as it ensures that the sample is representative of the diverse student population, allowing for more generalizable findings compared to other sampling methods such as stratified or convenience sampling. The respondents numbered 44 people of mixed gender (male and female). The instrument uses a google form and likert scale to measure the responses of respondents [15]. Respondents can answer based on the score on the instrument, namely 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree [16]. The success of this Teaching Factory program is measured in 6 aspects, namely marketing, technical and operational, resource management, legal, financial, and education, which are needed to evaluate the implementation of the Teaching Factory program comprehensively.

The marketing aspect measures the effectiveness of promotion in attracting students and the industry. Technical and operational ensure the readiness of facilities and operational efficiency, while resource management assesses the management of teaching staff and mentors so that learning runs optimally [17]. The legal aspect ensures compliance with regulations and safety, finance ensures efficient funding, and education measures the program's impact on improving student competence. All of these aspects support each other for the success and sustainability of the Teaching Factory. The data analysis method in this study uses Rasch modeling [18]. Rasch modeling is used because the calculation results can show the conformity of the actual results according to the response results [19]. This Rasch modeling can also see whether gender affects the response results and whether bias in the questionnaire items can make the questionnaire results invalid. The following are details of the questionnaire items. This model was selected because it provides a robust framework for evaluating the data, allowing for the identification of item bias and ensuring the validity of the questionnaire results. Specifically, Rasch modeling can effectively assess whether gender influences the responses and can highlight any potential biases in the questionnaire items that may compromise the validity of the findings. This is particularly important in the context of Teaching Factory evaluations, where understanding the nuances of student responses is crucial for accurate program assessment.

The following six aspects were chosen as indicators of the program's success: marketing, technical and operational, resource management, legal, financial, and education. This selection is grounded in both theoretical and empirical evidence, as these aspects encompass the critical dimensions necessary for a comprehensive evaluation of the Teaching Factory program. Marketing is essential for attracting students and industry partners, while technical and operational aspects ensure that the program is effectively implemented. Resource management is vital for optimizing the use of teaching staff, and legal compliance safeguards the program's integrity. Financial management is crucial for sustainability, and education impacts the overall effectiveness of the program in enhancing student competencies. Together, these indicators provide a holistic view of the program's success and areas for improvement.

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TABLE I
DETAILS OF THE QUESTIONS IN THE QUESTIONNAIRE INSTRUMENT

No	Aspect	Statement	Code
1	Marketing	The activities produced by this program are relevant to industry needs.	APM1
2		The Teaching Factory program has an effective promotional strategy.	APM2
3		The Teaching Factory program contributes to improving the positive image of the study program.	APM3
4		The Teaching Factory program can attract students and prospective new students.	APM4
5	Technical and Operations	The Teaching Factory program has adequate equipment and technology to support learning.	ATO1
6		The Teaching Factory program runs smoothly without significant technical constraints.	ATO2
7		This program implements efficient operating procedures in every stage.	ATO3
8		The quality of work results in this program is in accordance with industry standards.	ATO4
9	Resource Management	The management of human resources in this program has been running well.	AMS1
10		The Teaching Factory program has sufficient competent educators and mentors.	AMS2
11		This program provides training opportunities for educators to improve their skills.	AMS3
12		Time management and scheduling of activities in this program are carried out effectively.	AMS4
13	Legal	The Teaching Factory program has met all applicable regulations and legal standards.	AH1
14		This program pays attention to occupational health and safety (K3) rights and safety.	AH2
15		There are clear contracts and agreements with the industry partners involved.	AH3
16		The Teaching Factory program consistently protects the intellectual property rights of each party involved.	AH4
17	Finance	The Teaching Factory program has sufficient funding for its sustainability.	AK1
18		The use of the budget in this program is carried out efficiently.	AK2
19		This program provides significant financial contribution to the study program.	AK3
20		The Teaching Factory program has transparent and accountable financial reports.	AK4
21	Education	The Teaching Factory program is able to improve students' technical competence.	AP1
22		This program helps students to understand real practices in the industry.	AP2
23		The Teaching Factory program helps students develop critical thinking and problem-solving skills.	AP3
24		This program provides relevant and useful learning experiences for students.	AP4

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III. RESULT AND DISCUSSION

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Person
12	113	24	3.28	.47	1.05	.28	1.09	.43	.59	.45	75.0	74.9	R12L
41	112	24	3.07	.45	.97	-.06	.95	-.16	.63	.44	70.8	70.8	R41L
14	111	24	2.88	.43	.95	-.23	.94	-.27	.34	.43	66.7	66.7	R14L
16	111	24	2.88	.43	.99	.02	.98	-.06	.30	.43	66.7	66.7	R16L
26	111	24	2.88	.43	1.55	2.77	1.58	2.72	-.27	.43	58.3	66.7	R26L
28	111	24	2.88	.43	.93	-.37	.91	-.44	.64	.43	66.7	66.7	R28L
35	111	24	2.88	.43	1.02	.15	1.01	.12	.57	.43	66.7	66.7	R35L
18	110	24	2.69	.42	.96	-.25	.94	-.31	.31	.42	62.5	62.5	R18L
22	110	24	2.69	.42	.86	-.94	.84	-1.01	.67	.42	70.8	62.5	R22L
42	110	24	2.69	.42	1.03	.27	1.04	.31	.53	.42	54.2	62.5	R42L
9	109	24	2.52	.41	.89	-.81	.89	-.78	.35	.42	62.5	59.2	R09L
21	109	24	2.52	.41	.98	-.15	.96	-.23	.28	.42	45.8	59.2	R21L
24	109	24	2.52	.41	.98	-.15	.96	-.24	.28	.42	45.8	59.2	R24L
37	109	24	2.52	.41	.93	-.48	.92	-.53	.60	.42	70.8	59.2	R37L
3	108	24	2.35	.41	.91	-.73	.90	-.76	.60	.42	62.5	57.0	R03L
13	108	24	2.35	.41	1.28	2.13	1.27	2.03	-.09	.42	66.7	57.0	R13L
19	108	24	2.35	.41	.96	-.33	.95	-.33	.56	.42	54.2	57.0	R19L
27	108	24	2.35	.41	1.02	.19	1.03	.30	.21	.42	54.2	57.0	R27L
29	108	24	2.35	.41	1.39	2.89	1.38	2.76	-.19	.42	41.7	57.0	R29L
8	107	24	2.18	.41	1.02	.18	1.03	.27	.49	.42	62.5	55.7	R08P
10	107	24	2.18	.41	1.33	2.51	1.33	2.50	-.16	.42	50.0	55.7	R10L
11	107	24	2.18	.41	1.03	.30	1.03	.30	.18	.42	54.2	55.7	R11L
15	107	24	2.18	.41	.95	-.41	.94	-.44	.55	.42	54.2	55.7	R15L
20	107	24	2.18	.41	.96	-.28	.96	-.31	.54	.42	54.2	55.7	R20L
30	107	24	2.18	.41	1.01	.12	1.02	.18	.50	.42	54.2	55.7	R30L
33	107	24	2.18	.41	1.10	.80	1.11	.88	.43	.42	45.8	55.7	R33L
4	106	24	2.02	.41	.92	-.61	.91	-.62	.56	.42	62.5	56.4	R04P
6	106	24	2.02	.41	.96	-.28	.95	-.30	.52	.42	45.8	56.4	R06L
25	106	24	2.02	.41	.85	-1.13	.85	-1.15	.61	.42	70.8	56.4	R25L
36	106	24	2.02	.41	.98	-.09	.98	-.07	.50	.42	54.2	56.4	R36P
38	106	24	2.02	.41	.93	-.54	.92	-.56	.55	.42	62.5	56.4	R38L
43	106	24	2.02	.41	.96	-.28	.96	-.24	.23	.42	62.5	56.4	R43L
44	106	24	2.02	.41	.99	-.02	.99	-.01	.50	.42	54.2	56.4	R44P
31	105	24	1.85	.41	.87	-.89	.87	-.89	.58	.42	66.7	58.5	R31P
32	105	24	1.85	.41	1.21	1.41	1.25	1.63	-.11	.42	70.8	58.5	R32L
1	104	24	1.69	.41	.79	-1.31	.77	-1.37	.63	.42	70.8	61.6	R01P
5	104	24	1.69	.41	.89	-.59	.89	-.59	.54	.42	70.8	61.6	R05L
17	104	24	1.69	.41	1.00	.05	1.01	.11	.45	.42	62.5	61.6	R17P
23	104	24	1.69	.41	.86	-.78	.86	-.81	.57	.42	70.8	61.6	R23L
34	104	24	1.69	.41	.98	-.07	.98	-.06	.47	.42	54.2	61.6	R34L
39	104	24	1.69	.41	.91	-.48	.91	-.49	.53	.42	62.5	61.6	R39L
40	104	24	1.69	.41	1.02	.17	1.02	.15	.44	.42	54.2	61.6	R40P
2	103	24	1.52	.42	.83	-.86	.80	-.97	.58	.42	62.5	64.9	R02L
7	103	24	1.52	.42	.97	-.08	.97	-.11	.46	.42	62.5	64.9	R07L
MEAN	107.3	24.0	2.24	.42	1.00	.02	1.00	.01			60.4	60.3	
P.SD	2.6	.0	.44	.01	.15	.95	.15	.95			8.4	4.6	

Fig. 1. Person statistics measure order

Figure 1 shows the results of the Person Statistics Measure Order table, which describes the respondents' ability to agree with implementing the teaching factory program in Mechanical Engineering Education based on the JMLE logit measure. From this analysis, it can be seen that respondent number 12 showed the highest agreement with the program. In contrast, respondent number 7 had the lowest logit value, reflecting a lower level of agreement. All 44 respondents had positive JMLE logit values, indicating that, in general, the respondents agreed with the questions in the questionnaire.

Thirty-three respondents achieved a JMLE logit value of +2.00, which is classified as an extreme value. This indicates that the 33 respondents strongly agreed with all the questions in the questionnaire compared to the other 11 respondents. When these results were analyzed further, it was found that respondents with high JMLE logit values were predominantly male. In contrast, respondents with lower logit values comprised a mixed gender group, namely male and female.

This difference may be related to several factors. One of them is the difference in perception of the teaching factory program in Mechanical Engineering, which is generally considered relevant to technical and practical skills. Male respondents may feel more familiar with or have a higher interest in the program because the field of Mechanical Engineering is often dominated by men, allowing them to understand better the direct benefits of implementing the program. On the other hand, female respondents or mixed-gender groups may have different experiences and perspectives. Hence, the program's approval level is not as strong as that of male respondents.

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	JMLE MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	Item
2	151	44	4.90	.31	1.87	6.62	1.83	6.15	.24	.22	61.4	60.8	APM2
7	193	44	.31	.31	.83	-1.34	.82	-1.38	.43	.22	68.2	61.8	ATO3
9	193	44	.31	.31	.98	-.10	.98	-.10	.09	.22	59.1	61.8	AMS1
4	195	44	.13	.30	.91	-.77	.91	-.79	.29	.22	61.4	59.9	APM4
14	195	44	.13	.30	.89	-.94	.89	-.92	.33	.22	65.9	59.9	AH2
20	195	44	.13	.30	.93	-.56	.93	-.56	.24	.22	56.8	59.9	AK4
1	197	44	-.05	.30	.93	-.65	.93	-.62	.27	.22	63.6	58.8	APM1
12	197	44	-.05	.30	.92	-.74	.92	-.77	.30	.22	59.1	58.8	AMS4
8	198	44	-.14	.30	.99	-.06	1.00	.03	.15	.22	56.8	58.5	ATO4
13	198	44	-.14	.30	.98	-.13	.98	-.13	.17	.22	52.3	58.5	AH1
17	198	44	-.14	.30	.88	-1.17	.88	-1.16	.39	.22	61.4	58.5	AK1
18	198	44	-.14	.30	.96	-.37	.95	-.42	.22	.22	52.3	58.5	AK2
24	198	44	-.14	.30	.94	-.61	.93	-.64	.28	.22	65.9	58.5	AP4
3	199	44	-.24	.30	.98	-.16	1.00	.00	.17	.22	61.4	58.7	APM3
21	199	44	-.24	.30	1.04	.46	1.05	.53	.04	.22	61.4	58.7	AP1
5	200	44	-.33	.31	.91	-.90	.91	-.89	.35	.21	63.6	59.1	ATO1
11	200	44	-.33	.31	.96	-.40	.95	-.45	.25	.21	63.6	59.1	AMS3
22	200	44	-.33	.31	1.04	.43	1.05	.48	.05	.21	54.5	59.1	AP2
6	201	44	-.42	.31	1.06	.60	1.08	.75	.01	.21	63.6	60.1	ATO2
19	201	44	-.42	.31	.98	-.13	.99	-.08	.19	.21	59.1	60.1	AK3
10	202	44	-.52	.31	.97	-.23	.98	-.15	.22	.21	56.8	61.2	AMS2
16	202	44	-.52	.31	1.08	.72	1.08	.67	-.01	.21	47.7	61.2	AH4
15	204	44	-.71	.32	1.02	.17	1.03	.29	.12	.20	63.6	64.1	AH3
23	207	44	-1.03	.33	.92	-.51	.88	-.63	.36	.19	70.5	70.5	AP3
MEAN	196.7	44.0	.00	.31	1.00	-.03	1.00	-.03			60.4	60.3	
P.SD	10.1	.0	1.07	.01	.19	1.48	.19	1.41			5.2	2.5	

Fig. 2. Item statistics measure order

The number of JMLE measure logits needs to be considered in the order of the item statistics measure. It was found that the APM2 item showed an extreme logit value of 4.90. This indicates that the item that is difficult to agree with on average in the questionnaires is the APM2 item. On the other hand, the most agreed upon by the questionnaires is the AP3 item with a logit of -1.03.

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MEASURE                            Person - MAP - Item
                                       <more>|<rare>
    5                                        +  APM2
                                             |
                                             |
                                             |
                                             |
    4                                        +
                                             |
                                             |
                                             |
                                        R12 T|
    3                                   R41  +
                        R14 R16 R26 R28 R35  |
                R09 R18 R21 R22 R24 R37 R42 S|
                        R03 R13 R19 R27 R29  |
                R08 R10 R11 R15 R20 R30 R33 M|T
    2           R04 R06 R25 R36 R38 R43 R44  +
                                    R31 R32 S|
        R01 R02 R05 R07 R17 R23 R34 R39 R40  |
                                            T|
                                             |
    1                                        +S
                                             |
                                             |
                                             |  AMS1  ATO3
                                             |  AH2   AK4   APM4
    0                                        +M AMS4  APM1
                                             |  AH1   AK1   AK2   AP1   AP4   APM3  ATO4
                                             |  AK3   AMS3  AP2   ATO1  ATO2
                                             |  AH4   AMS2
                                             |  AH3
   -1                                        +S AP3
                                       <less>|<freq>
```

Fig. 3. Variable wright maps

Figure 3 shows that as many as eight items in the questionnaire have positive logit values, indicating that these items tend to be difficult for respondents to agree with. These items include APM2, AMS1, ATO3, AH2, AK4, APM4, AMS4, and APM1, with the marketing aspect as the most dominant category. Based on the answers to the APM2 item, the average respondent gave a neutral answer, indicating that they may not have fully understood the promotional information the teaching factory management carried out. This shows that promotional activities from the teaching factory still need to be improved to reach a wider community. More effective marketing strategies, such as social media or direct promotional activities, can help increase understanding and attract more interest [20]. By expanding the marketing reach, the teaching factory can gain more significant support and maximize involvement from various groups. On the other hand, 16 items have negative logit values, indicating that respondents highly agree. The most dominant aspect in this category is education. Based on these results, it can be concluded that this teaching factory program has excellent strength in supporting learning. This is also reflected in the Wright Maps, where the AP3 item is at the bottom, indicating that the respondents highly agree.

Respondents expressed that the teaching factory program helped them develop critical thinking and problem-solving skills, core components of 21st-century learning or the 6C concept. Through critical thinking skills, students are encouraged to analyze various technical and strategic problems in the industrial world in depth [9], [21]. They learn to consider multiple perspectives before concluding, convey information carefully, and make decisions based on data and comprehensive analysis. This program provides students with direct experience in facing real challenges, so their critical thinking skills are honed with relevant situations in the industry. Problem solving, as an element that accompanies critical thinking, is also an essential skill that is strengthened in this program. Students imagine practical scenarios that require them to find innovative, effective, and efficient solutions [9], [21]. Involvement in the teaching factory allows them to develop a solution-oriented thinking pattern, where they not only identify the root of the problem but also explore and apply appropriate solutions in natural conditions. These skills give them the confidence to handle complex problems requiring technical understanding and analytical insight.

Through this approach, the teaching factory program acts as a place for practice and a space to hone two critical skills in the modern professional world. Students become better prepared to face various challenges in the world of work with strong analytical and solution-oriented skills, which support them in contributing effectively and sustainably in multiple fields. Similar research was also conducted by Bisma Putera et al., which showed that the teaching factory program was successfully implemented with a good predicate. The study results revealed that this program successfully produced students who were ready and in accordance with industry needs. However, one of the suggested improvements is in the promotion or marketing aspect, which needs to be improved to attract more parties and support the creation of quality vocational education. Improvements in this promotional strategy will allow the teaching factory program to be better known by the community and industry and expand its impact in producing competent and ready-to-use workers [22]. Other studies have also shown that the teaching factory program has effectively addressed the gap between the competencies produced by Vocational High Schools and the competencies needed by the industrial world [21]. Using a structured and focused learning model, the teaching factory provides students with an in-depth and relevant learning experience. This approach allows students to develop skills and knowledge that align with the industry's demands and needs so that they are ready to enter the workforce with the right competencies. The success of the teaching factory, in this case, shows the importance of close collaboration between the world of education and the world of industry in creating graduates with the qualities and skills needed in the world of work.

Another study measured the effect of practical and practical learning outcomes through a work-based learning (WBL) approach combined with a teaching factory (TEFA). The results showed that using the WBL-TEFA learning model was proven to significantly improve students' academic achievement, especially in automotive engineering learning. WBL-TEFA learning was considered very practical, reflected in the practicality assessment results, with an average lecturer response of 90.17% and a student response of 90.21%, both of which were in the Very Practical category. This confirms that the combination of work-based learning and teaching factory provides an applicable and practical learning experience, improving theoretical understanding and students' practical skills according to industry demands [23].

Person CLASSES	SUMMARY DIF CHI-SQUARED	D.F.	PROB.	BETWEEN-CLASS/GROUP UNWTD MNSQ	ZSTD	Item Number	Name
2	.4327	1	.5107	.4756	.01	1	APM1
2	2.4383	1	.1184	5.0718	1.99	2	APM2
2	2.8888	1	.0892	3.7249	1.64	3	APM3
2	1.6213	1	.2029	1.9108	.98	4	APM4
2	.2568	1	.6123	.2778	-.27	5	ATO1
2	2.1328	1	.1442	2.7281	1.31	6	ATO2
2	.0951	1	.7577	.1019	-.66	7	ATO3
2	.0513	1	.8207	.0549	-.84	8	ATO4
2	1.3988	1	.2369	1.6578	.86	9	AMS1
2	.4766	1	.4899	.5272	.06	10	AMS2
2	.2568	1	.6123	.2778	-.27	11	AMS3
2	1.7629	1	.1843	2.1589	1.09	12	AMS4
2	3.1458	1	.0761	4.3961	1.83	13	AH1
2	.3233	1	.5696	.3520	-.15	14	AH2
2	.1646	1	.6849	.1774	-.46	15	AH3
2	1.8203	1	.1773	2.2658	1.14	16	AH4
2	.9024	1	.3421	1.0219	.49	17	AK1
2	1.4576	1	.2273	1.7420	.90	18	AK2
2	3.6522	1	.0560	4.9755	1.97	19	AK3
2	.0359	1	.8497	.0385	-.93	20	AK4
2	.1456	1	.7028	.1570	-.51	21	AP1
2	.9161	1	.3385	1.0475	.50	22	AP2
2	2.3395	1	.1261	2.9348	1.39	23	AP3
2	.0513	1	.8207	.0549	-.84	24	AP4

Fig. 4. Differential item functioning class

Figure 4 shows the effect of gender on items in the questionnaire shown in the probability value (Prob.). Items are said to be not influenced by gender if the probability value is <0.05 (5%). Based on the result,s in Figure 4, it can be concluded,d that 24 items have a probability value of <0.05, which means that 24 items in the questionnaire are not influenced by gender (male and female).

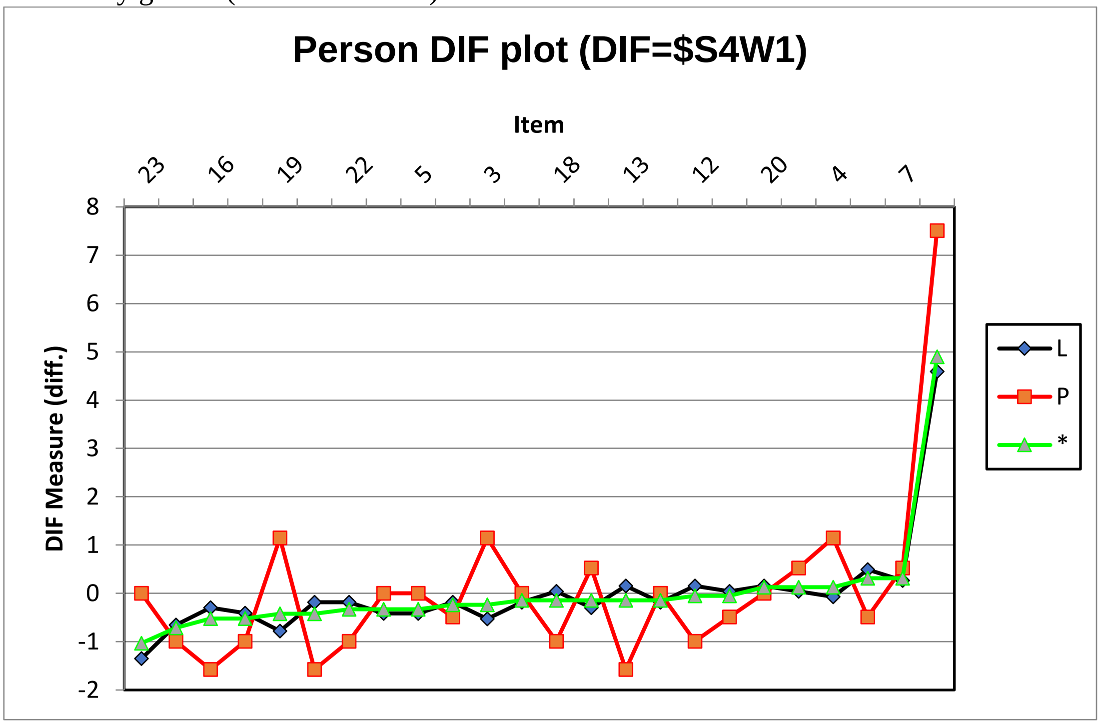

Fig. 5. Person differential item functioning plot graph

Figure 5 is a graph of a person's differential item functioning plot, where the plot line for men and women is still within the ideal line, like the green line (*). Items 3, 13, and 19 show a slightly extreme line for women because the probability value is close to 0.05, but the results show that the value is still within the criteria and is still ideal. This indicates that gender does not affect the results of the questionnaire.

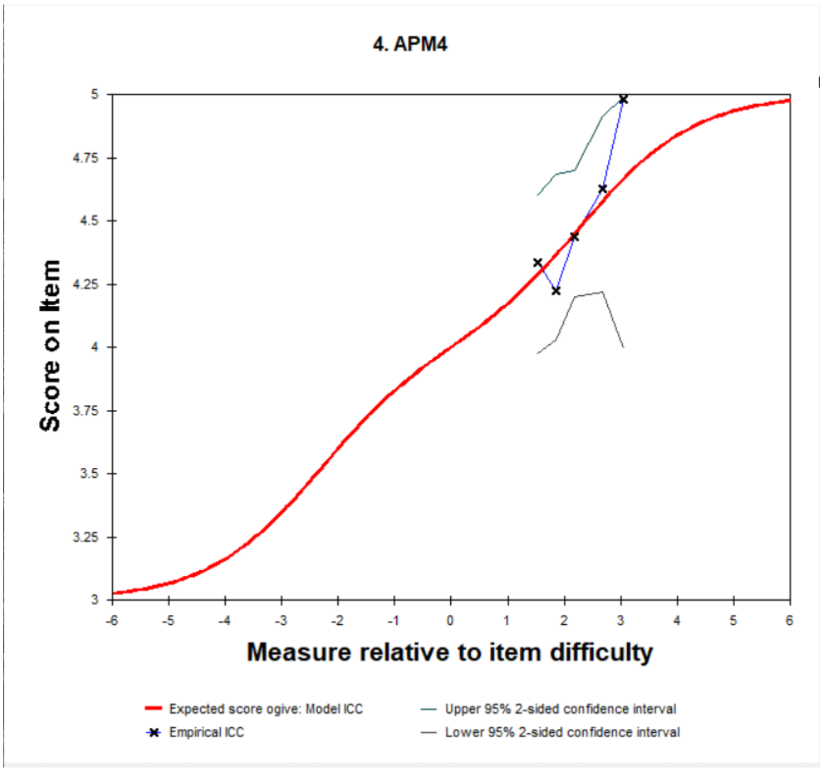

Fig. 6. Graphic display by item DIF with ICCs

Figure 6 shows a graph of item and response inconsistencies, showing that the APM4 item shows an inappropriate response compared to other items. The graph shows that the experimental line shows extreme changes outside the model line, but these results show that it is still ideal and appropriate. However, according to the results of this measurement, the APM4 item needs to be examined again.

IV. CONCLUSION

Based on the results of the responses and statistical testing using Rasch modeling, the teaching factory program at the Mechanical Engineering Education Study Program at Surabaya State University showed a very positive response in the educational aspect. This reflects that the program has succeeded in making a significant contribution to supporting the development of 21st-century skills in students, especially within the framework of 6C: Critical Thinking, Communication, Collaboration, Creativity, Character, and Citizenship. Students gain practical experience that trains them to think critically and solve real problems, which are essential in preparing them for challenges in the industrial world. However, the results also indicate the need for improvement in the promotional aspect so that information about this teaching factory can be more widely disseminated. With a better promotional strategy, the wider community can be more familiar with the existence of this program, supporting Citizenship or active community involvement in the field of education. Effective promotion also opens up opportunities for collaboration with external parties and allows more students to participate so that the Collaboration and Communication aspects in 6C can be adequately facilitated. Thus, the teaching factory program not only helps students master technical skills but also strengthens 21st-century competencies that are relevant, useful, and applicable in their professional lives.

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