

Relevance/Importance of Artificial Intelligence in Teaching Vocational Education and Training Case study at Ethiopia Federal TVET Institute

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Abstract: Vocational education and training (VET) play a crucial role in equipping individuals with the skills and knowledge necessary for gainful employment and economic development. However, traditional teaching methods in VET institutions often face challenges in delivering personalized and adaptive learning experiences to a diverse student population. This is where AI can significantly contribute by enhancing teaching methodologies and improving student outcomes. The case study conducted at the Ethiopia Federal TVET Institute demonstrates the relevance of AI in teaching VET. By leveraging AI technologies such as machine learning and natural language processing, the institute implemented innovative solutions to address the unique needs of its students. The study examined the relevance of AI in the key areas: curriculum development, personalized learning, adaptive assessment, practical application, and teacher training and professional development. Therefore, the study states that the relevance of AI to enhanced curriculum development ensures that the content and structure of vocational courses align with industry demands and job market trends. This ensures that students receive relevant and up-to-date training, increasing their employability. And also, AI facilitates personalized learning experiences by tailoring educational content to the individual needs and learning styles of students. The respondent to the study states especially for teacher training and professional development and also assesses the study of whether teachers possess the necessary skills and knowledge to effectively teach AI concepts and applications to students. This reduces the burden on teachers and allows them to focus on providing targeted support to students who require additional assistance

. Keywords: - Artificial intelligence, Vocational education, and training (VET), Teaching methods

1. INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative technology with the potential to revolutionize various industries, including education. In particular, AI holds significant relevance and importance in the field of vocational education and training (VET). VET plays a critical role in equipping individuals with the practical skills and knowledge required for specific careers. By leveraging AI, educators can enhance the effectiveness, efficiency, and accessibility of vocational education, ultimately preparing individuals for the demands of the modern workforce (1). This research work explores the relevance and importance of AI in teaching vocational education and training, with a focus on the case study of Ethiopia Federal TVET Institute.

As a rapidly developing country, Ethiopia recognizes the crucial role of vocational education and training in its socio-economic development. The Ethiopia Federal TVET Institute is a key institution providing vocational education across various disciplines. However, the institute faces challenges such as limited resources, outdated teaching methods, and the need to align vocational programs with the changing needs of industries (3). In this context, AI offers significant potential to overcome these challenges and improve the quality and effectiveness of vocational education.

One of the primary advantages of AI in teaching vocational education at the Ethiopia Federal TVET Institute is its ability to personalize the learning experience for students. AI-powered systems can analyze vast amounts of data, including student performance, preferences, and learning patterns. By understanding each student's unique needs (3), AI can tailor the content, pace, and difficulty level to their individual requirements. This personalization ensures that students receive targeted instruction and support, enabling them to acquire the necessary skills efficiently (5).

Furthermore, AI can play a crucial role in providing real-time feedback and assessment in vocational education. Traditional assessment methods in practical fields can be subjective and time-consuming (8). AI tools, such as computer vision and natural language processing, can analyze student work in real time, providing immediate and objective feedback (10). This allows instructors at the Ethiopia Federal TVET Institute to evaluate student performance accurately and identify areas for improvement. Students can receive timely feedback, make necessary adjustments, and enhance their learning outcomes.

Another significant application of AI in vocational education is bridging the gap between theoretical knowledge and practical application. Hands-on experience is vital in vocational fields, and AI can facilitate this integration by providing virtual simulations and immersive experiences. For instance, virtual reality (VR) and augmented reality (AR) technologies can create realistic training environments, allowing students to practice skills in a safe and controlled setting (7). The Ethiopia Federal TVET Institute can leverage AI-powered simulations to enhance the practical training experience and prepare students for real-world work scenarios.

Additionally, AI can enhance the accessibility and inclusivity of vocational education at the Ethiopia Federal TVET Institute. Some students may face barriers to accessing traditional VET programs, such as geographical limitations, financial constraints, or physical disabilities (4). AI-powered platforms can deliver vocational education remotely, breaking down these barriers. Through online platforms and virtual classrooms, students can access high-quality vocational training regardless of their location. AI can also provide adaptive interfaces and assistive technologies to accommodate students with disabilities, ensuring equal opportunities for all learners (12).

Furthermore, AI can contribute to the overall improvement of VET systems at the Ethiopia Federal TVET Institute. AI can analyze large-scale data sets to identify emerging labor market trends, industry needs, and skill gaps. This data-driven approach enables educators to align vocational programs with the evolving demands of the job market, ensuring that students acquire the skills that are in demand. The institute can provide accurate and up-to-date information about job prospects, required skills, and potential career pathways by integrating AI into career counseling and guidance. This empowers students to make informed decisions about their vocational choices and enhances their transition from education to employment (11).

AI significantly transforms and enhances vocational education and training (VET) by providing numerous benefits and improving the overall learning experience. Here are some key points highlighting and analyzing the relevance and importance of AI in teaching vocational education and training focus in the case of Ethiopia's federal TVET institute.

2. OVERVIEW OF THE ETHIOPIA FEDERAL TVET INSTITUTE

The Ethiopia Federal Technical and Vocational Education and Training (TVET) Institute is a key institution in Ethiopia's educational landscape. It plays a vital role in providing vocational education and training to equip individuals with the practical

skills and knowledge required for various careers. The institute focuses on bridging the gap between education and industry needs, contributing to the country's socio-economic development (4).

Established under the Ministry of Science and Higher Education, the Ethiopia Federal TVET Institute aims to meet the growing demand for a skilled workforce in Ethiopia. The institute offers a wide range of vocational programs across diverse fields, including engineering, agriculture, health sciences, business, information technology, and construction, among others. Its comprehensive curriculum is designed to provide students with both theoretical knowledge and practical skills necessary for the job market (4).

The Ethiopia Federal TVET Institute operates under the framework of the Ethiopian TVET strategy, which emphasizes the importance of vocational education in building a skilled workforce and driving economic growth (4). The strategy aims to enhance the quality and relevance of vocational education by promoting industry collaboration, providing professional development opportunities for instructors, and incorporating emerging technologies into teaching and learning.

The institute's programs are structured to cater to the needs of different learners. It offers both full-time and part-time courses, allowing individuals to pursue vocational education while accommodating other responsibilities. The duration of programs varies depending on the field of study, ranging from short-term certificate courses to diploma and degree programs. This flexibility enables students to choose programs that align with their career goals and time constraints.

To ensure the quality of education, the Ethiopia Federal TVET Institute employs qualified instructors who possess both academic qualifications and industry experience. The institute emphasizes practical training through the use of well-equipped workshops, laboratories, and simulation facilities. By providing hands-on experiences, students develop the necessary skills and competencies required in their respective fields.

Furthermore, the institute recognizes the importance of industry partnerships in delivering relevant vocational education. It actively collaborates with various sectors, including businesses, industries, and government agencies, to align its programs with industry needs. These partnerships provide opportunities for students to engage in practical internships, on-the-job training, and apprenticeships, enabling them to gain real-world experience and develop industry connections.

In recent years, the Ethiopia Federal TVET Institute has embraced emerging technologies to enhance the teaching and learning experience. The institute recognizes the potential of digitalization and the integration of technology in vocational education. It has incorporated computer-based learning, e-learning platforms, and interactive multimedia resources into its programs (5). These technological advancements enable students to access educational materials, engage in interactive learning activities, and collaborate with peers and instructors remotely.

The Ethiopia Federal TVET Institute also places significant emphasis on continuous improvement and quality assurance. It regularly reviews and updates its curriculum to align with industry standards and emerging trends. The institute conducts assessments and evaluations to monitor the effectiveness of its programs and identify areas for enhancement. This commitment to quality assurance ensures that students receive a high standard of vocational education that meets industry demands (5).

Moreover, the Ethiopia Federal TVET Institute plays a crucial role in promoting inclusivity and gender equality in vocational education. It strives to create an environment that supports the participation of individuals from diverse backgrounds and marginalized communities. The institute offers scholarships, grants, and financial aid to students in need, enabling them to access vocational education and training opportunities.

3. RESEARCH OBJECTIVE AND RESEARCH DESIGN

3.1. Research Objective

- To examine the relevance of AI integration in vocational education and training at the Ethiopia Federal TVET Institute.
- To assess teachers' and students' perceptions and attitudes toward the relevance and importance of AI in vocational education and training.

3.2. Research Design

The research design used in this study was descriptive research design. descriptive research, specifically a Quantitative method approach in carrying out the investigation. Through descriptive research survey design, the research examined 4 Colleges/ faculty under Ethiopia's Federal TVET institute to conduct the assessment on the relevance of AI in teaching vocational education

and training. This design was selected since it enables the research to describe and explain the relevance of AI and its impact extent of on vocational education in terms of quantitative analysis.

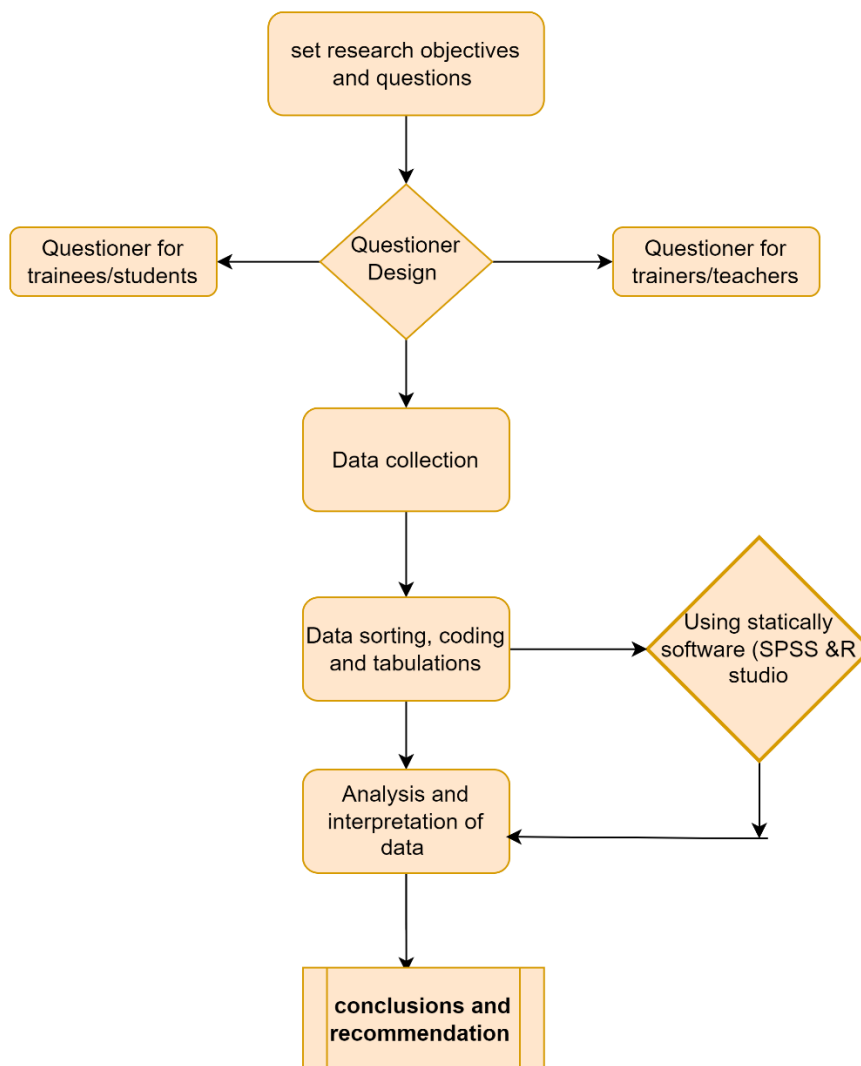


Figure 1. Technical route of the research

3.3. The study population, sampling techniques, and sample size

Two different populations (students and trainers or teachers, of Ethiopia Federal TVET institutions) will be considered as potential sources of the data needed in this survey. Hence, the first population of the study comprises all students of the Ethiopian Federal TVET institution (i.e., considers all the students’ undergraduates and masters students in all faculty/ college). The second population consists of all Trainers or teachers of the respective departments of the institutions. In this survey study, the size of the population is **5528** for both students and teachers, for this research sample size determination 95% confidence interval was used, so now the sample size is calculated by the formula.

$$n = \frac{N}{1 + Ne^2} \quad \text{where } n = \text{sample size} \quad N = \text{population}$$

e=level of precision or confidence level (for this research work 95% level of precision is considered as input)

Table 1: Summary of population and sample size and sampling technique of the respondents.

No.	Respondent	Population	Sample size	Sampling technique
1	Trainers (teachers)	128	97 (75%)	Simple Random
2	Students	5120	371 (7.24%)	Simple Radom
Total		5528	468	

4. RESULT AND DISCUSSION

Results and discussion deal with the presentation, analysis, and interpretation of the data. The study groups were current students/trainees and teachers/trainers of Ethiopia’s Federal TVET institute. Thus, the data from the students and teachers of the institute were secured through questionnaires, Furthermore, observation and document analysis were conducted to gather additional information.

A total of 468 copies of questionnaires were distributed to 84 teachers and 347 students. Out of those questionnaires distributed, 71 (84.5 %) teachers, and 315 (90.7 %) students filled correctly and returned them. Thus, the total return rate of the questionnaires was 82.5% of the sample population the remaining 17.5% of the questionnaire was rejected.

The analysis of quantitative data was computed by SPSS statistical software. The percentage was widely used for analysis. The data gathered through observation, and document analysis were analyzed qualitatively to substantiate the quantitative data. The analyzed data were compiled and organized to suit the interpretation of the results in addressing the objective of the assessment.

In this way to assess the extent of relevance of artificial intelligence in teaching vocational education in the case of the Ethiopian federal TVET institute set to assess the relevance of AI on Personal Learning, Teacher Training, and Professional Development, Adaptive Assessments Practical Application, Enhanced Curriculum Development, and virtual simulation and training, therefore, the descriptive analysis where done based on those variables. And also constructed a data sheet categorizing the variable of the study in thematic groups which in detail deal with the responses of participants on the relevance of AI on technical vocational education and training for use in the case of the Ethiopian Federal TVET institute.

4.1. Demography information of the respondents

Understanding the overview of the respondents’ characteristics was important for further analysis of their responses. Hence, attempts were made to describe the respondents' background which directly or indirectly related to the study's objectives. Accordingly, the teachers’ and students’ demographic characteristics, sex, age, educational level, the field of study (faculty), were separately treated.

Table 2. Demography information of the respondents

Item	labels	Response			
		Teacher N=71		Student N=315	
		No.	%	No	%
Age of respondents	18-25	6	8.45	160	50.8
	26-35	32	45.1	146	46.3
	36-45	26	36.62	8	2.5
	>46	7	9.86	1	0.3
Gender of respondent	Male	54	76	210	66.67
	Female	17	24	105	33.43
Educational level	MSc	46	64.8	34	10.8
	BSc	11	15.5	281	89.2
	PhD	14	19.7	00	00

Colleges /faculty	Textile and Apparel Fashion Technology	21	29.6	101	32.06
	Manufacturing Technology	21	29.6	82	26.03
	Civil Technology	16	22.5	85	26.98
	Electrical /Electronics and ICT	13	18.3	47	14.92

As Table.2. indicates the distribution proportion of respondent students among the faculty was, 101 (32.06%), 82 (26.03%), 85 (26.98 %), and 47 (14.92%) from Textile and Apparel Fashion Technology, Manufacturing Technology, Civil Technology, and Electrical /Electronics and ICT respectively.

The Gender proportion of the respondent in the above Table 2. also shows that 17 females, 54 males, 105 females, and 210 males have data for Students and Teachers respectively. Those imply have different proportions to each other and this seems low participation of females in hard skill vocational education and training in the Ethiopian Federal TVET Institute and it gives the information of low enrollment of females. Age-wise the Table shows that the majority of respondents of students are under the age group of 19 – 24 and 26- 35 which is 160 (50.8 %), and 146 (46.3%) respectively, and the teachers are under the age group of 26- 35 and 36-45 which is also 45.1% and 36.62 respectively. This depicts that they were young and easily familiar with new teaching technology especially related to AI. Further, the above Table 2 shows that the respondent educational level for students is 281 (89.2%) bachelor’s and 34 (10.8 %) master but for teachers, it includes 11 (15.5%) bachelor’s, 46 (64.8%) master, and 14 (19.7%) Ph.D. the data result of the respondent indicate that most of the students are under age 18-25 and 26-35 but the teachers are in the age range 26-35 and 36-45, therefore they are young and active to familiarize with AI technology to improve their educational careers.

The table also shows the field of study of the students and the teachers about four colleges/faculty with inside have 14 departments involved in the given response. Thus, all respondents 101 (32.06%) s,21 (29.6) Textile and apparel fashion technology,82 (26.03%),21(29.6 %) Manufacturing Technology 85 (26.98%),16 (22.5%) Civil technology, and 47 (14.92%),13 (18.3%) Electrical/electronic and ICT for students and teachers respectively. This implies the survey covers a large number of respondents which resembles the actual fields offered at the moment and helps to get the actual result of the study.

4.2. Analysis of the relevance of AI on personal learning of VET

To assess the extent of relevance of Artificial Intelligence on personal learning in vocational education and training in the case of Ethiopia’s federal TVET institute, the study raised the extent to which the AI-based teaching methodology accommodates personalized learning, determine if adaptive learning technologies are employed to tailor the educational experience to individual student needs, allowing for customized pacing, content, and assessments., and the relevance level of AI for personal learning of students, and the extent of helping AI for personal learning and lesson preparation for vocational teachers. Thus, the subsequent Tables with quantitative data were acquired and discussed the results of both responses of students and teachers and the result of the respondent both the student and teachers are in Table 3.

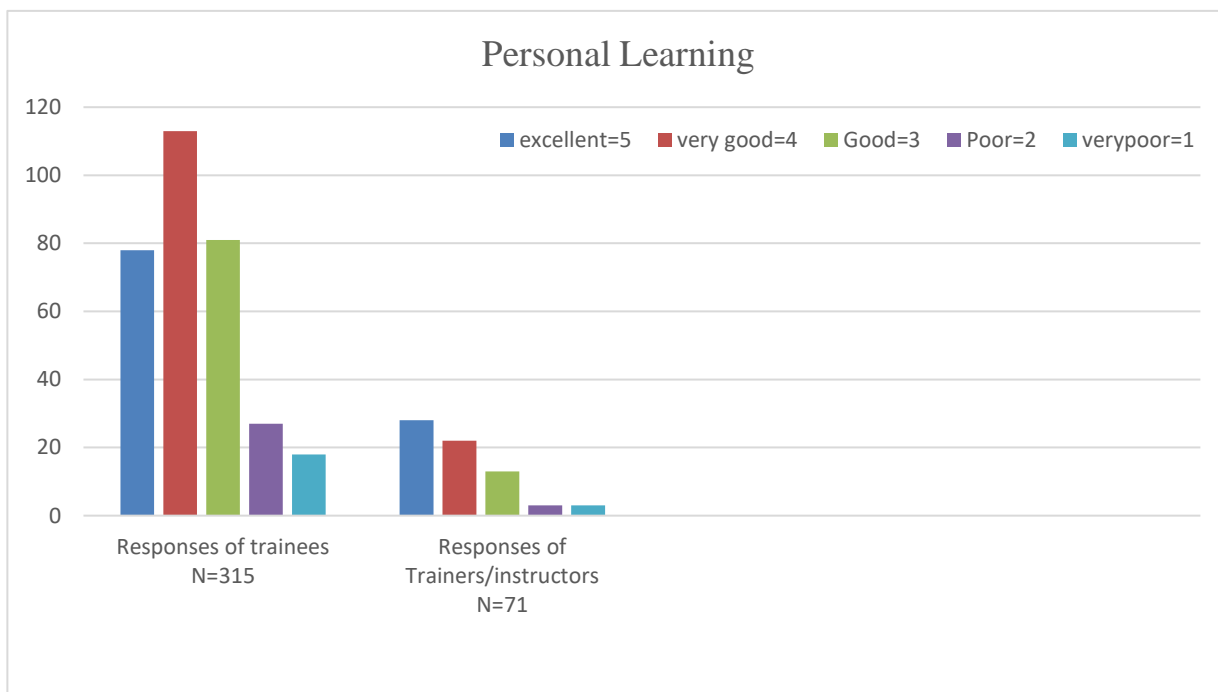
Table 3 Descriptive result of personal learning

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Personal learning	315	3.67	1.094	71	4.00	1.085

The result above in Table 3. describes the importance of artificial intelligence in personal learning in vocational education with a mean value of 3.67 and 4.00 for students and teachers respectively and the descriptive result indicates there is more important in the case of AI-based teaching methodology in vocational education and training, individual student needs, content, and assessments for the students and professional development skill and knowledge improvement for teachers in the vocational education case of Ethiopia Federal TVET institute.

Figure 2. Frequency graph of responses for personal learning

According to the respondent data in Figure 2, the majority of the students’ and teachers’ respondents agreed to the issues



on the bases of individual observation on the importance of artificial intelligence in vocational education teaching methodology in the professional ability of personal learning.

4.3. Analysis of the relevance of AI on teacher training and professional development

The result of the study in the frequency graph for the respondents in Figure 3 shows that 79% (64,96 and 89 i.e. excellent, very good, and good respectively) of the respondent of the trainees/students and 91.5% (35,22 and 10 i.e. excellent, very good and good respectively) of the respondents of the trainers/teachers concluded that artificial intelligence is more important in vocational education and training, especially for teacher training and professional development, and also assesses the study of whether teachers possess the necessary skills and knowledge to effectively teach AI concepts and applications to students.

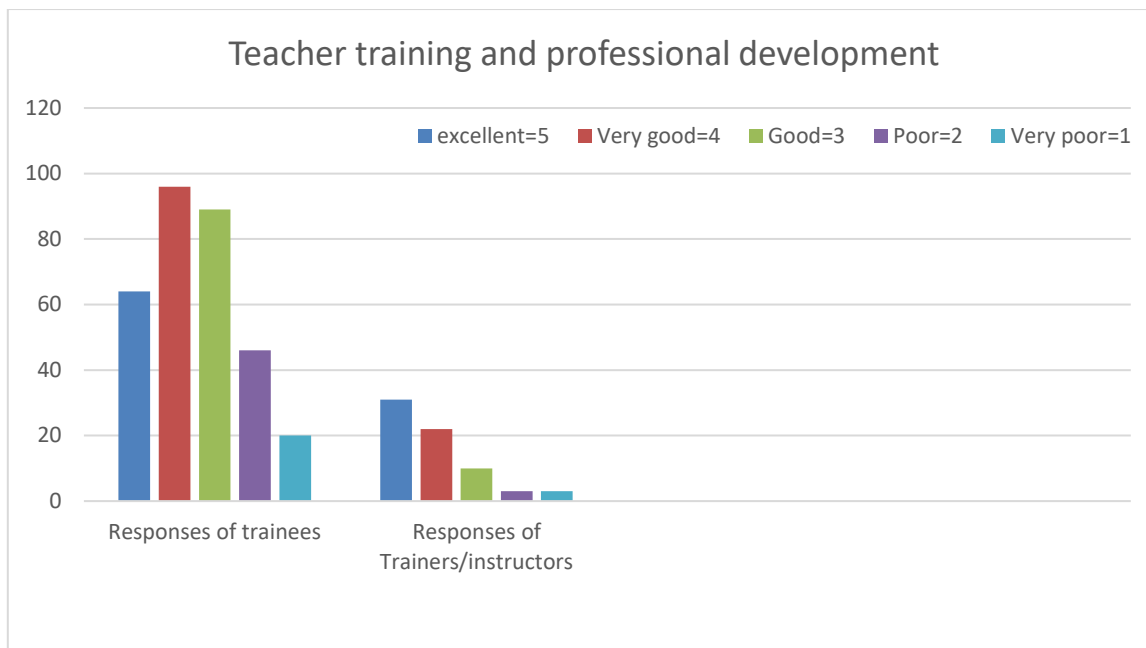


Figure .3. Frequency graph of respondents for Teacher training and professional development

The descriptive analysis of the result of the respondents as indicated in Table 4 to analyze the importance or the relevance of AI on teacher training and professional development at Ethiopia Federal TVET Institute, the majority of the trainees and trainers responded with, Mean Values of both respondents are 3.44 and 4.09 respectively and the descriptive statistics show that AI was very important, for improving the necessary skills and knowledge if vocational educators receive adequate training and professional development opportunities in AI.

Table 4. Descriptive result of teacher training and professional development

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Teacher Training and Professional Development	315	3.44	1.153	71	4.09	1.081

4.4. Analysis of the Relevance of AI on Adaptive Assessments

In accordance with the study's results, which are depicted in Figure 4 frequency graph for the respondents, 95.6% of the trainers/teachers counted 26,25 and 17 excellent, very good, and good respectively, and 83.2% of trainees/students counted 77,95 and 90 excellent, very good, and good respectively this result implies that the respondent where agreed that artificial intelligence is more crucial for vocational education and training, particularly for teacher and student’s adaptive assessment applications.

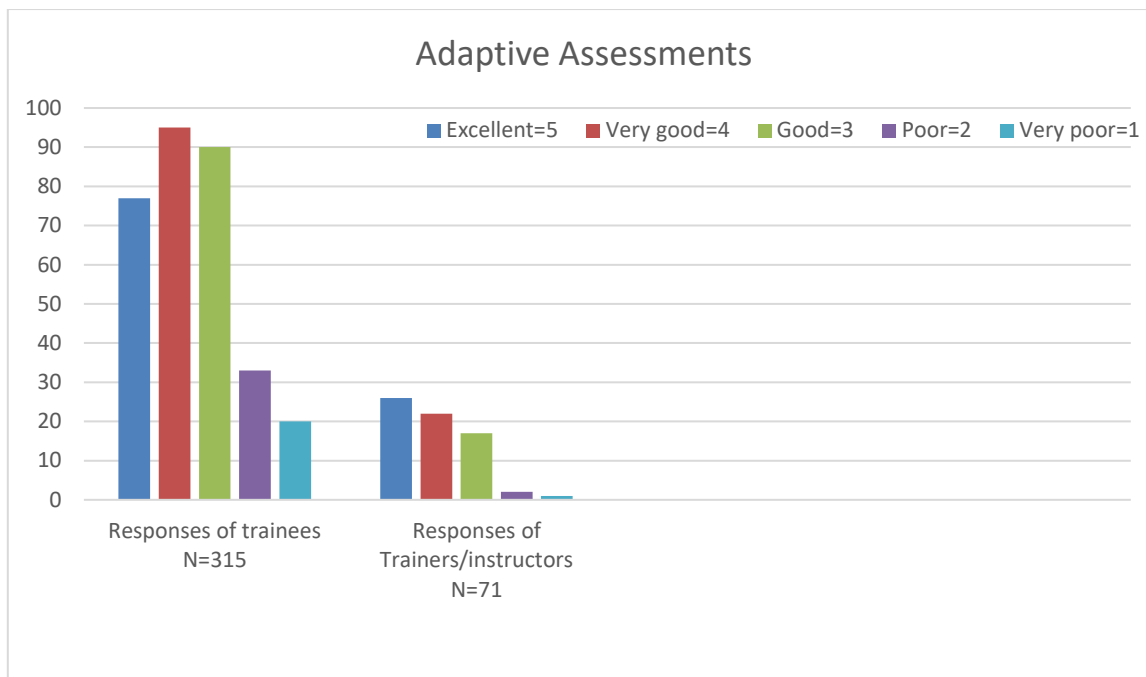


Figure.4. Frequency graph of respondents for Adaptive assessment

The majority of trainees and trainers responded to the relevance of AI in vocational education and training on adaptive assessment as values in figure.4. Based on the data of the respondents the descriptive analysis of the results, which is shown below in Table 5, determines the significance or relevance of AI on adaptive assessment at Ethiopia Federal TVET Institute. The mean values of both respondents’ teachers and students are 4.03 and 3.56, respectively, and the descriptive statistics reveal that AI was crucial for enhancing the necessary skills and knowledge of vocational educators in an adaptive assessment.

Table 5. descriptive result of the adaptive assessment of the respondent

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Adaptive Assessments	315	3.56	1.153	71	4.03	0.946

4.5. Analysis Relevance of AI on Practical Application

According to the result of the respondents, which are shown in Figure 4 frequency graph for the respondents, 91.5% of teachers/trainers tallied 30, 24, and 11 excellent, very good, and good responses, respectively, while 69% of trainees /students tallied 42, 88 and 87 excellent, very good, and good responses, respectively on the issues of AI application in practical machine and equipment digitalization and simulation to help practical application matched with the industry technology demand therefor this result advocates that the respondents especially the trainers/trainers were agreed that artificial intelligence is more important for vocational education and training, especially for teachers and students in helping for practical applications of the vocational course.

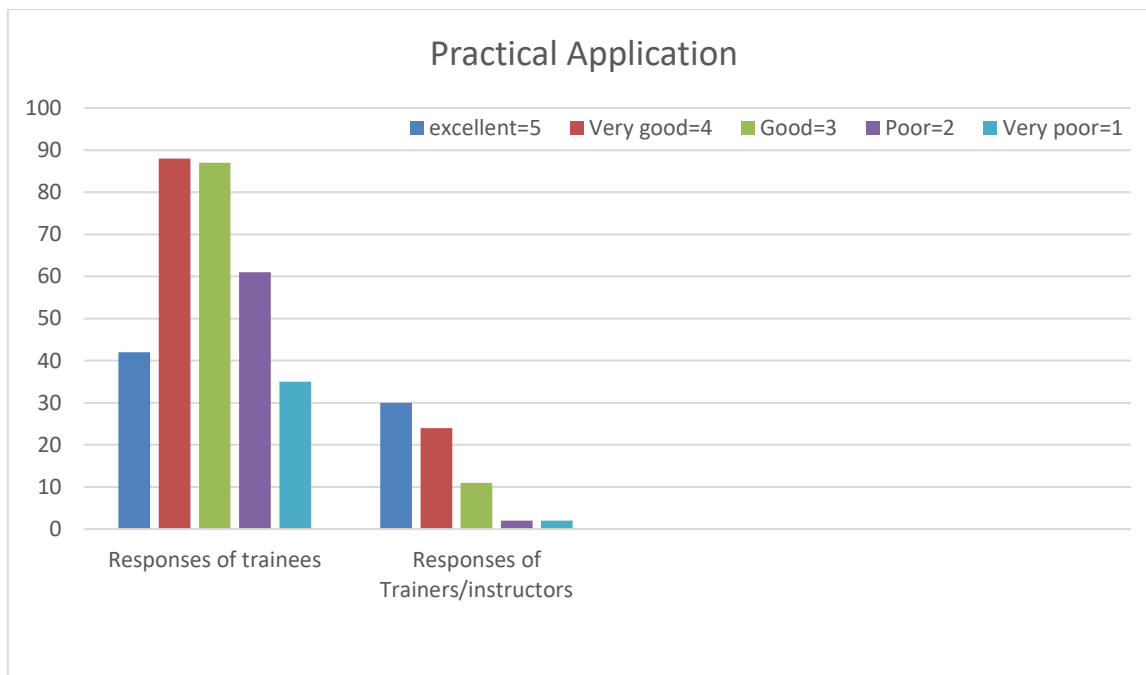


Figure.5. Frequency graph of respondents for practical application

As indicated in Table 6 below, a descriptive analysis was made to assess the reflection of trainees and trainers on the relevance of AI in the Practical Application of vocational education in the case of the Ethiopian Federal TVET Institute. Thus, as shown in Table 6 the result of the respondents with the mean value 3.13 and 4.13 of trainees and trainers respectively expressed their response as AI is very important or relevant to the Practical Application of vocational education. And also, the descriptively analyzed result tells us that AI has a very significant impact on TVET institutions and the surrounding Small /Micro Enterprises and industry’s technology with integration as the guideline to enhance their Practical Application in the real work of the world.

Table 6. Descriptive result of the practical application of the respondent

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Practical Application	315	3.13	1.203	71	4.13	0.984

4.6. Analysis Relevance of AI on Enhanced Curriculum Development

As shown in the data result of response in Figure 6, trainees and trainers were asked if AI was important for enhanced curriculum development based on the skill and knowledge as well as the technology demand of the industry achievement and assess whether AI concepts are integrated across various vocational programs and if they are taught in a practical, hands-on manner. so Accordingly, 76.5% of the trainees respond 69,91, and 81 excellent, very good, and good respectively and 91.5% of trainers respond 24,27, and 14 excellent, very good, and good respectively there the result indicates that the respondents agreed that Artificial intelligence very helps full in enhanced vocational curriculum design and development.

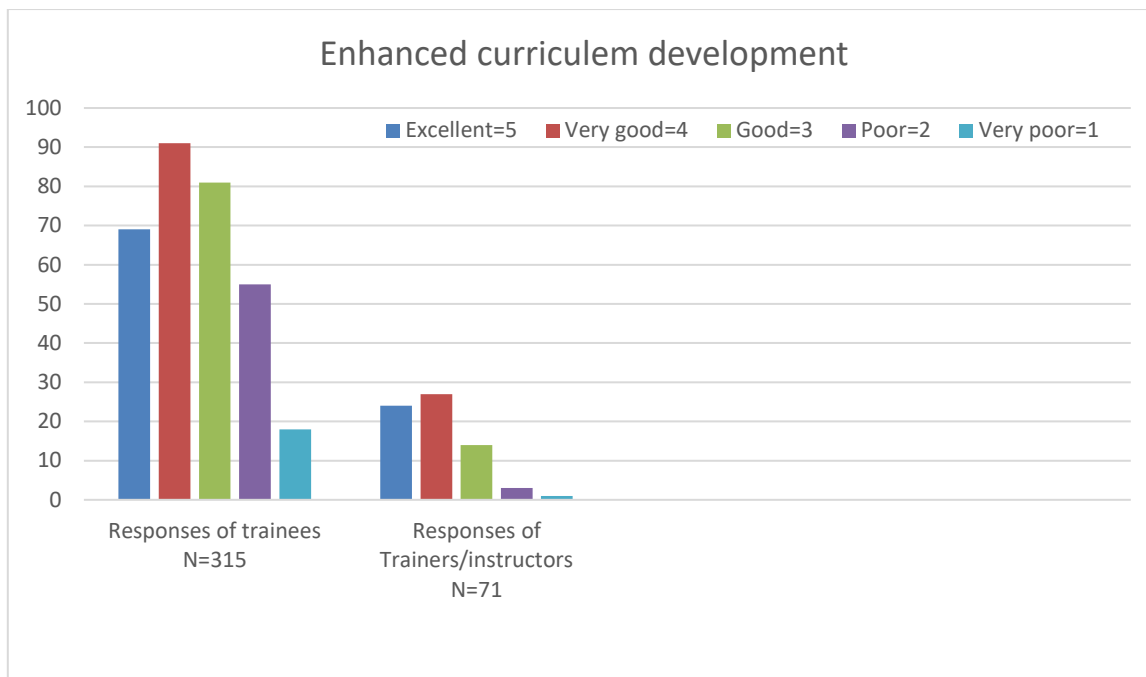


Figure 6. Frequency graph of respondents for enhanced curriculum development

A descriptive analysis was conducted to evaluate trainees' and trainers' perspectives on the usefulness of AI in the improved curriculum creation of vocational education, as can be seen, the descriptive result of the respondents in Table 7, indicated that AI is highly significant or relevant to improve curriculum development of vocational education, with the mean values of 3.44 and 4.01 for trainees and trainers, respectively. Additionally, the results of the descriptive analysis show that AI has a big impact on TVET institutions and the technological advancement of the sector. It also determines if AI concepts are taught in various vocational programs and if they are integrated into them.

Table 7. Descriptive result of the enhanced curriculum development

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Enhanced Curriculum Development	315	3.44	1.177	71	4.01	0.931

4.7. Analysis Relevance of AI on Virtual Simulations and Training

The result of the study in Figure 7 shows the relevance of artificial intelligence in vocational education and training, especially for virtual simulation and training, therefore virtual simulation and training in vocational education offer immersive and engaging experiences, enhance learning outcomes, and prepare students for real-world vocational challenges.

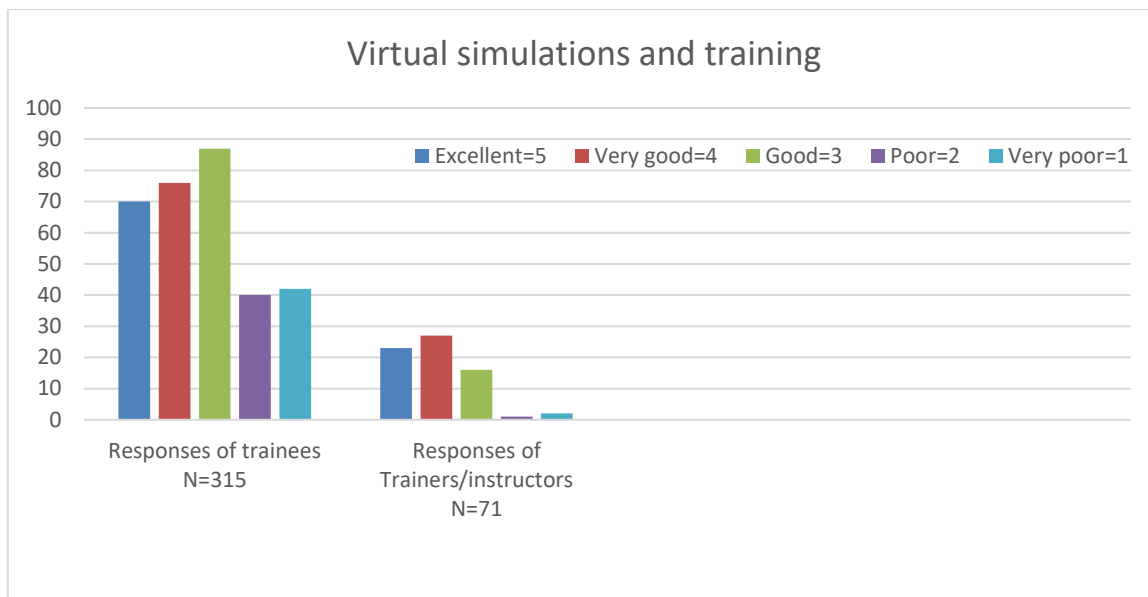


Figure 7. Frequency graph of respondents for virtual simulations and training

Table 8 displayed the mean, and standard deviation, of the respondents on virtual simulation and training. The descriptive statistics indicated that the mean values of virtual simulation and training for both respondents i.e. students and teachers were 3.29 and 3.99 respectively. The standard deviations for both variables 1.308 and 0.947 respectively indicated that data were widely spread around their respective means.

Table 8. Descriptive result of the enhanced curriculum development

Parametria	Responses of trainees			Responses of Trainers/instructors		
	N	Mean value	Std. Deviation	N of respondent	Mean value	Std. Deviation
Virtual simulations and training	315	3.29	1.308	71	3.99	0.947

5. CONCLUSION

In conclusion, the relevance and importance of AI in teaching vocational education and training cannot be overstated. The case study conducted at the Ethiopia Federal TVET Institute demonstrates how AI technologies can revolutionize traditional teaching methods and address the unique challenges faced by VET institutions. By leveraging AI for curriculum development, personalized learning, and assessment, educators can provide tailored and effective educational experiences that enhance students' skills, knowledge, and employability in the rapidly evolving job market.

The findings from the case study highlight the positive impact of AI in VET at the Ethiopia Federal TVET Institute. Students reported increased engagement, improved learning outcomes, and enhanced employability prospects. Additionally, instructors benefited from AI-powered tools that streamlined administrative tasks and provided valuable insights into student progress.

AI brings numerous benefits to teaching vocational education and training, including personalized learning, adaptive assessments, virtual simulations, administrative efficiency, predictive analytics, lifelong learning support, accessibility, and data-driven decision-making. By leveraging AI technologies, VET institutions can enhance the quality, relevance, and effectiveness of their educational offerings, ultimately preparing students for the demands of the modern workforce.

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