



Robotics and Artificial Intelligence Knowledge and Skills of Textile Technology Students/Graduates: A Case Study of Ethiopian Higher Vocational Education and Training

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Abstract

The introduction of automation and recent technological advancements have changed the textile industry in different ways. Intelligent types of machinery have been developed in different textile production departments, which increased product quality and efficiency. Higher education is necessary to provide the advanced knowledge and skilled workforce required to handle these latest machines. Advanced manufacturing systems must be taught to textile technology students in higher VET to provide a workforce capable of meeting the demands of a rapidly growing industry. Collaborations between industry and higher education are essential for meeting the rapidly changing needs of industries. The knowledge and skills of VET textile technology students and graduates in intelligent manufacturing have been assessed in this study. The study employed a quantitative research methodology. Teachers of textile technology, students/graduates, and textile industry professionals were surveyed using a questionnaire to gather data. The findings indicate that textile technology students and graduates in higher VET have a knowledge and skill gap in intelligent manufacturing. This is due to the current textile technology curriculum lacking intelligent manufacturing content.

Subject Areas

Pedagogy

Keywords

Intelligent Manufacturing, Robotics, Higher Vocational Education and Training (VET), Textile

1. Introduction

Vocational Education and Training (VET) is frequently perceived as the solution to improving the opportunities of youths lacking the resources, skills, or motivation to continue with higher education [1]. According to the report of [2], policymakers want to know how strong VET systems manage challenges like rapid technological change, matching labor market demand for skills, attracting enrollment, and creating high-status VET programs.

In developing countries, VET is an essential component of economic development [3]. Most advanced economies also view VET as a means of reducing youth unemployment [4].

As Krishnan and Shaorshadze [5] noticed, the TVET program in Ethiopia is primarily supply-driven. The government determines the curriculum, the specializations offered, and the allocation of students among TVET educational institutions, despite the TVET strategy's emphasis on the need to make sure that TVET is adaptable enough to meet demand. According to the National TVET Qualification Framework (NTQF), the TVET program should be outcome-based, demand-driven, and focused on wages and self-employment to meet the needs of the Ethiopian economy's sustainable development [6].

According to Scott [7], the skills and knowledge students need to survive and thrive in the twenty-first century are driven by the urgency of globalization, new technologies, migration, international competitiveness, shifting markets, and transnational environmental and political issues. Increased technological innovation skills among TVET graduates can lead to quality and innovation ecosystems [8].

The prerequisites for jobs change along with the textile industry. There is a noticeable trend toward jobs with artificial intelligence skills, jobs like automation specialists in textile manufacturing, and AI application developers [9]. Textile companies are looking more for graduates who can drive innovation in manufacturing processes besides adapting to technology renewal.

According to Bhardwaj [10], most of the Eastward migration in textile production occurred in the last several decades when labor prices in Asian nations, particularly China, started to rise. Textile manufacturing companies that have access to historical and current operational data can use Artificial Intelligence (AI) to boost productivity and complement the skills of their human workforce due to the industry's growing adoption of industrial automation.

Intelligent manufacturing systems enable improved quality control, better productivity, and sustainable practices across the supply chain in the context of textile technology [11]. By using intelligent systems, textile manufacturers may enhance production accuracy, reduce waste, and become more sensitive to changes in the market.

There are many benefits for students studying textile technology when intelligent manufacturing systems are implemented in the TVET curriculum. As companies increasingly use cutting-edge technologies, graduates with knowledge and skills in robotics and AI systems are certain to be conversant with current industry practices [12].

The textile industry is expected to add new jobs due to the adoption of smart manufacturing, according to Mckeegan [13], which highlights the demand for skilled professionals who can oversee sophisticated manufacturing procedures. Productivity, efficiency, and quality can be increased by intelligent systems, enabling textile companies to satisfy customer demand without using excessive amounts of resources. A workforce accustomed to modern technologies is required for this transformation [13].

2. Research Design and Methods

The study employed quantitative research methods. The research design used in this study was a descriptive research design method. By methodically describing a population's or phenomenon's characteristics, descriptive research enables researchers to collect data without manipulating variables [14]. The study collected, processed, and analyzed data using a non-experimental design. The study's objective necessitated the employment of a quantitative research design. The main goal of quantitative research, which is a methodical examination, is to quantify data and phenomena using organized techniques. It identifies patterns, computes averages, assesses correlations, and obtains broad insights, quantitative research entails the analysis and collection of numerical data [15].

In this study, closed-ended Likert scale questionnaires were used as a quantitative instrument to collect data from the higher VET textile teachers, students/graduates, and textile industry professionals. Rating scale questions were used. According to The Editorial Team [16], these questions assess levels of agreement or satisfaction on a scale, such as a 1 - 5 rating system. They help quantify sentiments and offer insights into overall participant attitudes.

2.1. Population and Sample of the Study

Three different groups comprise the research target population the study's first group consists of higher vet teachers of textile technology and engineering textile technology students/graduates of higher vet and industry experts working in textile companies the location of the study is Addis Ababa City, Ethiopia and nearby because Addis Ababa is the place where higher VET and a huge number of textile industries are located. The respondents' selection and inclusion in the study were based on a quota sampling technique as a sampling strategy. According to Julia Simkus, quota sampling is a non-probability sampling technique in which the researcher chooses participants based on predetermined criteria, guaranteeing that they reflect particular traits proportionate to how common they are in the population [17]. The questionnaires were distributed to 40 textile technology/engineering teachers, 96 textile technology students/graduates of higher vet and 24 textile industry professionals.

2.2. Methods of Data Analysis

The responses to the survey questionnaire were entered into SPSS version 27

Software and Excel for analysis. The data were checked for error and completeness. The collected data after data processing was analyzed using descriptive statistics. In the descriptive analysis, percentage, frequency, means, mode, standard deviation, graphs, and tables were used in this research.

3. Results and Discussion

This study focused on the determination of intelligent manufacturing curriculum knowledge and skills of textile technology/engineering sectors in higher VET. For this research, the data were obtained from higher VET teachers, students/graduates and textile industry professionals about their activities, training experience and views on status of intelligent manufacturing systems in world of work and training program.

Robotics and Artificial Intelligence Knowledge and Skills in Higher Vocational Education and Training

In Ethiopia's higher VET sector, the development of robotics and Artificial Intelligence (AI) knowledge and skills is a new area that aims to give students the skills they need to succeed in a technology-driven economy. However, as the knowledge and skills level indicate, this study suggests that it has not yet been widely embraced and applied. The following graphs show the status of intelligence manufacturing knowledge and skills in higher vocational education and training, specifically in textile technology.

According to teachers' response results in **Figure 1**, 37.5% of respondents were neither in agreement nor disagreement with the statement that "TVET graduates have relevant knowledge in machine learning and artificial intelligence", while 40% disagreed and 10% strongly disagreed. Just 7.5% of the teachers who took the survey agreed. Of the student participants, 39.6% were neutral, 42.7% disagreed and 16.7% strongly disagreed. Among textile industry respondents, 39.6% were neutral, 42.7% disagreed and 20.8% strongly disagreed with the statement.

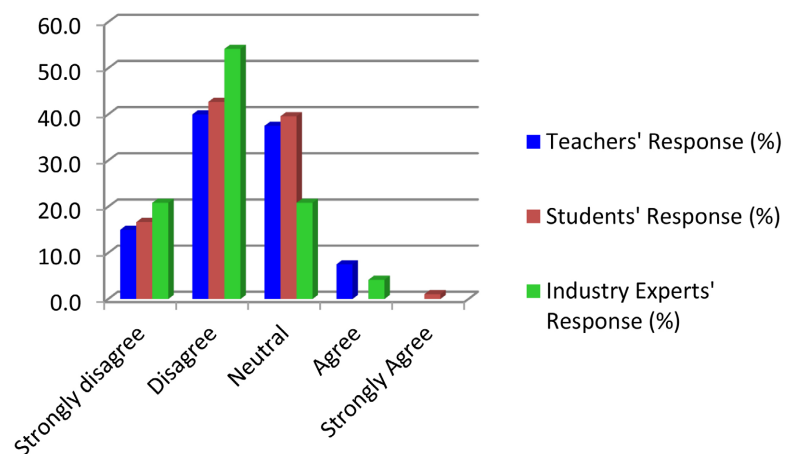


Figure 1. TVET graduates have relevant knowledge and skills in machine learning and artificial intelligence.

According to the result, there may be a bottleneck in transmitting machine learning and artificial intelligence knowledge and skills in higher vocational education and training.

Figure 2 from teacher responses demonstrates the insufficiency of skilled laborers/experts to handle AI and robotic systems in the textile industry. In response to the statement, “There are plenty of skilled laborers/experts to handle AI and robotic systems”, 55% disagreed, 20% strongly disagreed, and 22.5% were neutral. Of the students/graduates, 43.8% disagreed, 18.8% strongly disagreed, and 30.2% were neutral. Among textile industry respondents, 45.8% disagreed, 16.7% strongly disagreed, and 29.2% neutral.

According to the result, there are insufficient skilled laborers/experts to handle artificial intelligence and robotic systems in the textile industry.

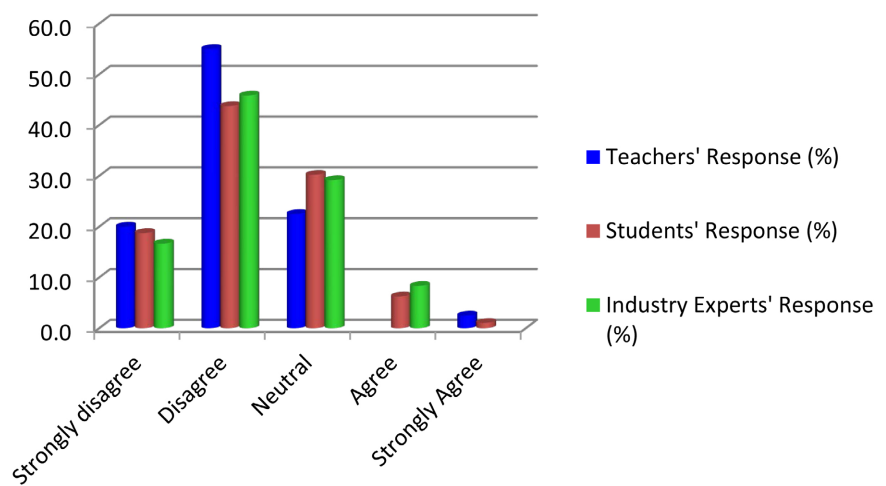


Figure 2. There are plenty of skilled labors/experts to handle AI and robotic systems.

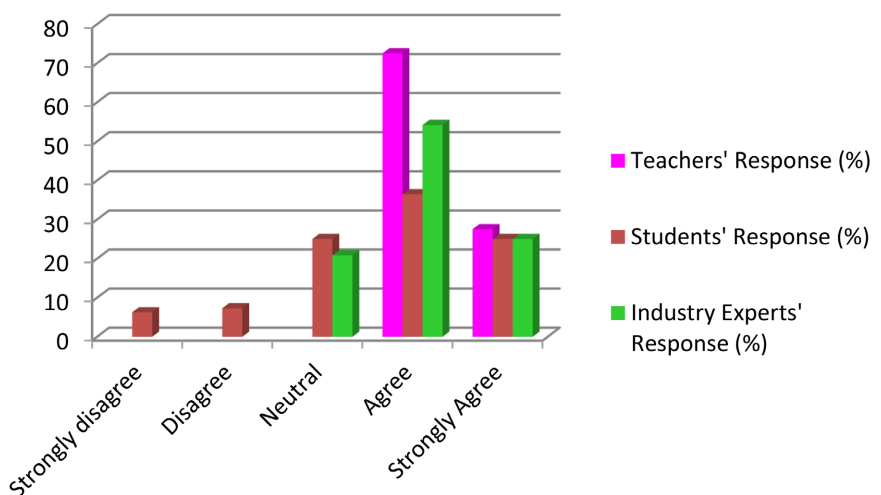


Figure 3. There is a mismatch between skills available on the labor market and the skills necessary in industry.

The majority of research participants agreed, that “there is a mismatch between

the skills required in the textile industry and the skills readily available in the labor market” according to **Figure 3**.

All the teachers agreed that there is a mismatch between skills available in the labor market and those necessary in the textile industry. On the issue, 27.5% strongly agreed and 72.5% agreed. Of the graduates and students, 36.5% agreed with the topic and 25.0% strongly agreed. Of the survey respondents in the textile company, 20.8% were neutral, 54.2% agreed, and 25.0% strongly agreed.

According to Lukas Hensel, there are skills mismatches in Ethiopia due to several factors, one of which is a lack of adequate education-industry partnerships that could facilitate a better alignment between educational outcomes and market requirements [18].

According to **Figure 4**, most of the teacher respondents disagree that all TVET graduates have a basic understanding of artificial intelligence technologies. Of the responders, 42.5% were neutral, 12.5% strongly disagreed, and 45% disagreed. Of the students/graduates, 18.8% strongly disagreed, 40.6% disagreed and 27.1% were neutral. Most industry respondents disagreed on the issue as shown on the graph, *i.e.* 20.8% strongly disagreed, 58.3% disagreed and 12.5% were neutral.

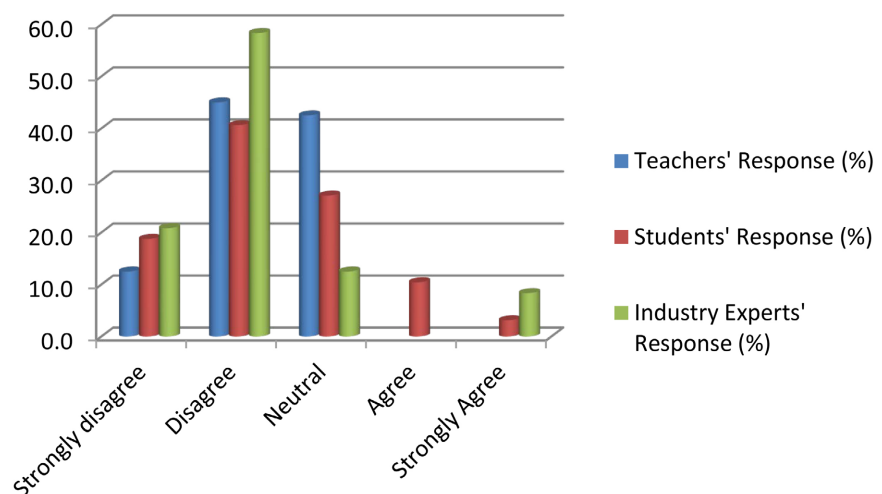


Figure 4. All TVET graduates have a basic understanding of the AI technologies.

The concept that “TVET students are practicing AI and robotic systems in industry during cooperative training” was doubtful by the majority of respondents. Teachers’ results in **Figure 5** show that 60% disagreed, 17.5% strongly disagreed, and 22.5% were neither in agreement nor disagreement with the topic.

Among the students and graduates, 24.0% strongly disagreed, 43.8% disagreed, and 22.9% were neutral. And of industry respondents, 16.7% strongly disagreed and 58.3% disagreed on the issue.

The result indicates that there is a gap in practical training of artificial intelligence and robotics systems in the textile industry during cooperative training sessions for textile technology students.

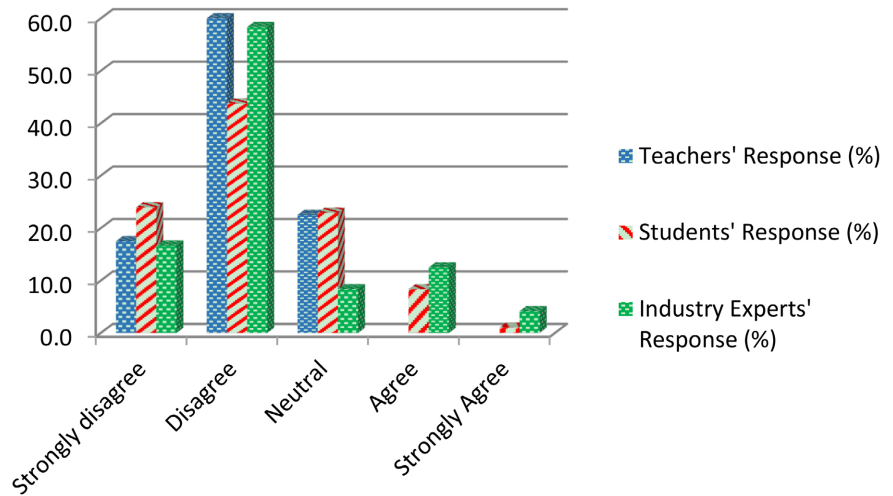


Figure 5. TVET students are practicing AI and robotic systems in industry during cooperative training.

The majority of respondents expressed dissatisfaction with TVET graduates’ robotics and AI skills. **Figure 6** shows that, concerning the statement, “TVET graduates are skilled in robotics and artificial intelligence”, 60%, 46.9%, and 54.2% of teachers, students/graduates, and industry professionals respectively disagreed, 17.5%, 11.5%, 20.8% of teachers, students/graduates and industry professionals respectively strongly disagreed on the matter. Of the respondents, 22.5%, 31.3%, and 25.0% of teachers, students/graduates, and industry professionals respectively neither agreed nor disagreed with the statement.

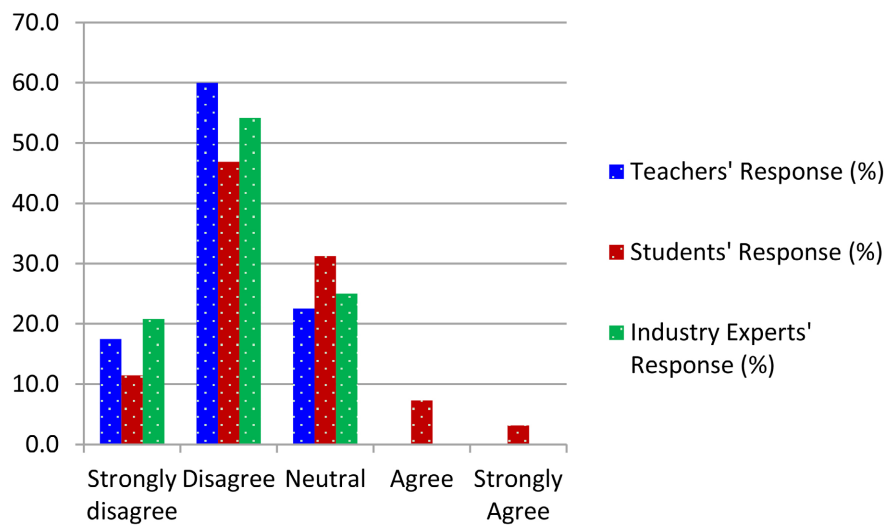


Figure 6. TVET graduates are skilled in robotics and artificial intelligence.

The result in **Figure 7** shows most respondents disagree with the statement, “The teachers have fundamental knowledge and skills in robotics, artificial intelligence, and intelligent manufacturing systems”. On this matter, 47.5%, 42.7% & 66.7% of teachers, students/graduates, and industry professionals respectively

disagreed; 12.5%, 16.7%, and 4.2% of teachers, students/graduates & industry professionals respectively strongly disagreed. On the other hand, most respondents (40%, 32.3%, and 29.2% of teachers, students/graduates & industry professionals respectively) neither agreed nor disagreed (neutral).

The result indicates that teachers of high VET of textile technology have knowledge and skills limitations in intelligent manufacturing systems.

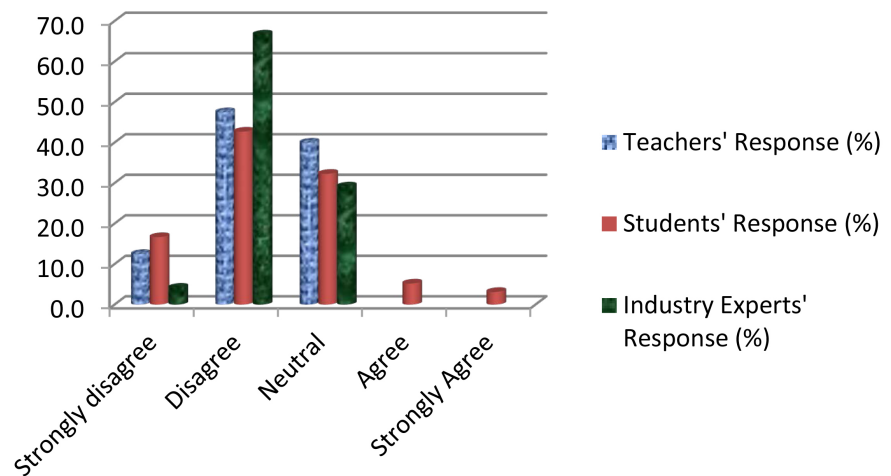


Figure 7. The teachers have fundamental knowledge and skills in robotics, artificial intelligence, and intelligent manufacturing systems.

4. Conclusions

The results of this study show that there are knowledge and skill gaps in robotics and artificial intelligence manufacturing systems at higher VET in textile technology in Ethiopia. This speaks about the discrepancies between the knowledge and skills needed to function well in the textile industry and what is currently taught in higher VET.

According to the result, there may be a bottleneck in transmitting machine learning and artificial intelligence knowledge and skills in higher vocational education and training. There are also insufficient skilled laborers/experts to handle artificial intelligence and robotic systems in the textile industry. Furthermore, there is a mismatch between the skills required in the textile industry and the skills readily available in the labor market.

Higher vocational education and training teachers and trainers should continuously update and broaden their knowledge and skills in intelligent manufacturing to prepare students for employment in the rapidly changing labor market. As the industry continues to embrace these advanced technologies, it becomes imperative for TVET programs to adapt accordingly to ensure that their graduates remain at the forefront of textile manufacturing innovation.

5. Recommendation

- There should be a way to update the knowledge and skills gaps of textile teachers

and trainers in higher VET.

- The curriculum should be updated to an outcome-based curriculum to respond to 21st-century textile industry needs.
- Curriculum development and training should be in collaboration with textile industry to maximize knowledge and skills of intelligent manufacturing and employability of higher VET graduates.

Conflicts of Interest

The authors declare no conflicts of interest.

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