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# The Importance and Impact of Robotics and Intelligent Manufacturing System in Textile Sector. Case of Ethiopian Higher Vocational Education and Training Textile Industry in Addis Ababa

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***Abstract:-*Adopting intelligent manufacturing technologies is a strategic step toward a more effective and ecologically conscious future for the textile industry, which will be critically important for sustaining competitiveness and attaining operational excellence as the industry continues to change in response to shifting consumer demands and technological breakthroughs. Assessing the degree of awareness regarding the importance and effects of robotics and intelligent manufacturing skills and knowledge in the textile industry, as well as higher vocational education and training in textile technology in Addis Ababa, Ethiopia, is the primary objective of this study. A quantitative research method was used. The researcher collected the data through questionnaires from textile technology teachers, students/graduates, and textile industry professionals. The results indicate that robotics and artificial intelligence have a significant impact on the manufacturing industry in general and the textile industry in particular.**

***Keyword*: Robotics, artificial intelligence, textile industry, VET**

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## 1. INTRODUCTION

Intelligent manufacturing in the textile industry is changing traditional practices by integrating advanced technologies to enhance efficiency, productivity, and sustainability. It optimizes production processes and boosts overall operational performance by combining automation, artificial intelligence (AI), the Internet of Things (IoT), and data analytics. This paradigm shift is critical in the textile industry, defined by intricate supply chains and shifting consumer needs [1]

Automation plays a crucial role in intelligent manufacturing, employing systems and robotics to streamline various processes. This technology significantly enhances production speed and accuracy while reducing labor costs and human error [2]. Furthermore, AI applications, including machine learning and computer vision, are vital for analyzing large datasets to identify trends, predict maintenance needs, and improve quality control [2].

According to Vishakha Somani, adopting an intelligent factory model offers several advantages. Predominantly, it increases efficiency and productivity by automating monotonous tasks, thus significantly reducing production timelines and labor requirements [3]. IoT-enabled equipment, for example, can offer real-time insights into production parameters, making it easier to locate and fix bottlenecks [3]. Real-time defect identification using AI-powered vision systems lowers the number of faulty items [4]. According to [5], an approach to quality management that detects and prevents possible issues early in the production process improves customer satisfaction and increases overall output.

Despite the advantages, there are many challenges to overcome before intelligent manufacturing technologies may be used in the textile industry. These include the requirement for worker training, large initial expenses, and the integration of new technologies with current systems. The complexity of their production procedures is a common problem for textile manufacturers, which can make the shift to an intelligent manufacturing environment intimidating and resource-intensive [6] [7]. Significant obstacles may include managing data security and staff resistance to change [6].

The textile industry in Ethiopia is increasingly embracing robotics and artificial intelligence (AI) systems to enhance productivity, streamline processes, and maintain competitiveness in a rapidly evolving market. Ethiopia has collaborated with organizations like UNIDO to promote circular economy principles and adopt resource-efficient technologies within the textile industry. A recent $28 million investment aims to boost the sector's growth, emphasizing sustainability and innovation [8]. The government has begun crafting policies aimed at enhancing technological adoption in manufacturing. These policies focus on building IT infrastructure and supporting research initiatives for robotics and AI [8].

## 2. RESEARCH DESIGN AND METHODS

The study employed quantitative research methods. Quantitative research involves analyzing and gathering numerical data to uncover trends, calculate averages, evaluate relationships, and derive overarching insights [9].

The research design used in this study was a descriptive research design method. Descriptive research is employed to systematically describe characteristics of a population or phenomenon, allowing researchers to gather data without manipulating variables [10]. The study used a non-experimental design.

In this study, closed-ended questionnaires were used as a quantitative instrument to collect data from the higher VET textile teachers, students/graduate and textile industry professionals. Rating scale questions were used. According to [11], 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.

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### 2.1. Population and Sample of the Study

The target population of the research includes three different categories of population. The first group of the study population is textile technology/engineering teachers of higher VET; the second group is textile technology students/graduates of higher VET; and the third group is industry professionals working in textile companies. The location of the study is Addis Ababa city Ethiopia and around because of Addis Ababa Ethiopia availability of higher VET and many textile industries.

The current study respondents for the survey were selected and included using a non-probability quota sampling technique as a sampling strategy. Quota sampling, according to [12], is a sampling technique in which the researcher selects participants based on specific characteristics, ensuring that they represent those attributes according to their abundance in the population.

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

Excel and SPSS version 27 software were used to analyze the survey questionnaire responses. The accuracy and completeness of the data were examined. Descriptive statistics were used to examine the acquired data following data processing. Percentage, frequency, means, mode, standard deviation, graphs, and tables were all employed in this study's descriptive analysis.

## 3. RESULTS AND DISCUSSION

The knowledge and skills of textile technology and engineering sectors in higher VET were the main focus of this study on intelligent manufacturing curricula. 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 the status of intelligent manufacturing systems in the world of work and training programs.

### 3.1. Understanding of the importance and impact of intelligent manufacturing and robotics in the textile technology department of higher VET and the textile industry in Ethiopia

Under this topic, the importance/significance and impact of robotics and intelligent manufacturing were analyzed by requesting seven indicating questions. The study focuses on the outcome-based curriculum development of textile technology majors in higher VET under the smart manufacturing system in Ethiopia. Understanding of the importance and impact of artificial intelligence in textile manufacturing and robotics gathered from teachers, students/graduates, and textile industry professionals.

According to Figure 1, most respondents agree that “Artificial intelligence and robotics significantly impact a company's economic performance."

The chart (figure 1) shows among the teachers 47.5% strongly agreed, and 40% agreed that artificial intelligence and robotics greatly contribute to a company's economic results (financial performance). Only 10% were neutral and 2.5 % disagreed. Of students/graduates 28.1% strongly agreed and 44.8% agreed with the idea mentioned, 17.7% were neutral, 5.2% disagreed, and 4.2% strongly disagreed with the statement. On the other hand among the industry experts who participated in the study survey 50.0% strongly agreed, 33.3% agreed, 12.5% were neutral and 4.2% disagreed with the statement.

As the result demonstrated on the graph robotics and artificial intelligence greatly contribute to a company's income.

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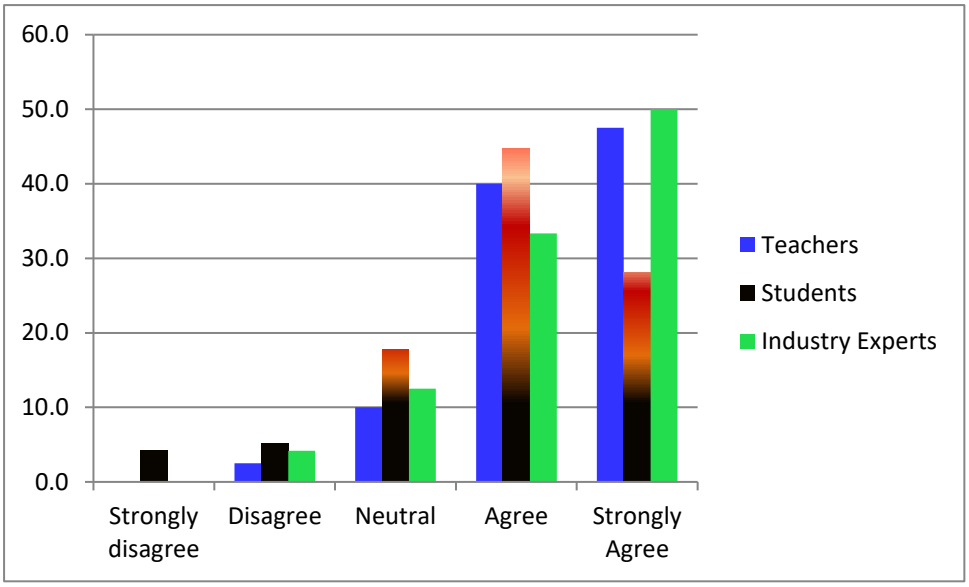


Figure 1: Artificial intelligence and robotics significantly impact a company's economic performance.

Most respondents think that robots and artificial intelligence development can open up opportunities for new careers for the younger generation, as seen in the chart in Figure 2. Teachers' response shows that 40% agreed, and 32.5% strongly agreed; that it will create new job opportunities for the young generation that graduates from vocational education and training. Among teacher respondents 12.5% were neutral, 12.5% disagreed and 2.5% strongly disagreed with the issue.

The students' responses indicate that, of those who participated, 21.9% strongly agreed, 33.3% agreed, 22.9% were neither in agreement nor disagreement, 12.5% disagreed, and 9.4% strongly disagreed on the statement "considering developments in the area of robotics and AI create new job opportunities for young generation."

According to the industry experts' survey results, the degree of disagreement has somewhat grown compared to other categories of respondents. Among the respondents from the textile industry 33.3% strongly agreed, 20.8% agreed, 12.5% were neutral 16.7% disagreed 16.7% strongly disagreed on the statement.

According to [13], a remarkable million new jobs are expected to be produced by 2025, even though intelligent technology may replace many jobs. This indicates a shift in employment rather than a fall. Flexible educational structures and strategies for skill and knowledge upgrade are essential given the need for shifting skill sets for the emergence of new positions.

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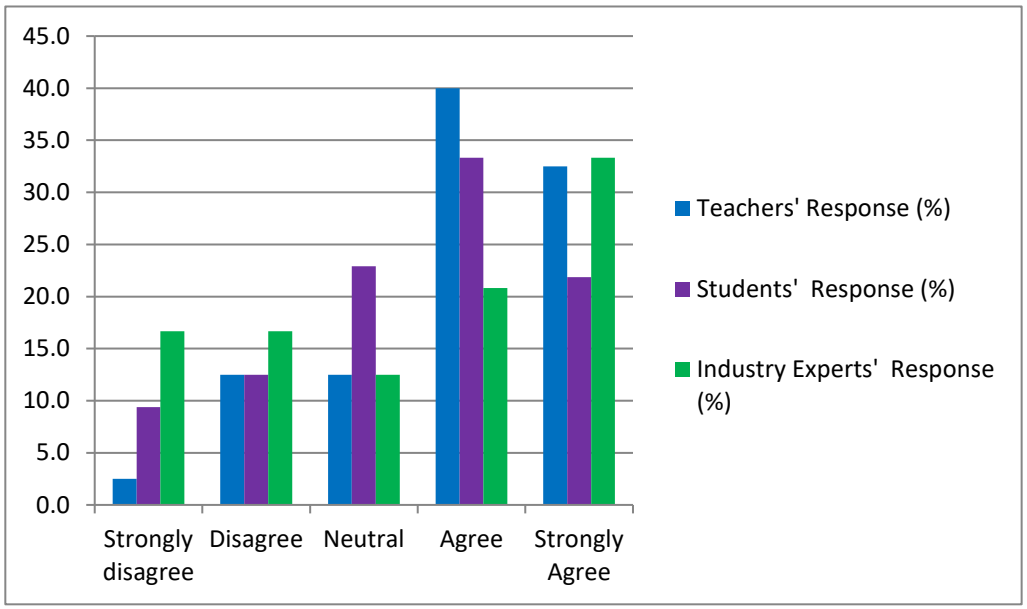


Figure 2: Developments in the area of robotics and AI create new job opportunities for young generation

The following chart (figure 3) shows that most respondents believed that artificial intelligence revolutionized the textile industry. Of the total teacher respondents, 52.5% agreed, while 32.5% strongly agreed with the statement. A mere 2.5% of teachers expressed disagreement. Thus, it demonstrates that artificial intelligence has revolutionized the textile industry.

Of all the students who responded, 44.8% agreed and 26.0% strongly agreed that artificial intelligence had changed the textile industry. 14.6% of students were neutral, 10.4% disagreed, and 4.2% strongly disagreed.

Artificial intelligence has changed the textile industry, according to the majority of respondents from textile industries. Of the responses, 12.5 were neutral, 37.5% agreed, and 50.0% strongly agreed.

Besides contributing to changing operating procedures, the application of AI is tackling urgent sustainability challenges and making the industry sustainable as well as adaptable to customer desires, claims Trivedi [14]. Artificial intelligence-driven quality control mechanisms utilize the abilities of artificially intelligent vision for recognizing defects before they occur, guaranteeing higher standards for goods and happier clients.

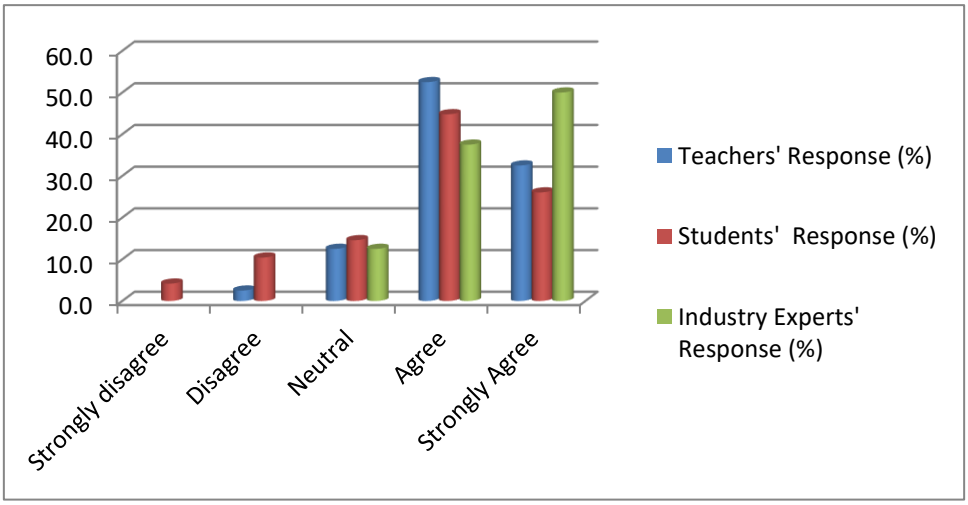


Figure 4.3: Artificial intelligence revolutionized the textile industry

International Journal of Engineering Research & Technology (IJERT)
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Most of the respondents approved that artificial intelligence developments make industries, in general, more productive. On this issue according to Figure 4, 37.5% of teachers agreed and 55% strongly agreed and only 7.5 % were neutral.

The students' response in Figure 4 shows that 30.2% strongly agreed, 44.8% agreed, and 16.7% neither agreed nor disagreed with the statement "new artificial intelligence developments make industries, in general, more productive."

Most research survey participants in the textile industry (95.9%) agreed (66.7%, 29.2% strongly agreed, and agreed, respectively).

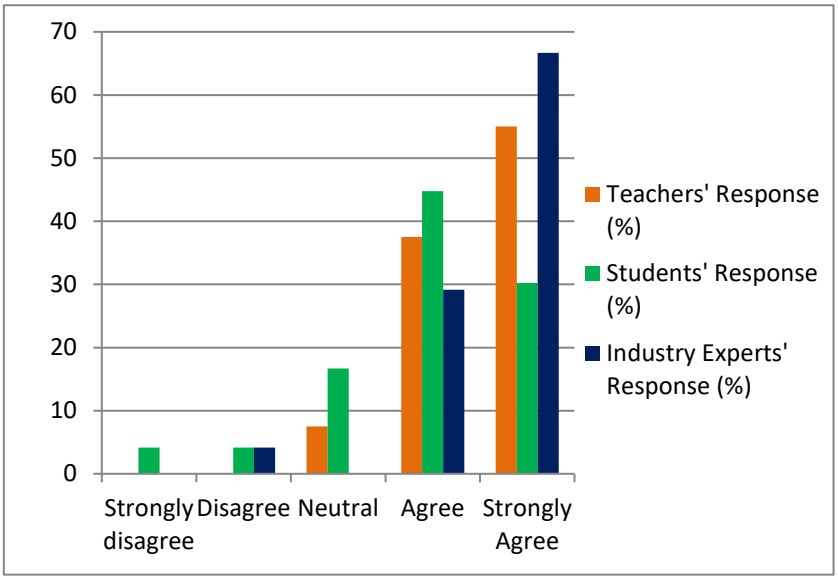


Figure 4: New artificial intelligence developments make industries, in general, more productive.

Considering developments in robotics and artificial intelligence (AI), labor laws need to be adjusted to provide appropriate protection to employees. According to the teacher response displayed in the following chart (figure 5), 55% of respondents agreed with this statement, and 32.5% strongly agreed.

Of the textile technology students and graduates who took part in the survey, 22.9% strongly agreed, 41.7% agreed, and 22.6% were neutral on this matter as shown in Figure 5.

On the other hand of textile industry experts/professionals, 50.0% strongly agreed, and 29.2 agreed on robotics and artificial intelligence (AI), labor laws adjustment.

CLJE Lab. (2024) expressed the same intension "legislative measures to control the use of AI in the workplace should be taken, including safeguarding employees' rights to participate in protected concerted activity, guaranteeing openness and worker involvement in the implementation of AI technologies, and putting in place guidelines and enforcement procedures to lessen the risks associated with AI-enabled monitoring and decision-making." Therefore as the response from the respondents' survey shows as robotics and AI progress in the workplace, labor laws need to be adjusted to better protect employees by addressing different concerns.

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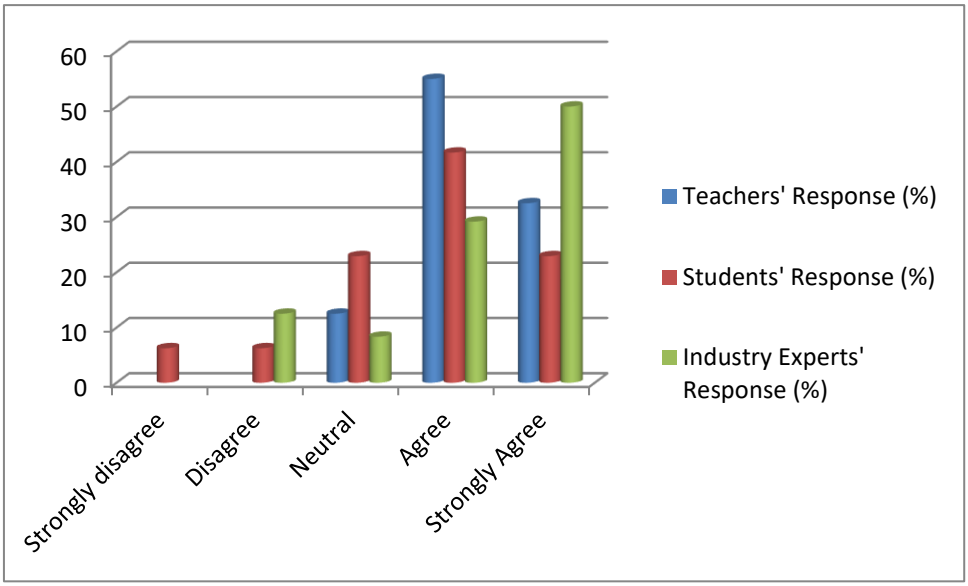


Figure 5: Considering developments in the area of robotics and AI, labor laws need to be adjusted to provide appropriate protection to employees

Among the total teachers who participated in the survey 35% agreed and 15 strongly agreed that "AI technologies do threaten a career." (10%) strongly disagreed, 15% disagreed, and 25% neither agreed nor disagreed according to Figure 6.

According to the result on the graph (figure 6) most of the students/graduates were neutral and disagreed on the issue. 39.6% were neutral and 29.2 % disagreed.

Textile industry experts' response indicates that 41.7% were neutral and 25.0% disagreed with the statement "AI technologies do threaten a career."

The chart shows that some respondents fear AI technologies threaten their careers, while others are confident they may not. The majority were neutral i.e. it may or may not threaten careers. Administrator claims that when the threat created by artificial intelligence (AI) to certain jobs becomes more obvious, there is also a greater focus on skills adaptation. More advanced cognitive, innovative, and interpersonal competencies resistant to automation are recommended for professionals [15].

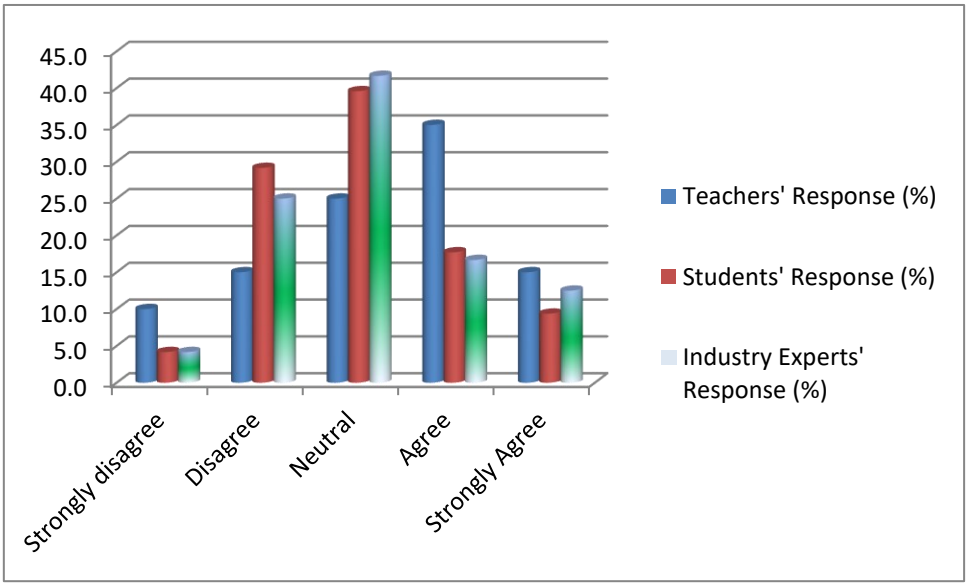


Figure 6: AI technologies do threaten career.

International Journal of Engineering Research & Technology (IJERT)
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Vol. 14 Issue 01, January-2025

According to the results plotted on the graph (figure 7), most respondents agreed that Ethiopia has laws governing robotics and artificial intelligence, even though many are unaware.

Most of the teachers who participated in the survey agreed that Ethiopia has rules and regulations regarding artificial intelligence and robotics. 35% of participants agreed with the statement, 15% strongly agreed, 15% disagreed, and 10% strongly disagreed. However, 25% of the respondents are unaware of Ethiopia's laws governing robotics and artificial intelligence.

Of the textile technology students and graduates, 21.9% strongly agreed, 40.6% agreed and 29.2% were neutral. On the other hand textile industry respondents' responses indicate 16.7% strongly agreed, 41.7% agreed, and 25.0% were neutral.

According to the literature, Ethiopia has taken significant steps in establishing rules and regulations concerning artificial intelligence (AI) and robotics. Yoseph [16] pointed out that the newly established AI policy in Ethiopia includes several vital components designed to facilitate a structured approach to AI deployment data management, human resource development, research and development, and law and ethics. Additionally, the Council of Ministers adopted Ethiopia's first National Artificial Intelligence Policy, according to [17].

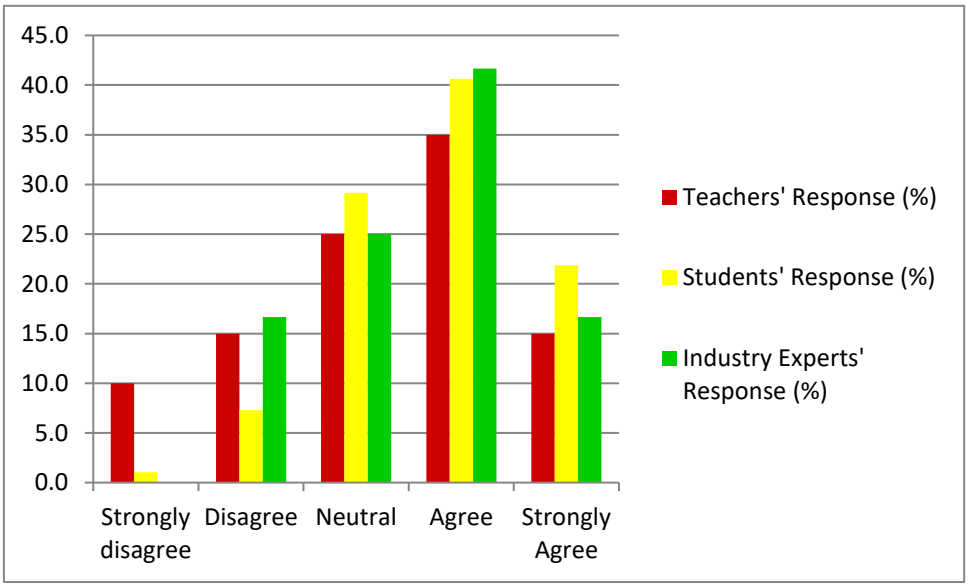


Figure 4.7: Ethiopia has rules and regulations of AI and robotics.

## CONCLUSION

Findings indicate that robotics and intelligent manufacturing play an important role in modernizing the textile industry by maximizing productivity, minimizing expenses, and resolving many issues the textile industry faces. Intelligent manufacturing systems development in the textile industry may create new job opportunities for the young generation. New roles and the necessity for evolving skill sets underscore the importance of adaptive educational frameworks and reskilling initiatives.

According to the findings, labor laws need to be adjusted to provide appropriate protection to employees in the textile industry by addressing different concerns. AI and robotics may threaten certain careers so it is encouraged to reskill and up-skill modality in higher VET.

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