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AN ERGONOMIC STUDY OF SKILL DEVELOPMENT BY POSTURE CORRECTION USING RAPID UPPER LIMB ASSESSMENT FOR TRAINING PURPOSE IN INDIA

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Abstract

Background: In terms of population and unskilled labour, India is among the top countries. Because of the annual growth in inflation, as well as the increase in daily costs and lack of awareness, a major problem in the industries and greater responsibility is leading individuals to work longer hours, generating physiological, psychological, and emotional problems.

Problem statement: Because of a lack of skills, people are working for low wages that are insufficient to survive, and peoples choices destination to private institutions is inflating their cost of living, making the issue worse after COVID-19, when people suffered greatly due to job loss and income sources, creating a gap for the replacement of need for industrial growth in India, which is one of the United Nations' sustainable development goals.

Procedure/ approach: The majority of people's postures are static, with only their upper limbs moving. Rapid upper limb assessment (RULA) is the best technique to evaluate the problem's severity, giving a score that determines whether the posture is acceptable or not and whether further research is necessary to implement the correct posture so that workers can work more productively and with less effort while being supervised by trainees.

Results: People found it difficult to keep good posture during the early phases of training, receiving scores of 5-7, indicating that there is an immediate need to adjust the posture, as the worker develops musculoskeletal disorders, which result in psychological changes that undoubtedly affect social behaviour, which is not desirable. After training sessions, participants had the confidence to finish the activities by simply following the instructions, scoring well between 1-2 for appropriate posture and 3–4 for need for improvement after investigation.

Conclusion: People use advanced technologies to support finances after completing skill enhancement programmes by applying in the appropriate manner, which allows each other to benefit and also creates jobs for the individuals around them, allowing them to grow both personally and socially and contribute to India's industrial growth, which will also significantly increase the GDP of the country due to an increase in tax revenue.

Key words: Rapid upper limb assessment (RULA), skill development programs, Government schemes and initiatives, musculoskeletal disorders, psycho social behaviour

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1. Introduction:

Skill development is a basic requirement for industrial growth since India has a lot of unskilled labour and there is a lot of room for investments and enterprises to start because India is a developing country[1]–[3]. According to Lowy Institute of Asia power index key findings, India is the fourth largest comprehensive power after United States, China and Japan. Since Japan has been a dependable partner to India since the sixth century, also India expects growth in the manufacturing sector, as well as in the year 1953 when Japan assisted India in surviving the Bengal famine, which was brought on by the failure of British policies under British rule and caused malaria, neurodegenerative disorders, and other diseases, Japan is aiming to help India strengthen its economy[4]–[7]. Article 21-A of the Act of 2002 mandates that all children between the ages of six and fourteen have a fundamental right to free and compulsory education, which is also the United Nations' fourth sustainable goal, equity education. With proper education students can achieve knowledge needed for the skill development and training at the initial stage [8]–[10].

India has the second-largest population in the world, and its citizens suffer from a lack of employment and education opportunities because they were not aware of the programmes and initiatives that were available to them for taking advantage of and finding high-paying jobs both domestically and abroad. Most individuals don't want to move because they want to care for their parents in their own communities, which is the main concern. After the country gained its independence, the number of schools, colleges, and universities increased along with the unemployment rate, which has now reached a point where the government is unable to offer suitable employment to the indigenous population or the economically weaker regions of the country.[8], [11]–[16].

The COVID-19 epidemic disproportionately harmed indigenous peoples because it exposed and intensified systematic racism and pre-existing structural inequities. Particularly heavily hit were vulnerable populations like indigenous children and people with disabilities, Native women and elders also. The transmission of indigenous languages and traditional knowledge had also been hampered by the epidemic, which had an impact on their distinctive cultures. Since the COVID-19 outbreak, numerous reports have attested to this disease's disproportionately negative effects on indigenous peoples around the world and offered recommendations to States on how to put human rights at the centre of their response, include and consult indigenous peoples adequately and systematically, and ensure that they are informed about and protected from the disease in a way that is appropriate for their culture. Indigenous people's way of life, adaptability, social interactions, communal living, and culture of joint families help to preserve their traditional values for future generations. Due to language barriers between different regions, the fact that most people live in villages, and the fact that they are not aware of the various government programmes and initiatives aimed at raising their standard of living, since India is the second-largest country in terms of its indigenous population and diverse cultures after Africa [9], [17]–[25].

The current study describes the perspectives and breadth of start-ups, as well as the different problems involved, and how to accept and overcome the challenges to develop new sources of revenue for all age groups, regardless of location, caste, religion, or faith.

In India, there are three types of social security, which are administered by the federal and state governments of India and consist of a variety of statutory insurances

and social grant programmes, Non-contributory and supported by tax payers, followed by employer- and joint-paid[26]–[28].India is renowned for its underpaid labour force, which includes unskilled, semiskilled, skilled, and highly skilled individuals working in a variety of industries to support their daily expenses. Because of government policies, increased industrialization is forcing people to relocate or leave their homes, which are worsening their predicament. Due to their conditions and incompetency to obtain self-employment and start-ups, 95% of unskilled labourers are underpaid. The majority of the villages are connected to forests, and it is ideal for forest communities to create new revenue sources by making use of the local resources to provide a high income[9], [10], [17], [20], [23], [29]–[32].

2. Methodology and Approach: The Rapid Upper Limb Assessment tool is considered as physical ergonomics employs a systematic procedure to assess the required body position, force, and repetition for the work task under consideration. Evaluation of required or desired body posture, frequency of muscle activity, and strong exertions can be done on a single page of a worksheet.

The RULA method is used 1) To offer a technique for screening working people to determine their exposure to high risk for upper extremity ailments connected to their line of work. 2) To recognise the physical effort that is connected to certain working positions and excessive pressures used during repetitive or static activity, which may lead to muscle fatigue. 3) To offer a straightforward scoring system that identifies an indicator of urgency and produces a result at the action level. 4) To offer a simple assessment method that needs little equipment, time, or effort[33]–[38].

For assessing the RULA, we have considered the students performing various tasks like marking, punching, cutting, filing or finishing in different positions in skill development. Different tasks are assessed with professional trainer with utmost accuracy. Different tasks are interrelated with the sociotechnical systems along with the assessment of orientations of hand gestures like orientation of upper arm at different angle, flexion, extension, radial deviation, ulnar deviation, pronation and supination of the forearm

Poor posture can damage the tissues of the body permanently. Posture correction based on the suggestion results in design of job and work place. Working condition forces the worker to take risk in performing a task in poor posture.

RULA is a tool which provides a score after assessment of the body posture by considering the training of the posture, force, and the movement required. The risk is calculated into a score of 1 which is low considered for good posture and a score of 7 which is considered high as bad posture. These scores are grouped into different action levels that provide an indication of the time frame in which it is reasonable to expect the risk control to be initiated.

The application of the RULA is used to assess the posture force and movement associated with sedentary tasks such as screen based or computer based tasks, manufacturing or retail tasks where the worker is seated or standing without moving about. The main focussed areas of RULA are Neck, Trunk, Upper arm, fore arm, Hand.

The procedure of the RULA is explained in three steps. 1) Posture or Postures are selected for the assessment, 2) The Postures are score using scoring software, body part, diagrams, and tables, 3) The scores are converted in to one of the action levels.

3. Rapid Upper Limb Assessment (RULA)

The standard selection procedure was approached which technically implicate with a motive for tangible outcome.

3.1 Observing and selecting the posture to assess: It is important to observe the posture adopted during the full work cycle prior to selecting the posture for assessment. The section could be the longest held posture or the worse posture adapted. It can be useful to estimate the proportion of time spent in the various postures being evaluated.

3.2 Scoring and recording the posture: Divide weather the left, right or both upper arms are at risk need to be assessed. Then score the posture of each body part using the software or the paper version. Use the RULA assessment diagrams to score the posture for each body part along with the forces/ loads and the muscle use required for that particular posture. Follow the score sheet to calculate the posture score for groups A and B if using the paper version. In the software version they are calculated automatically. The final score in the table give the grand score for the assessment of the posture. In the table A, upper arm, lower arm, wrist, wrist twit, and the effects of muscles due to the forces applied and in the Table B, neck, trunk and legs while performing a task.

3.3 Action level: The grand score can be compared with the list of action levels. In most cases to ensure that this guidance is used as an aid in efficient and effective control of any risks identified the action levels lead to a more detailed investigation.

Upper arm: According to the position of the upper arm deviation from the neutral posture scales 1, 2, 3 and 4 are given from the table by taking the medial plane as reference. Add 1 if the shoulder is raised and add 1 if the shoulder is abducted, subtract 1 if leaning or supporting the weight of the arm. Maximum score for the upper arm is 6.

Lower arm: If the lower arm angle is 60° - 100° score 1, 0° - 60° score is 2 and more than 100° score 2. Add 1 if working across the midline of the body or out of medial plane.

wrist: Add 1 if the wrist angle is 0°, score 2 if the wrist is 15°flexion or extension, score 3 for flexion extension of more than 15°. Add 1 if the wrist is bent away front he mid line. The maximum score for the wrist is 4.

Wrist twist: If the wrist is in the hand shake position score 1 and it is twisted away from the hand shake position, score 2.

3.4 Forces and load score for the arm: No resistance or less than 2 kg intermittent load or force score is 1. 2-10 kg intermittent load or force score 1. 2-10kg static load 2-10 kg repeated load or forces or 10 kg or more intermittent load or force, score 2. 10 kg static load, 10 kg repeated load or forces, shock or force with rapid build up, the score is 3.

Muscle use score: Raise the score by 1 if the posture is mainly static i.e., held for longer than 10 minutes, repeated more than 4 times in a minute.

Neck: If the neck is bend from 0° to 10°score 1, 10° -20° score 2, and more than 20° score 3. If the neck is in extension position score 4 for any angle. Add 1 if the neck is twisting. Add 1 if the neck is side bending,

trunk: If the trunk is in the neutral position score is 1, flexion from 0° to 20° score is 2, 20° - 60°, score 3 and more than 60° score is 4. If the trunk is twisted add 1. If the trunk is bending add 1.

Legs: If the legs and feet are well supported and evenly balance posture score is 1, and feet are not evenly balanced and supported score is 2.

Forces and load score for neck, trunk and legs: if there is no resistance or less than 2 kg intermittent load or force score is 0, 2-10 kg intermittent load or force, score is 1. 2-10 kg static load or 2-10kg repeated load or forces, 10kg or more intermittent forces or load score is 2. 10 kg static load, 10 kg repeated load or forces, shocks or forces with rapid build up score is 3.

Muscle use score is increased by 1 if the posture is mainly static i.e., held for longer than 10 minutes, repeated more than 4 times per minute.

3.5 RULA action levels:

Action level 1: a score of 1 or 2 indicates that the posture is acceptable if it is not maintained or repeated for long periods.

Action level 2: score of 3 or 4 indicates that further investigation is required and changes may be required.

Action level 3: score of 5 or 6 indicates that the investigation and changes are required soon.

Action level 4: Score of 7 indicates that investigation and changes are needed immediately,

It is crucial in using RULA, and it is suggested that a user in recording the posture for latest scoring.

Photographs are taken directly from the side and back to avoid parallax error.

Table 1: Action Level for RULA Scores, description and investigation required.

Action level	RULA score	Description	Investigation required
Action level - 1	1-2	Posture is acceptable	Not required
Action level - 2	3-4	Posture need investigation	Required for changes
Action level - 3	5-6	Posture need investigation to improve the posture	Required for taking action
Action level - 4	7	Posture not acceptable need further investigation for quick action	Immediate action required

4. Results and Discussions

During the first week of the training the trainee students face difficulty in identifying the various tools and its application in the industry related applications. After knowing the tools and its utilization, the training has started and during training RULA assessment tool is use to identify the vulnerability of the posture and the training is given by expert in posture correction who vast experience in the posture correction. The assessment is done in by the photographic memory technique at various levels of the training. During first three weeks the trainee students face the problems in holding the tools and their posture require immediate research to change since the final score of RULA assessment tool is in between 5 and 7. At this stage the trainee students undergo a physiological and psychological stress which can damage their muscle tissues of the body and the cognitive behaviour changes will occur soon after the physiological stress based on the sociotechnical context.

The static posture and repeated movements of the upper limbs cause transient musculoskeletal diseases that de-motivate their working ability because they are lacking an ideal position to handle the tools and the right approach to use them successfully. The operation time has increased to more than 30 minutes due to inappropriate tool usage and a loss of concentration caused by extreme weariness, resulting in a total abandonment of duties. The main causes of the abandonment of the work is due to the improper holding of the tool in the flexion, extension, radial deviation, ulnar deviation, pronation and supination positions causing

excessive musculoskeletal stresses at the wrist, forearm and upper arms. When they are unable to accomplish the exercise, cognitive changes appear on their faces in the shape of aggravation and rage; occasionally, they cry, and they stop working on the activity, which takes only 2-3 minutes to complete for an expert. At this moment the posture is much vulnerable to spoil the training and they won't learn the proper techniques to hold the tolls in an appropriate manner where the task completion is much lesser than that they expect and the RULA score will be 5-7 as shown in the figures 2 and 3, where the posture will shift to the condition where the expert has to give the suggestion to correct the posture without delay, so that they will come to the posture where the effort required is less and task completion is more and the RULA score at this position is 1-3 as shown the figure 6.

Because the trainee students' physical fitness levels are low, they will shift their posture back to the previous one because they are unaware of the techniques that will be used because training only plays a 10% role, and the rest of the role is by communication of the techniques and experience during the tasks[30], [39]–[42].

When safety is taken into account, communication between the instructor and the student is more crucial because it will improve the student's ability to complete tasks effectively, will help them be completed in less time, will help to reduce the wear and tear on the muscles caused by the instructions given, and will help to prevent physiological stresses.

Students' industry-ready skills are improved through skill development, enabling them to earn higher salaries and lead better lives.

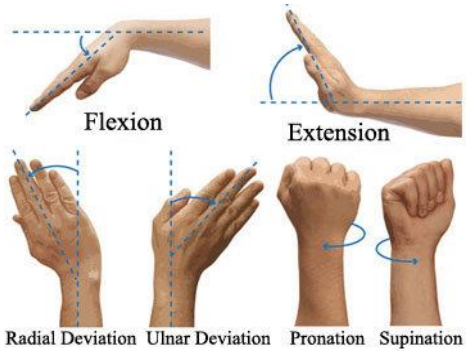

Figure-1: flexion, extension, radial deviation, ulnar deviation, pronation and supination gestures

Fig-2: RULA score of 5-7 while making on the work piece

In the figure 2, the trainee student is measuring the assigned work item in preparation for marking and cutting it. In this position, the upper portion is bent more than 45°, creating considerable pain in the lumbar region, and his RULA score is 5-7 due to posture changes during marking and measurement and pronation position of the wrist, as well as the increase in the score due to upper arm and forearm.

Fig-3: RULA score of 5-7 while cutting a metal piece.

In the figure 3, the trainee student is holding the hack saw for the purpose of cutting a metal piece, and his upper limbs are moving more than 4 times per minute, and his lumber region is effected and has the application of more than 10 kg force while cutting, giving an RULA score of 5-7, where immediate research is done and action level is applied for the improvement in the student's posture to reduce the permanent injury.

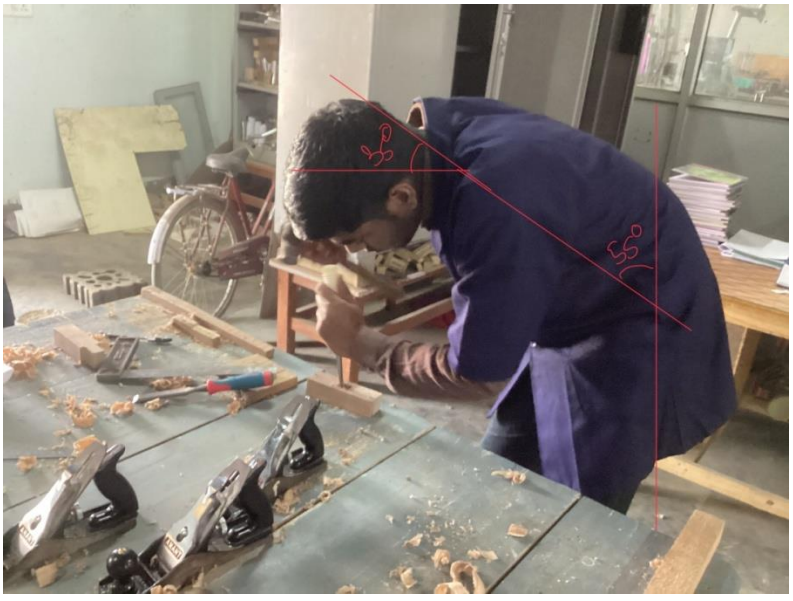

Fig-4: RULA score of 5-7 while chiselling a wooden block.

Figure 4 shows the trainee student working with a chisel, in the awkward posture where his spine is having a bend of more than 45° and his forearm and upper arm are working repeatedly

for the chiselling purpose and due to repeated movement of limbs, bent posture cause a RULA score of 5-7 since his posture changes repeatedly and

Fig-5: RULA score of 3-4 while preparing a joint using sheet metal work

In the figure 5, trainee student is doing sheet metal work for preparing a pipe by using different operations like marking, cutting, bending, joining. In these process, are comparatively taking less effort due to that the posture is considerably good in nature and she has a RULA score of 3-4 where the action level is to consider her posture not to bend completely so that her lumbar region will get less stress and in this condition the psychological stresses are also less and work will be completed faster.

Fig-6: RULA score of 1-2 while cutting the work piece

In the figure 6 the trainee student gets sufficient experience like how to keep his posture while cutting so that the stresses in the lumbar region is minimized to an extent and the work completion rate is highly increased and the forces applied while cutting is less than 2 kg and the cutting is a repeated to and from motion of the hands along with the hacksaw and the maximum time taken to compete the task is less than 5 minutes in this position and there are no psychological stress are occurred since the physiological stresses are minimum.

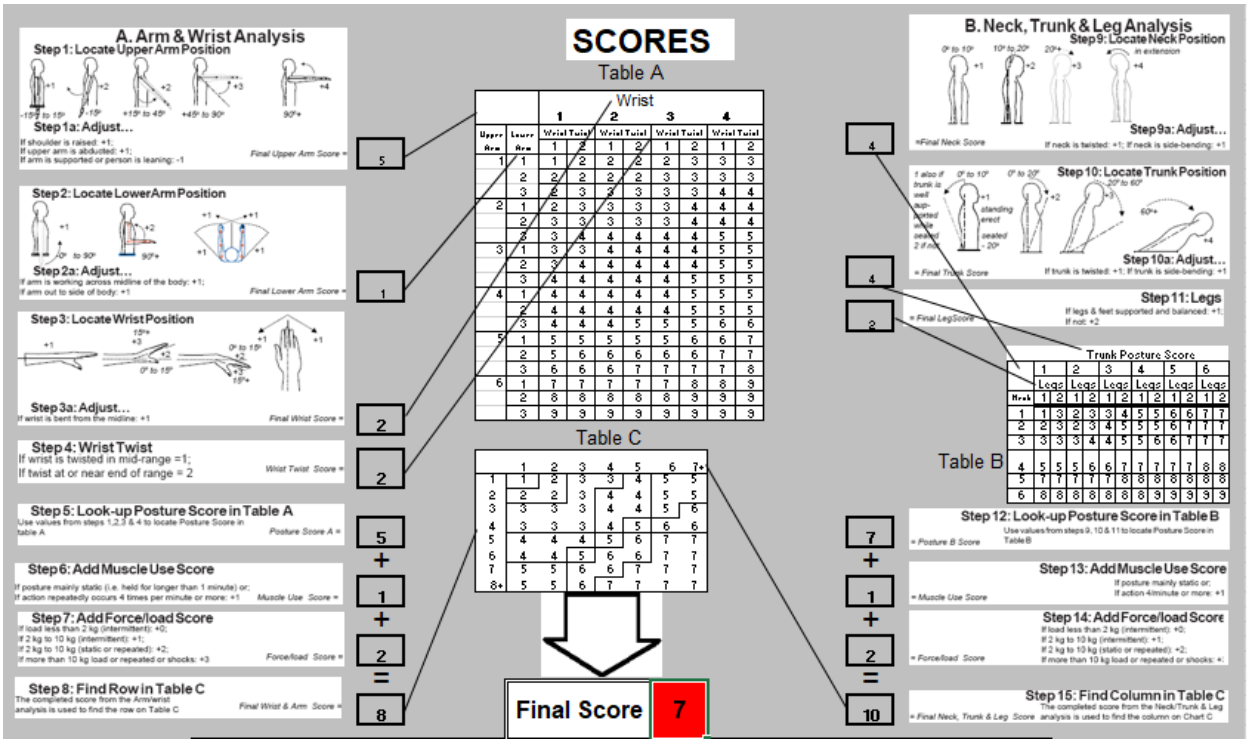

Figure 7: RULA software scores for the highest score of 7 and awkward posture to take immediate action for posture correction to reduce the physiological stresses.

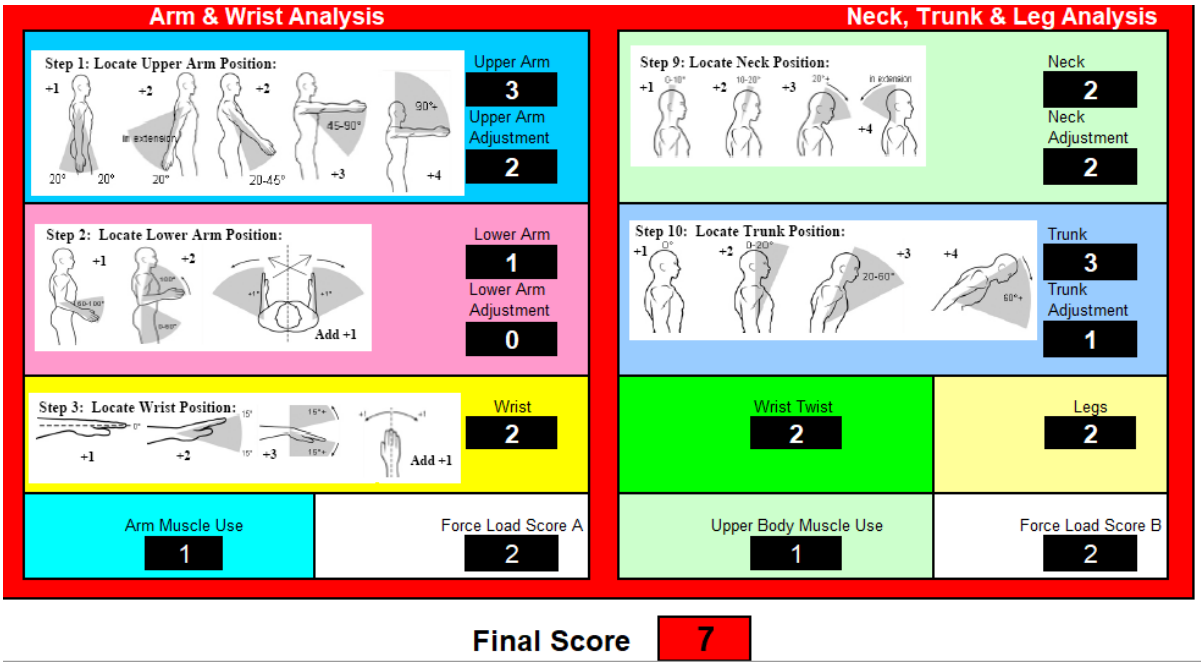

Figure 8: Posture analysis Using RULA when the posture is having high RULA score and awkward posture of the trainee student during early stage of training.

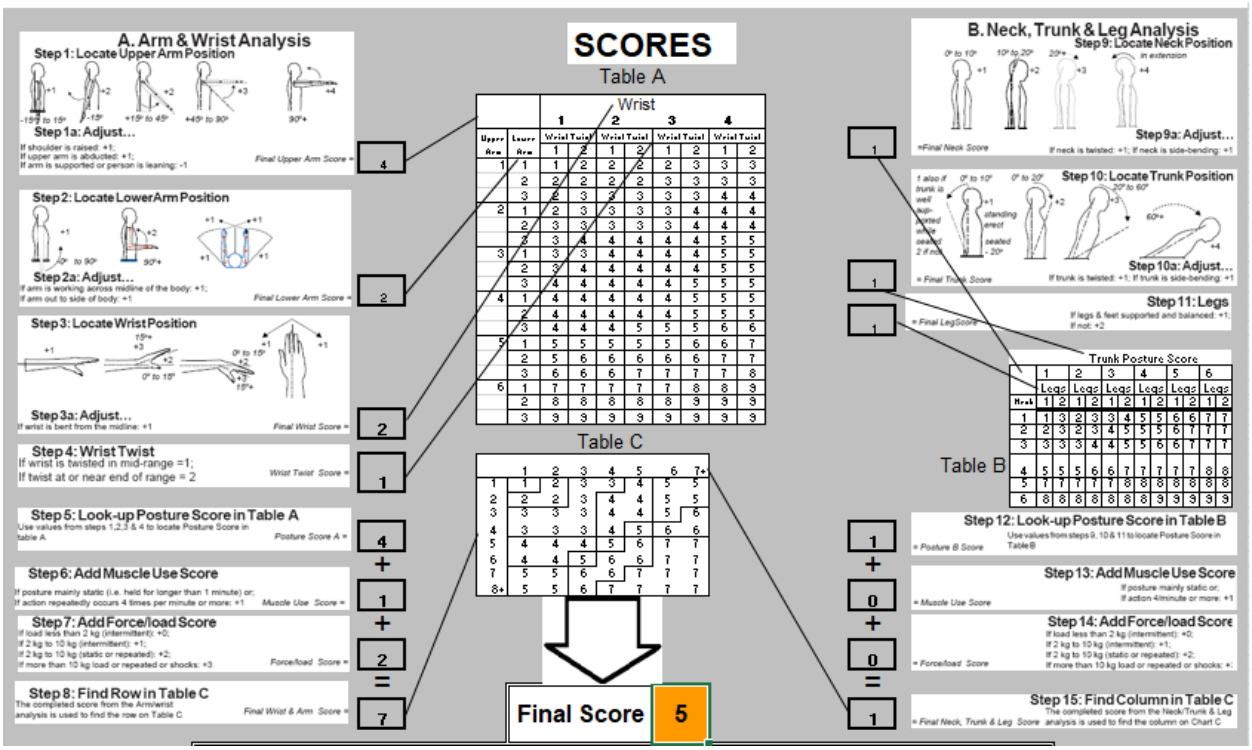

Figure 9: RULA software scores for the moderate score of 5 and posture correction needed to some extent to reduce the physiological stresses

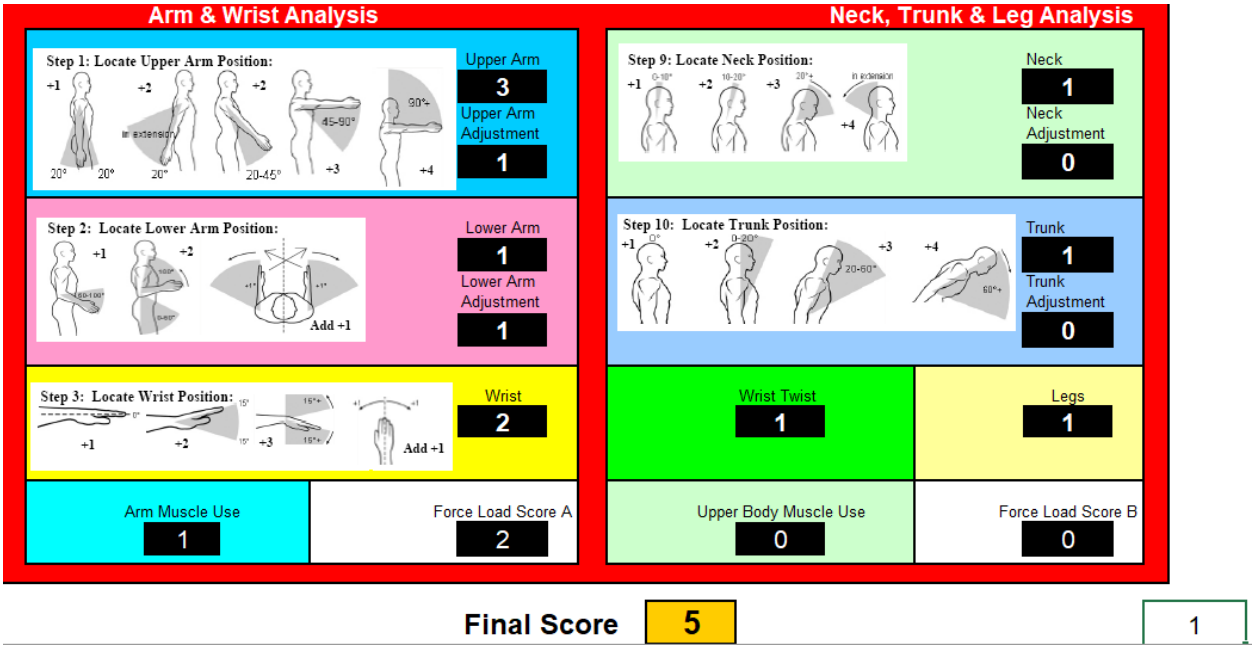

Figure 10 : Posture analysis Using RULA when the posture is having high RULA score and awkward posture of the trainee student during early stage of training.

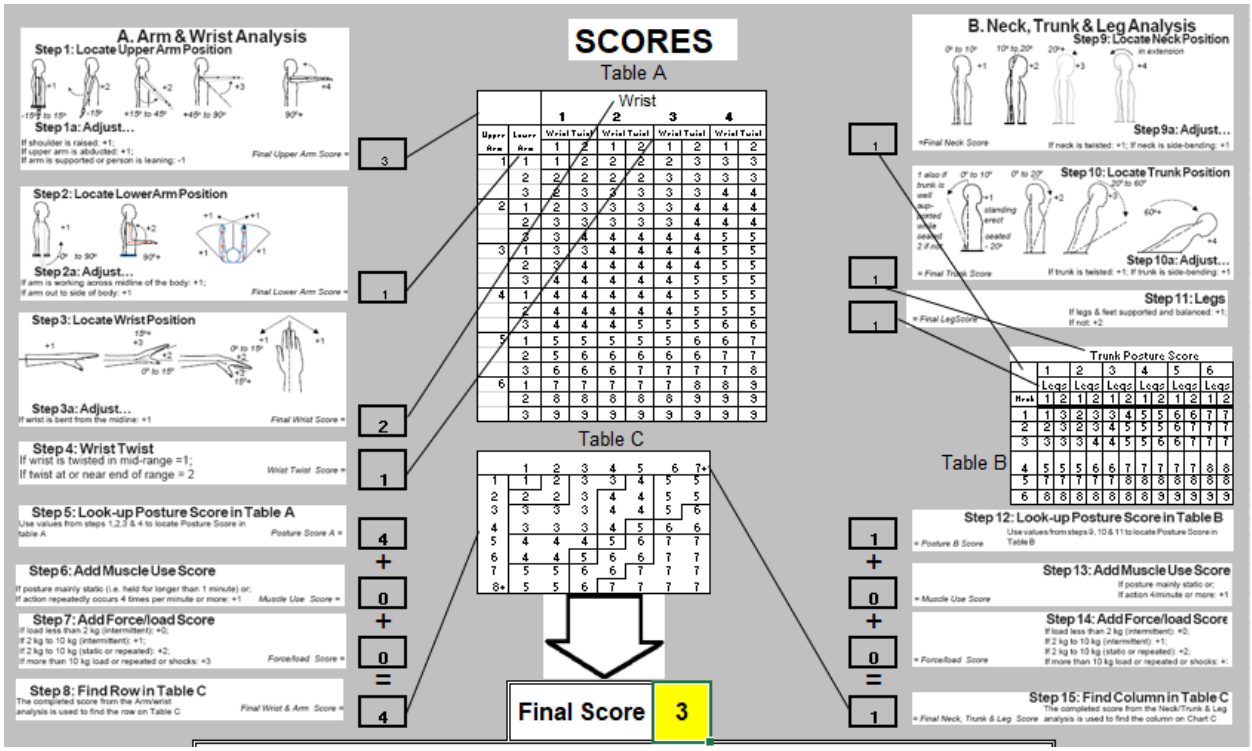

Figure 11: RULA software scores for the highest and awkward posture to take immediate action for posture correction

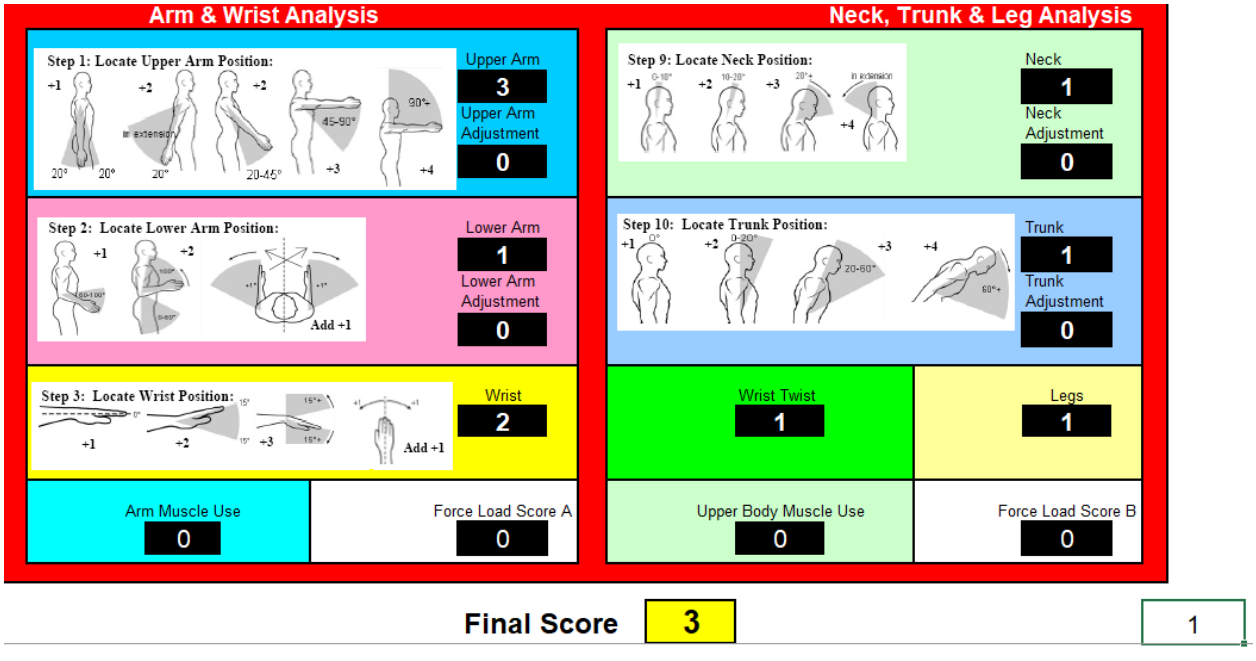

Figure 12: Posture analysis Using RULA when the posture is having high RULA score and awkward posture of the trainee student during early stage of training.

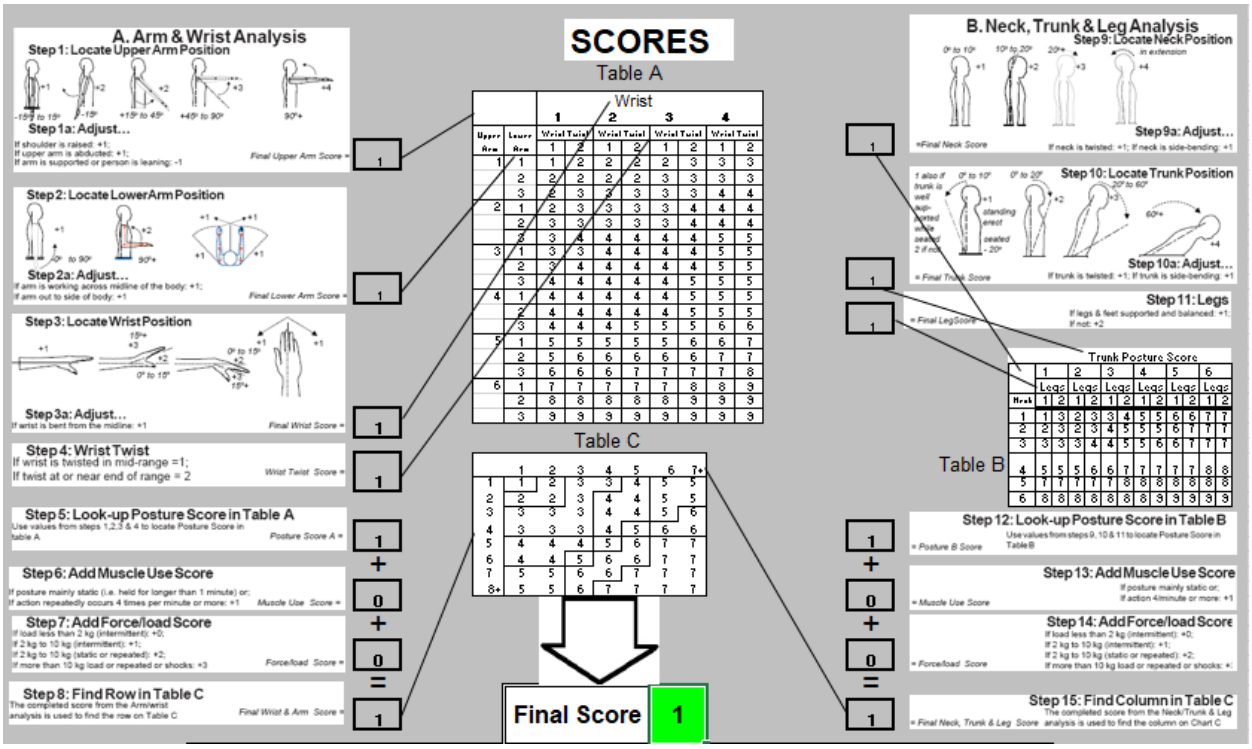

Figure 13: RULA software scores for the good posture

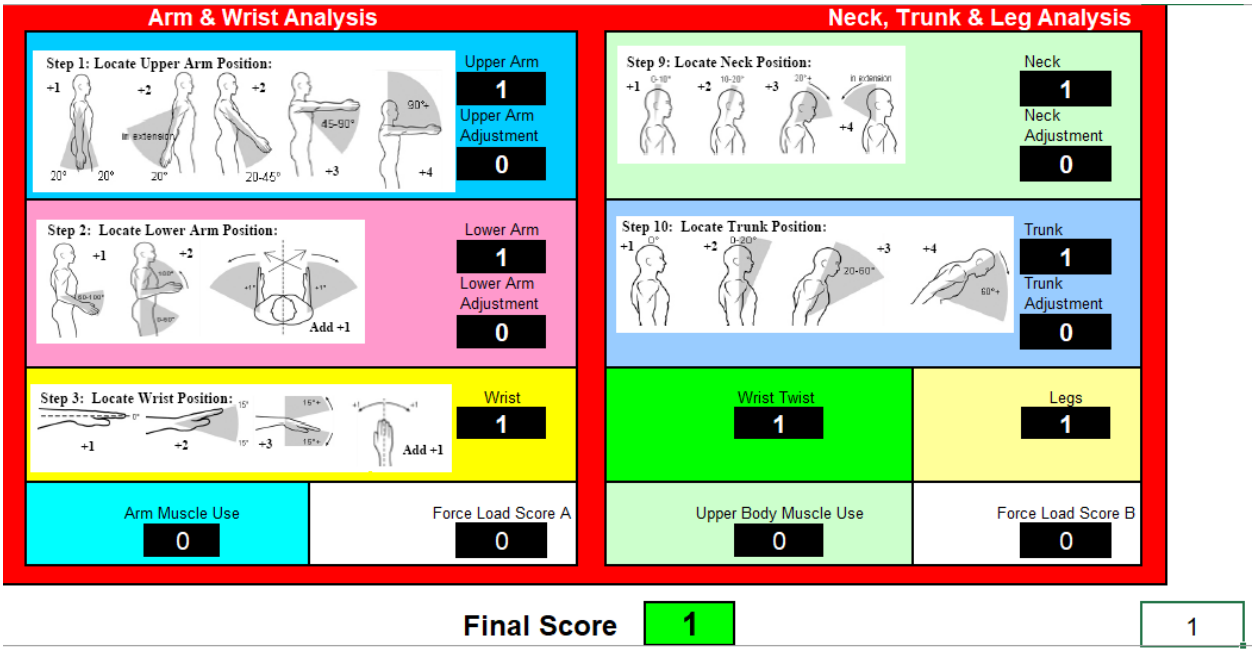

Figure 14: Posture analysis Using RULA when the posture is having low RULA score and good posture of the trainee student after gaining experience.

5. Conclusion: Training is essential for the development of skills in the youth, especially in a country like India, which has a huge potential to replace the global need for skilled with immense potential in and adaptability because the growth of industries in the near future can mitigate unemployability and open the doors for new jobs and opportunities in the business sector, particularly in the northeast region of India, where natural resources are abundantly available.

The biggest disadvantage of the northeast region is its lack of rail and road connectivity, as well as its low employability due to a lack of industries and people who rely on natural resources and have little communication with potential prospects.

Due to the abundance of natural resources, the relative scarcity of training facilities, the lack of awareness of these facilities among the general public, and the need for people to learn the jargon associated with new technologies, many people have the opportunity to start their own businesses. In addition to technical and training skills, communication and soft skills are also very important.

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