



CONSOLIDATED REPORT

**Electric Vehicles, Refrigeration & Air-Conditioning Systems, and
integrated Teaching Methodology sessions**



CEMCA

In association with BSDU Jaipur and WTC, Sri Lanka

Acknowledgement

We, at BSDU, earnestly acknowledge the immense contribution of **Prof. Madhu Parhar**, Director, Commonwealth Educational Media Centre for Asia (CEMCA) and **Mr. Saurabh Mishra**, Programme Officer (Skills), Commonwealth Educational Media Centre for Asia (CEMCA), for conceptualizing and making possible the highly need-based and demand driven workshops for upgrading the capacity of the Vocational Trainers of Sri Lanka.

We are sure that this excellent endeavour by CEMCA will have a profound impact and result in the qualitative enhancement of the Vocational Trainers of Sri Lanka from the perspective of both knowledge & the methodology its dissemination.

We consider it a privilege to be associated with CEMCA and WTC, Sri Lanka and be a part of this value-driven and impact-oriented mission.

Prelude

Bharatiya Skill Development University (BSDU) is recognised as the pioneer and leading institutional skill provider in the country. It is the first university in India to exclusively offer skilled-based programs. The institution focuses on providing holistic skills training using the famed Swiss Dual System; it is a leading force and significant contributor to the skill and entrepreneurial ecosystem of the country.

Commonwealth Educational Media Centre for Asia (CEMCA) is an international organisation established by the Commonwealth of Learning (COL), Vancouver, Canada, to promote meaningful, relevant, and appropriate use of information and communication technologies to serve the educational and training needs of Commonwealth member states in Asia. CEMCA strives to increase the access to good quality vocational training digital content that aims at developing the skills of the youth in the country. CEMCA also focuses on building capacity of vocational trainers and mainstreaming the skilled and semi-skilled workers.

Wayamba Technical College is a leading Private Vocational and Technical Training provider in Sri Lanka. Wayamba Technical College is recognized as a 4 Star Training center for conforming to the (QIS) Quality Improvement System, (QMS) Quality Management System and system focusing on the scope of Technical and Vocational Education. It is the largest NVQ Accredited private training provider in Sri Lanka and is highest annually NVQ Certificate provider among private and public sector in Sri Lanka. The Sole Private NVQ Diploma accredited institute for Automobile Technology in Sri Lanka. It owns largest Academic Hybrid Workshop in South Asia.

CEMCA in association with BSDU Jaipur and WTC, Sri Lanka organised two Workshops on ‘Electric Vehicles’ and ‘Refrigeration and Air-Conditioning Systems’ from 22nd-26th September 2021 and 29th September-02nd October 2021 respectively. These Workshops were also accompanied with an integrated training session on Teaching Methodology. During the course of the workshop, the participants had the unique opportunity to interact with eminent experts who hold great experience and knowledge in their respective fields. The key objective of these Workshops is to train the Vocational Trainers in Sri Lanka and thereby propagate a smoother flow of knowledge dissemination across the different institutions. Experts from two distinct schools at BSDU Jaipur took the initiative to train the participants in relevant areas and concepts. The Workshops included two days of synchronous training and 2 days of asynchronous support each.

To ensure a steady industrial growth, there is a distinctly discernible need for skilled professionals. For creating highly skilled professionals in a country, there must be a pool of highly competent Vocational Trainers. Hence, it can be inferred that this valuable initiative of CEMCA to upgrade the proficiency level of the Vocational Trainers in Sri Lanka is extremely logic-driven.

Given below is a table comprising the details of both the Workshops that were held.

Workshop	Date	Expert	Number of Participants
Electric Vehicles	22 nd and 23 rd September 2021	Col. Sanjay Gangwar Mr. Felix Lager Mr. Kantaprasad Kodihal	354
Refrigeration and Air-Conditioning Systems	29 th and 30 th September 2021	Prof. Shishir Chandra Bhaduri Mr. Najmool Haq Mr. Devendra Pathak	161
Integrated Training Session on Teaching Methodology	24 th and 25 th September 2021 01 st and 02 nd October 2021	Mr. Purandar Sengupta	244 and 106

Promotion and Registration

The Workshops were promoted through both offline and online modes. The posters were circulated through social media and registrations were invited through the means of Google Forms.

Background of the participants

The participants were mostly from Wayamba Technical College, Sri Lanka; there were participants from other institutions as well. Students and professionals from the respective fields were also a part of the workshop, apart from vocational trainers.

1. Report of the Workshop on Electric Vehicle (eV) and Teaching Methodology

Held from 22nd September 2021 to 25th September 2021

About School of Automotive Skills BSDU Jaipur:

The School of Automotive Skills came into existence in 2017, with a mission to impart knowledge, technical skills & hands-on training in automobiles, focusing on four wheelers & three wheelers, both petrol & diesel, and two wheelers. The skill programs of the school are designed to introduce the students to the operation of today's complex vehicles by giving them a comprehensive understanding from basic to advanced, of various automotive systems like transmission, brakes, steering, suspension, Electrical & Electronics, and Engine Performance, etc. Students under this program will acquire the necessary skills to diagnose and repair mechanical and computer controlled electronic systems on the latest models of automobiles.

Logical Rationale of the Workshop

Countries all around the world are concerned about carbon emissions and rising levels of pollution. This has several adverse effects on the environment that we live in and are serious threats to the survival of mankind. Scientists around the world are trying to combat the problem of pollution and its adversities by venturing to find 'green' solutions that would reduce or eliminate the adverse impact of pollution.

Vehicular emission is one of the leading contributors to global air pollution. Apart from pollution, vehicles running on conventional sources of energy are also facing yet another challenge in the form of increasing resource consumption. The fossil fuel supplies on the planet are being consumed faster than they can be replenished, and are likely to run out in the near future. This means that mankind would have to find newer, alternative sources of energy to fuel the future vehicles.

Many countries around the world including USA, UK etc. are planning elaborate measures to replace the conventional vehicles with electric vehicles (eVs) to reduce the carbon emissions, contain air pollution and in order to create alternative fuel sources for the future generations. With the current state of developments, it seems that electric vehicles are the future of transportation. Even in developing countries like India, Sri Lanka etc. where pollution, and energy and fuel consumption are major issues, electric vehicles are a suitable option. Electric vehicles and its market is slowly making their presence in the global market and hence it is imperative for stakeholders all around the world to know about its essentialities.

Hence, this workshop was organised to apprise the vocational trainers about different aspects of the electronic vehicle sector. Different topics dealing with electric vehicles were discussed which included imparting knowledge from both theoretical and technical domains.

Thus, it can be affirmed that the Workshop was motivated by a strong logical rationale. It was held from **22nd September 2021** to **25th September 2021**. Out of this, the initial two days focused entirely on electric vehicles (eV) and the following two days indulged in imparting knowledge on Teaching Methodology.

Objectives

- To introduce the participants to electric vehicles (eV) and its evolution
- To apprise the participants with situations in Europe and leading markets
- Imparting knowledge about different rules and regulations pertaining to electric vehicles
- To disseminate knowledge regarding the functioning of electric vehicles, especially the battery
- To help the participants understand the production of electricity in countries like India, Sri Lanka, Switzerland etc. and how it can be utilized in the eV sector
- To help the participants comparatively comprehend the differences between and conventional vehicles

Topics

- Training required for eV sector
- Rural/Urban Divide
- Repair Infrastructure
- Auto-Mechanics or Electricians
- Retro-Fitment
- Basic Production Steps
- History and Evolution of Electric Vehicles
- Lithium Batteries and Their Source
- Market Demands and Environmental Consequences
- Cobalt and the Conditions in Africa
- Conditions in Sri Lanka
- Electric Vehicles and Their Benefits
- Future of Electric Vehicles
- History and Types of Batteries
- Electric Vehicle Sector and Global Initiatives
- eV Trend: India, Sri Lanka, and Global
- Status of Electric Vehicles in Sri Lanka
- Anatomy of Electric Vehicles

Methodology

- Interactive discussion
- PowerPoint presentations
- Question & Answer sessions
- Explanation through pdfs
- Story telling

Proceedings

Programme Schedule

Day 1: 22nd September		
Time	Session Topics	Resource Person
10:00 AM-11:00 AM	Inaugural Speech	Mr. Saurabh Mishra Dr. Rajdeep Deb Colonel Sanjay Gangwar Mr. Felix Lagger Mr. Kantaprasad Kodihal
11:00 AM-11:30 AM	Training required for eV sector Rural/Urban Divide Repair Infrastructure	Colonel Sanjay Gangwar
11:30 AM-11:45 AM	Auto-Mechanics or Electricians Retro-Fitment	
11:45 AM-12:00 PM	Basic Production Steps History and Evolution of Electric Vehicles Lithium Batteries and Their Source Market Demands and Environmental Consequences	Mr. Felix Lagger
12:00 PM-12:15 PM	Training required for eV sector Cobalt and the Conditions in Africa Conditions in Sri Lanka	
12:15 PM-12:45 PM	Electric Vehicles and Their Benefits Future of Electric Vehicles History and Types of Batteries Electric Vehicle Sector and Global Initiatives	Mr. Kantaprasad Kodihal
12:45 PM-1:30 PM	eV Trend: India, Sri Lanka, and Global	

	Status of Electric Vehicles in Sri Lanka Worksheet Discussion	
Day 2: 23rd September 2021		
10:00 AM-12:30 PM	Anatomy of Electric Vehicles Worksheet Discussion	Mr. Kantaprasad Kodihal
12:30 PM-1:10 PM	Participants' Opinion Question and Answer Session	
1:10 PM-1:25 PM	Closing Remarks	Dr. Rajdeep Deb

4 Day Teacher Training Program (TTP) on EV Technology with CEMCA & TVEC Sri Lanka

Did the session live up to your initial expectations?

Response	Percentage
Yes	95.4%
No	4.6%
Not sure	0%

Would you recommend this TTP to your colleagues?

Response	Percentage
Yes	83.1%
Maybe	16.9%
No	0%

BSDU

A screengrab of the session in progress (Experts are highlighted)

The Workshop was inaugurated by Dr. Rajdeep Deb, the principal of the School of Entrepreneurship, BSDU. He discussed the growing significance of electric vehicles in countries across the world, and their impact on global energy consumption and pollution levels. He advocated the need for acquiring knowledge about this rising sector that is the future of the automobile industry and its sustenance. The Workshop was then later steered by experts in the field of automobiles. They interacted with the participants and discussed different topics related to electric vehicles. A step-by-step approach was adopted to help the participants comprehend these different aspects and gain an in-depth insight into them.

About the Experts

Colonel Sanjay Gangwar, is an alumnus of BITS Pilani, who has specialised in Vehicle Technology during a 28-year long stint in the Armed Forces. He has extensive academic experience; has been a part of College of Military Engineering, Pune, and has been Dean of Faculty of Vehicle Technology at EME School, Vadodara. He has worked extensively in the field of repair of vehicles and battle tanks involving modern technology and repair techniques.

Mr. Felix Lager is a Graduate in Technics, Math and Physics. He has done a two-year Apprenticeship in Car Mechanic and a three-years Diploma (1989-1992) in Automotive Engineering. He has 27 years of vast experience as Automotive Professional (Teacher & Instructor for all categories of vehicles). He is currently the Project Manager at School of Automotive Skills, BSDU, Jaipur.

Mr. Kantaprasad Kodihal is Training and Development Officer at FLEECA, Jaipur, where he trains service engineers, drivers etc., does coursework and content development, and also engages in product design and development. He is also a PhD scholar enrolled in BSDU, Jaipur. His research focuses on 'Design and Development of a Thermionic Regeneration System for Waste heat recovery in Hybrid Electric Vehicle applying Reverse Engineering'.

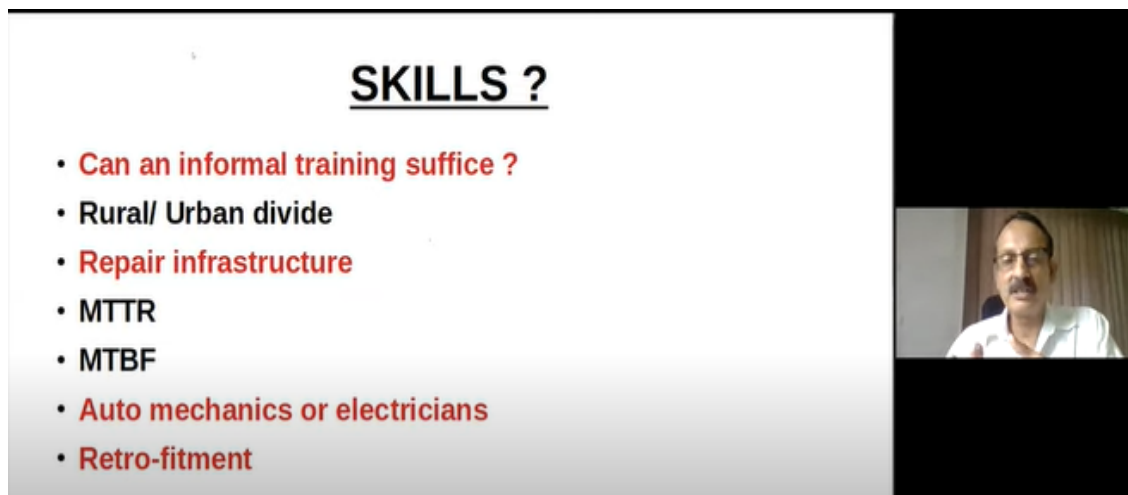
Facilitation Session by Colonel Sanjay Gangwar

The facilitator discussed the following topics with the participants. His rich experience in the Armed Forces and elsewhere served well in the discussion of different topics related to the field of automobiles and the specific areas that were concerned with electric vehicles. The discussions focussed on the scope of electric vehicles in countries like India, Sri Lanka etc.

- **Training Required:** The facilitator discussed the need of specific training that is required in the handling of electric vehicles. He also discussed how they are different from vehicles that run on conventional fuels. The focus of discussion revolved around the question whether informal training would suffice in the handling and maintenance of electric vehicles.
- **Rural/Urban Divide:** The facilitator explained to the participants about the perspective of different companies before investing in a particular economy or market. The company will undertake a detailed study of different parameters concerning the automobile industry in a certain country before investing and beginning production. It is only through this

understanding that a company can ascertain the conditions it is going to establish itself in and is key to its success. The knowledge of the rural-urban divide will help in better comprehension of different segments and their demand. This will also enable the company to develop a perception about different aspects such as infrastructure, staff, training of mechanics etc.

- **Repair Infrastructure:** The facilitator proceeded to discuss the repair infrastructure that a company is supposed to put in place after its establishment. The repair infrastructure is basically an after-sales service segment set up to attend to the repair requirements of a unit after it has hit the road once. In regard to this particular topic, the facilitator discussed **MTTR** and **MTBF**. **MTTR** stands for **Mean Time Taken to Repair**. The customer always wanted the MTTR to be the lowest. The MTTR will remain high if a company does not have the required logistics, skilled technicians and proper infrastructure. Now, **MTBF** stands for **Mean Time Between Failures**. A customer always wants the MTBF to be very high so that the cost of maintenance is less and infrequent, the vehicle is available for more time between each service. This is an area that most of the electronic vehicle manufacturers are working on.

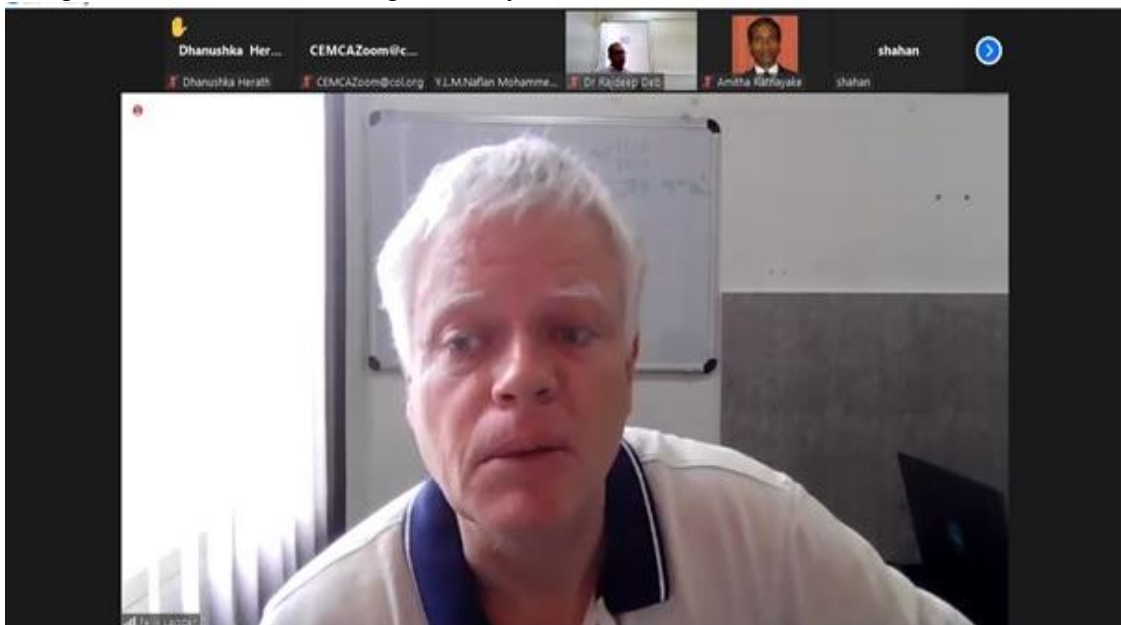


A screengrab of Colonel Sanjay Gangwar's session

- **Auto-Mechanics or Electricians:** The facilitator touched upon the importance of the auto-mechanics in the eV sector to also be trained as electricians in the first place due to the nature of the vehicle. The automotive and electrical skills need to be merged; this is an important area for the specific training faculty/institution to work upon.
- **Retro-Fitment:** In this topic, the facilitator dealt with the practice where the conventional engines of vehicles are replaced with electronic engines to make them a part of the eV segment. A lot of states across India have already encouraged policies to promote retro-fitment. Yet, there are a few concerns like safety that need to be studied on a short and long-term basis before arriving at concrete decisions on this particular matter.

Mr. Felix initially discussed about electric vehicles in Switzerland and different conditions there like availability of electricity, infrastructure etc. He also talked about the contemporary developments in the field of automobiles, in context to different companies. He discussed the imminent concerns and problems in the field, for instance, the availability of lithium and the production of batteries. He also discussed the latest laws concerning the industry, especially the BS VI norms and how they help the cause of better air quality. He also talked about the different challenges that are related to electric vehicles, primarily the need for charging infrastructure and the waiting time involved.

- **Basic Production Steps:** The lithium used in the electric vehicles' batteries is mined in Chile and sent to Japan, where a company produces the batteries. It is then shipped to an assembly line in the US (here, Tesla) from where the vehicles are shipped world over. With this, the facilitator opines that it is not such a 'green' solution as it is shown to be, and that there are pressing issues that need to be addressed in terms of saving resources and energy reserves.
- **Evolution of Electric Vehicles:** The facilitator shed light into the history and evolution of electric vehicles. He cited the Lohner-Porsche Mixed Hybrid that was made in the 1900s. This was the first electric-gasoline hybrid to be ever made. With this the facilitator discussed that the concept of electric vehicles is not as novel as it is presented to be by the modern-day tech-giants.
- **Lithium Batteries and Their Source:** The facilitator discussed the procedure of how electric vehicles are produced. He talked about the different stages of production. Battery production is one of the most essential stages in the production of an electric vehicle. Most electric vehicles in the present-day world run on Lithium-based batteries. This is an extremely rare element and is mainly found in Chile. It is mined in Chile and sent to other countries, probably in Asia, for the production of batteries. One gram of Lithium is used for the battery of a smartphone. An electric vehicle requires nearly 15 kilograms of lithium for a single battery unit.



Screengrab of Mr. Felix Lager's Session in progress

- **Market Demands and Environmental Consequences:** The facilitator explained that the Asian market is much bigger than the European market as the population is much substantially more in Asia, especially in countries like India where the population is nearly 1.4 billion. The requirements of electric vehicles in the Indian market would far outnumber the demand in European countries.
- **Environmental Consequences:** For this big a market, the amount of Lithium required for the large number of electric vehicles would be a challenge as Lithium is rare; this element is found in water in the South American region. 1 litre of water contains one gram of Lithium, which means that a lot of water too would be wasted in such a vast production of Lithium. The facilitator raised the concerns that the farmers in the surrounding region in South America face adverse scarcity of water for their crops. Almost 7 million litres of water is used up by the lithium producing mines in the region. The region is naturally dry and such outrageous use of the water resources has had a negative impact on the ecosystem in the region, affecting both plants and animals alike.
- **Cobalt and the Conditions in Africa:** Cobalt is also used in the batteries in marginal amounts. The facilitator talked about the conditions in Africa and also shared some heart-wrenching pictures where children work to dig up the mineral. This is a dangerous situation for them.
- **Conditions in Sri Lanka:** The facilitator discussed the conditions in Sri Lanka and pointed out that a majority of the country's electricity is produced from coal reserves and only a small amount is produced from solar or wind energy. In further discussion, the facilitator stated the urgent need for use of renewable forms of energy and substantiated with data that only a negligible amount of energy produced in the country came from renewable sources. He urged the current generation to be aware of the situations and work towards better solutions than what are at use presently.

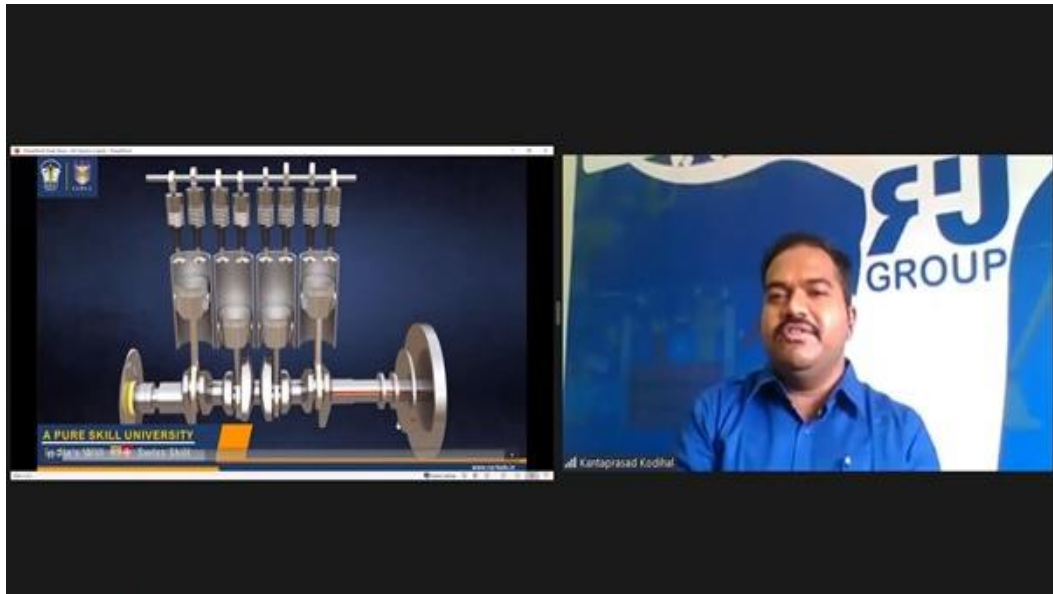
Facilitation Session by Mr. Kantaprasad Kodihal

Mr. Kodihal further elaborated on the topics that were brought into discussion by Mr. Lager. He discussed about the history of electric vehicles, the batteries used in these vehicles, the eV market in Sri Lanka, the global initiatives in the field and various other topics. Given below are major topics that the facilitator discussed with the participants.

- **Electric Vehicles and Their Benefits:** The facilitator discussed the major reasons that urge the need to switch to electric vehicles. In his talk, the facilitator stated the following reasons to choose electric vehicles over combustion models: controlling air pollution, lower operational cost and maintenance, better performance etc. He explained how the use of electric vehicles can help in bringing down the air pollution levels significantly. The cost of maintenance is relatively lower in eVs. He also stated that the use of electric vehicles is a solution for the current and upcoming fuel crisis as fossil fuels are being used up at a brisk pace. The facilitator also discussed the difference between engines in electric vehicles and conventional ones, pointing out how electric engines/motors perform better than the other. Electric vehicles are also safer and much quieter than the conventional ones. Another point that the facilitator made was about the new techniques used in the electric vehicle sector, for instance, its utility as a storage

unit or integration with the grid. The diversification of transportation fuels is another benefit; the introduction of electric vehicles would significantly cut down the dependence on petrol and diesel.

- **Future of Electric Vehicles:** The future electric vehicles will improve their performance towards 300-600 kms per charge. The battery prices and therefore the overall price of electric vehicles have come down significantly and are becoming on par with the conventional models. Fast charging options are also being worked upon and more models are being made available in the market.



Screengrab of Mr. Kantaprasad Kodihal's session

- **History of Electric Vehicles:** The facilitator explained the first crude electric vehicle was developed around 1832 by **Robert Anderson**, but electric vehicles came into practical existence only in the 1870s. This means that electric vehicles were in conception around the same time as the development of conventional vehicles, but the development of this idea impeded because of several factors including availability of fuels, storage facilities etc. In a brief timeline, the facilitator stated that the first eV made its debut in the 1890s. In the 20th century, the cost of eVs remained much higher than conventional vehicles, and hence fell out of contention. But the fuel shortage in the 1970s brought the concept of eVs back into the limelight. In the 1990s, EPA came into existence with new norms on emissions. In 1997, Toyota introduced the Prius Hybrid model, and in 2006, Tesla began to produce all-electric sports cars.
- **Brief History of Tesla:** Named after the famous inventor and engineer **Nikolas Tesla**, the Tesla company was founded by Martin Eberhard and Mark Tarpenning in California. It brought out the Tesla Roadster in 2008 (which achieved nearly 395 kms on a single charge) and has since then been producing electric sports cars. Its current CEO is **Elon Musk**.
- **History of Batteries:** Flooded Lead Acid batteries have been used since the 1880s and are still in use in many vehicles. This battery can be used for eVs but it does not produce much power and the storage capacity is also not great. After this, Nickel Metal Hydride

batteries came into the picture with the increase of electric components in vehicles. These batteries began to be used in the hybrid models. Subsequently, the Lithium-ion batteries came into existence, and is now the fastest growing system that is used across all segments.

- **Types of Lithium Batteries:** These batteries come in all forms from button cells, pouch cells, prismatic cells, to cylindrical cells. Each battery has a set of any of these types of cells to form a unit and meet the necessary power requirements for the vehicles. Lithium-ion and Lithium-metal batteries have higher current and longer runtime as compared to other battery types. In the near future, the production of Lithium batteries is going to scale up resulting in significantly lower costs. This type of battery is used in many products apart from vehicles.
- **Electric Vehicle Sector:** The facilitator showed that the electric vehicles sector is booming and it has made its presence felt across all sectors from small cars to hatchbacks to SUVs and sports cars. All major manufacturers have entered the electric vehicle sector.
- **Global Initiatives:** The facilitator discussed the different initiatives by major countries across Americas, Europe and Asia to promote the use of electric vehicles. He talked about how the governments have to rethink certain existing policies and refigure them for the betterment of the respective country. There has to be a ‘push’ in the form of different initiatives bring to about reforms. All major countries have set their goals on shifting their major transportation channels towards the electric alternative from fossil fuels, with the vision to create a green impact and better environment. He stated how norms like BS VI have brought tougher restrictions regarding emission control. He pointed out that Maruti Suzuki disowned their diesel car segment as a result of the introduction of the BS VI norms; he also cited the possibility of eliminating the petrol models too in the future. The governments across the globe are also taking various measures to support the cause of electric vehicles like making the market flexible for major companies to invest and produce, reducing the taxes on both the manufacturer and the consumer ends, provision of subsidies, convenience in registration etc.
- **Global eV Trend:** The facilitator presented a graph of the electronic vehicles sales of different countries across the world. It showed that countries like Norway, Sweden etc. are doing exceptionally well in this regard, while other countries are slowly picking up the trend.
- **India’s Trend in Electric Vehicles:** The facilitator discussed the FAME policy by the Indian government to push faster adoption of electric vehicles in the country, targeting 31st March 2024. India is the fifth largest automotive industry in the world and slated to be third by 2030, which means that India can be a game changer. The country has shown an upward trend in the adoption of eVs barring the car sector, in the financial year 2020. The facilitator showed the models of electric cars and two-wheelers that are presently available in India.
- **Status of Electric Vehicles in Sri Lanka:** The facilitator discussed the air pollution scenario in Sri Lanka and pointed out with evidence that how the transport sector is largely responsible for the air pollution. The combustion of fossil fuel by conventional

vehicles is a major factor contributing to high pollution levels. Hence, the Sri Lankan government has set a target to electrify all Light Duty Vehicles by 2040, and targets all state-owned vehicles to be electric-powered by 2025. The government also slashed the taxes on eVs and raised the taxes on other vehicles up to 200% which led to a massive revenue drain. Several new policies have been put into place and new measures taken to import and promote the use of eVs. Measures were also taken to curb pollution levels by discouraging vehicles older than 10 years in the current vehicle population. Presently there are commercial electric vehicle charging points at many places in Sri Lanka and also an app called Plug-Share is in place to show the availability of charging stations. These measures are significant because the private vehicle population is increasing rapidly in the country. Sri Lanka also manufactured South Asia's first electric sports car named **Vega EVX**.

- **The Anatomy of Electric Vehicles:** The facilitator also demonstrated the basic anatomy of electric vehicles by choosing Tesla Model 3. The facilitator discussed the different components in the specific model like charging socket, power train, motor, inverter, battery etc. The motor is the heart of an eV and plays the role of the engine in conventional vehicles. Tesla uses the induction motor principle.

Learning Input, Output and Outcome

- The participants were apprised about the history and evolution of electric vehicles. They were briefed about the initial developments and models, and were also enlightened about the latest developments in terms of technology, production, policy and availability. This knowledge will help the participants to understand the concept of electric vehicles, its significance and the role it can play in the future.
- The participants were told about the pressing concerns in the environment, especially the concerns relating to the rising pollution levels around the world. This will create an awareness in the participants about the major issues in the global scenario. One hopes that this will prompt them to adopt greener transportation options in the future.
- Different technical issues relating to production and use of electric vehicles were discussed by the experts. It was made clear that though electric vehicles are a far better alternative for the future, one must be aware of the different concerns that they come with.
- The benefits of adopting electronic vehicles were disseminated during the sessions. This will encourage the participants to adopt electric vehicles or transportation facilities in the future.
- Different policies and initiatives in various countries and around the world were briefed during the sessions. This will give a better picture of how governments and organizations worldwide are taking steps for a better future.
- The experts also told the participants about the different models of electric vehicles available to them across different sectors. This will help them know the options at their disposal in case they proceed to purchase an electric vehicle.
- The anatomy of the electronic vehicles was discussed to help the participants understand the operation of electric vehicles better. This will enable them to

comprehend different components and aspects of the vehicle including power generation, battery, motor etc.

Reflections and Observations

At the end of the session by the experts, the Chair, Dr. Rajdeep Deb summarized the major points of discussion in the session. He emphasized on the need to adopt electric vehicles. The resources and practices used in the production of electric vehicles should also be an area of focus and there must be efforts to ensure that the balance of nature is not compromised. The basic energy resource for the production of electricity to fuel electric vehicles should not be derived from non-renewable resources and newer renewable resources must be developed for the purpose. The electric vehicle segment is still a developing alternative and there are many areas of concern despite the potential benefits. These concerns must not be ignored while pushing electric vehicles as a better alternative.

The Chair also discussed the electric vehicle revolution that has found pace in India and the neighboring countries by citing the instance of Ola's intervention in the electric two-wheeler segment and their vast success in the initial phase itself.

The participants recollected and discussed the different issues and topics that were addressed by the experts.

2. Report of the Workshop on Refrigeration & Air Conditioning and Teaching Methodology

Held from 29nd September 2021 to 02nd October 2021

About School of Refrigeration and Air-Conditioning Skills BSDU Jaipur

School of Refrigeration and Air-Conditioning Skills was introduced in 2017, with a mission to impart knowledge and technical skills of Refrigeration and Air-conditioning systems by imparting hands-on training of installation, service, diagnosis, assembly and troubleshooting of different types of refrigeration and air-conditioning systems, e.g., Room air conditioner, refrigerator, split air conditioner, variable refrigerant flow air conditioning system and central air conditioning systems. Students under this program will acquire the skills and knowledge of mechanical, electrical and electronic components used in the latest refrigeration and air-conditioning systems. A Centre of Excellence has been established in the university campus by Daikin Air-conditioning India Private Ltd. for training in Daikin Air-conditioning systems.

Logical Rationale of the Workshop

Most often, air-conditioning and refrigeration are treated as similar subjects because of similarities in their basic purposes. A significant application of refrigeration is cooling an enclosed area and dehumidifying it, which serves the purpose for summer air-conditioning. In reserve, a refrigeration system can also be utilized for winter heating in the form of a heat pump. Refrigeration is applicable in many fields and is a much-needed service in many industries. The main application of refrigeration is the food industry where it essays a major role at the processing, preservation and distribution stages. Apart from the food industry, refrigeration is also useful in the chemical industry, medical field etc. Air-conditioning is most commonly in use for providing comfort spaces to humans and other living beings. It operates at various levels from home to the industrial.

Over the last few decades, refrigeration and air-conditioning technologies have evolved significantly. These technologies are being taught as part of the curriculum and training in all the leading technical vocational institutions around the world.

Hence, this workshop was organised to apprise the vocational trainers about different aspects and concepts in refrigeration and air-conditioning. Different topics related to these concepts were discussed which included imparting knowledge from both theoretical and technical domains.

Therefore, it can be affirmed that the Workshop was motivated by a strong logical rationale. It was held from **29th September 2021** to **02nd October 2021**. Out of this, the initial two days focused entirely on synchronous training dealing with refrigeration and air-conditioning along with asynchronous support, and the following two days indulged in imparting knowledge on Teaching Methodology.

Objectives

The prime objective of the workshop was to ensure that the participants get to learn about the upcoming technologies, and the significance of these concepts and technologies in the present-day scenario and also-

- To make the participants aware regarding the upcoming technologies in the refrigeration and air-conditioning sector
- To explain the concept of Inverter Technology
- To make them aware about the different types of air-conditioners.
- To facilitate the participants and help them have a clear understanding regarding the various elements used in refrigeration and air-conditioning technology

Topics

- ***Evolution of Air-Conditioning System***
- Inverter Technology
- Segments of Inverter Technologies in Present Market
- Inverter Devices
- BLDC Motor
- Inverter cord
- Electronic Expansion Valve
- Identifying Errors and Repair Procedure
- Introduction to AC cycle and system
- Multi Evaporator AC system
- Piping Size Selection, Installation and Configuration

Methodology

- Interactive discussion
- PowerPoint presentations
- Question & Answer session
- Explanation through pdfs
- Story telling

Proceedings

The following is an account of the proceedings of the Workshop. It includes the programme schedule, a brief description of the expert and that of the major topics discussed during the Workshop.



Dr. K A Lalithadheera and Dr. J A D J Jayalath from WTC addressing the Workshop

Programme Schedule

Day 1: 29 th September 2021		
Time	Session topics	Resource person
10:00 AM–11:00 AM	Inaugural speech	Prof. Madhu Parhar. Dr. Shishir Chandra Bhaduri. Mr. Saurabh Mishra Dr. Rajdeep Deb Dr. Lalitha Dheera
11:00 AM–12:00 PM	Evolution of air-conditioning system	Dr. Shishir Chandra Bhaduri
12:00 PM–1:00 PM	Explanation on Refrigeration and Air conditioning technology Question & Answer session	Mr. Devendra Pathak Mr. Devendra Pathak
1:00 PM	Closing session	Dr. Rajdeep Deb
Day 2: 30 th September 2021		
Time	Session topics	Resource person
10:00 AM–10:20 AM	Introduction of the participants from RAC Background	Dr. Rajdeep Deb

10:20 AM–10:30 AM	Demonstration of Basics of VRV/VRF.	Md. Najmool Haque
10:30 AM–10 :35 AM	VRV presentation	Md. Najmool Haque
10 :35 AM–10:40 AM	Table of content introduced	Md. Najmool Haque
10:40 AM–10:45 AM	Quiz session	Md. Najmool Haque
10:45 AM–12:30 PM	Introduction and explanation on AC cycle and system	Md. Najmool Haque
12:30 PM–1:00 PM	Quiz session	Dr. Shishir Chandra Bhaduri
1:00 PM–1:05 PM	Worksheets discussed	Dr. Rajdeep Deb

The inaugural session commenced with the opening address by **Prof. Madhu Parhar**, Director, CEMCA and key advisor for the workshop. She emphasized the need for the particular training session in both the countries and also stated that she looks forward to more workshops of this kind that will enhance the abilities of the trainers.

The technical session was conducted by Dr. Shishir Chandra Bhaduri, Dean (ARE).

In the very beginning, **Mr. Devendra Pathak**, the resource person from BSDU, discussed the importance of learners to enhance their knowledge in this sector; there is a need to develop the refrigeration and air-conditioning technology in the current pandemic situation and to also upgrade the training programme.



Prof. Madhu Parhar during her inaugural speech at the Workshop

On the second day of the training, Dr. Rajdeep Deb, in his opening remarks, encouraged the participants to interact with the experts so that they could gather a better understanding of the topics being discussed. The session began with a recapitulation of the overall approach of refrigeration and air-conditioning technology.

Proceeding further, **Mr. Md. Najmool Haque**, the resource person from BSDU, introduced the participants to the topic focussing on **VRV/VRF**. Mr. Haque demonstrated the VRV technology and the basics of the same through a demonstrative video, which helped the



Dr. Rajdeep Deb interacting with participants during the session

participants to have a better grasp of the concepts in discussion. The resource person then further demonstrated several experiments through some videos and PowerPoint presentations. The focus was on providing a good representation of technology to create awareness and to motivate participants in learning more about refrigeration and air-conditioning technology effectively, and to venture into new experimental developments, innovations and inventions. In the concluding session, Dr. Shishir Chandra Bhaduri, Dean (ARE), held a Quiz session for the participants.

About the Expert

Professor Shishir Chandra Bhaduri obtained his Masters and Doctorate from Indian Institute of Technology, Roorkee. With over 34 years of teaching, research, industry and administrative experience, he has held various positions in academics and industries in the capacity of Principal, Head of the Department, Chief Innovation Manager, Senior Manager in the domains of quality assurance, application development and product development.

Before joining BSDU Jaipur, Dr. Bhaduri had been associated with JK Lakshmipat University, Jaipur for nearly three years as Associate Dean and professor. He has held academic positions at several other institutes of high reputation including IIT (Bombay and Roorkee), and also worked in various corporate positions at Grassroot Innovation Augmentation Network (North), Mafatlal Industries, Tecumseh India etc. In the training program, he was assisted by **Mr. Najmool Haq, Mr. Devendra Pathak, Mr. Shyam Anand Chaturvedi and Ms. Nikita Singh.**



Screengrab of the session in progress

Major Topics discussed in the Workshop

The expert(s) discussed and demonstrated many topics related to the field of refrigeration and air-conditioning. The facilitator also constantly engaged in interactions with the participants and clarified their doubts. Listed below are the major topics that were taken into focus during the course of the workshop.

- **Evolution of Air-Conditioning System:** The facilitator apprised the participants that an engineer named **Willis Haviland Carrier** developed the initial version of the present-day air-conditioning technology in 1902. With the constant evolution of technology, humans have revolutionized the way cooling takes place today and Toshiba became the first company to introduce air-conditioners in the market. The concept was thoroughly explained through PowerPoint presentations, diagrams and other demonstrations so that the learners could comprehend the concepts with ease.
- **Inverter Technology:** The Inverter Technology is the latest evolution in the technology concerning the electro-motors of the compressors. An inverter is used to control the speed of the compressor motor, so as to continuously regulate the temperature.
- **Segments of Inverter Technologies in Present Market:** The inverter technology market is segmented on the basis of market by power rating, market by components, market by application, market by vertical, and market by geography.
- **Inverter Devices:** Inverter is a device which supplies variable frequency of power supply to equipment. There have been many recent developments in this technology concerning motors. In the latest available inverter technology, motor revolution speed can be controlled which leads to reduced energy consumption.
- **BLDC Motor:** A brushless DC motor (also known as a BLDC motor or BL motor) is an electronically-commutated DC motor which does not have brushes. The controller

provides pulses of current to the motor windings which control the speed and torque of the synchronous motor.

- **Inverter cord:** These are the cords and cable used in the inverter systems. There are different varieties of them, each with different benefits and disadvantages.
- **Electronic Expansion Valve:** Electronic expansion valves are found in air conditioners, heat pumps or any other equipment that follow the principle of refrigeration cycle. Their prime function is to control the refrigerant flow into the evaporator in precise measures.
- **Identifying Errors and Repair Procedure:** This is one of the most vital cogs in the maintenance procedures of cooling systems. The systems require regular maintenance to ensure best output and smooth functioning. The facilitator disseminated knowledge on different techniques used to identify errors or malfunction in the systems, and also discussed the follow-up repair procedures to rectify the respective issues.
- **Introduction to AC Cycle and System:** The AC Cycle also known as the Refrigeration Cycle was discussed elaborately during the facilitation session. Within this topic, the facilitator delved into the latest developments in this technology that are used by modern-day manufacturers. He also discussed the significant features of the concerned topics.
- **Multi-Evaporator AC system:** The Multi-Evaporator AC System is basically a vapor-compression refrigeration system that generally consists of four components, i.e., Evaporator, Compressor, Condenser and Thermal Expansion Valve. This system helps in functioning as per the needs of different conditions, such as different temperatures and pressures.
- **Piping Size Selection, Installation and Configuration:** The facilitator discussed elaborately about these topics and apprised the participants about different parameters and criteria that must be followed during these processes. Various techniques were discussed and demonstrated using PowerPoint presentations.

Learning Input, Output and Outcome

The following are the major inputs and outcomes that were drawn as a result of the Workshop conducted on Refrigeration and Air-Conditioning Technology:

- Participants in this program acquired the skills and knowledge of mechanical, electrical and electronic components used in the latest Refrigeration and Air-Conditioning systems.
- Participants got to know about the functions of Inverter devices and BLDC motors.
- Participants understood the theory of the electronic expansion valve.
- Participants got introduced to techniques and procedures to identify error and repair procedures. It is expected that this will help them to identify faulty systems accurately and fix the issues sooner.
- The participants would be able to identify the different kinds of devices available in Refrigeration and AC Systems in the market.
- They can put this knowledge to use in improving their skills and finding better employment opportunities.

Reflections and Observations

The Chair, the participants and the experts observed that Refrigeration and Air conditioning is an emerging and evolving technology. It is among the most used and important technologies of the 21st century. The development of cooling techniques has led to significant advancements in various fields, for instance it makes the preservation of perishable food possible in the first place. Likewise, the production of high-performance plastics would be inconceivable without the possibilities of process cooling. The air conditioning of buildings and vehicles has become indispensable due to the legitimate desire for comfort. Although air-conditioning technology and refrigeration are closely related, they are two independent sub-disciplines. Hence, knowing and learning about such a technology will help in finding new career opportunities, marketing, across different lines of professions that engage in this new age technology.

3. Report on Teaching Methodology Sessions integrated with the Workshops

Held from 23rd-24th September 2021 and 01st-02nd October 2021

Integrated Teaching Methodology sessions were administered to the participants during both the Workshops that are a part of this report. This was done taking into consideration the essentiality of possessing the skills necessary for knowledge dissemination by the trainers. Such a step would help the trainers impart knowledge to learners with more clarity and provide them with the necessary support.

Logical Rationale of the Teaching Methodology Sessions

Andragogy, in the simplest terms, is the method and practice of teaching adult learners. In recent times, the Andragogy vs Pedagogy debate has garnered much attention owing to the increasing focus on developing innovative teaching practices. The focus of Andragogy is to design and deliver teaching practices that address the problems at hand and are solution-driven. This concept can be applied at different levels of education and training to derive better output from the learners by helping them comprehend concepts in a better way.

To be a good teacher/trainer, it is important for a person to possess the right skills to disseminate knowledge, along with in-depth knowledge in the concerned subject/field. Without the necessary skills, any repository or faculty of knowledge would be rendered ineffectual.

Hence, the Teaching Methodology sessions integrated with the Workshops for vocational trainers in Sri Lanka is much-needed and logic-driven as it will help improve their knowledge dissemination skills which would ultimately benefit the learners. The sessions were held on the last two days of the respective Workshops.

Objectives

- To acquaint the learners with the principles of Andragogy viz. Adult Learning
- To enlighten the learners regarding the features of facilitation process

- To apprise learners regarding the features of facilitation that demarcate it from the traditional lecture method
- To highlight the importance of facilitation in online learning
- To apprise learners regarding the different psychosocial interventions that are deployed in facilitation
- To help learners comprehend the beneficial aspects of different learning models
- To sensitise learners about the different learning methods that are highly effective in online learning
- To administer practical exercises for fostering practice- teaching, with a goal-oriented approach.
- To strategically equip the participants with the competency for applying appropriate learning models, methods, tools and psychosocial interventions for engaging and empowering the students in the online platform

Topics

- Principles of Andragogy
- Beneficial Features of Facilitation
- Learning Models relevant to Online Learning
- Tools & Methods for fostering Participative & Inductive Learning
- Relevance of Psychosocial Interventions

Methodology

- Narration
- Slide Presentation
- Dialogue-driven Interaction
- Role Play
- Case Study
- Group Discussion
- Motivational Interview
- Constructive Feedback
- Appreciative Inquiry
- Probing
- Visioning
- Problem Solving through Design Thinking

Proceedings

About the Expert

Mr. Purandar Sengupta is a well-known Learning and Development Specialist. He has conducted more than 100 Training of Trainers Program on behalf of NIESBUD, Government of India. He has also delivered many sessions on behalf of other autonomous bodies and development initiatives of Government of India. He is an expert in training-design and training-evaluation, and has been involved in such initiatives with NGOs across the country. He is also a certified Life Coach.

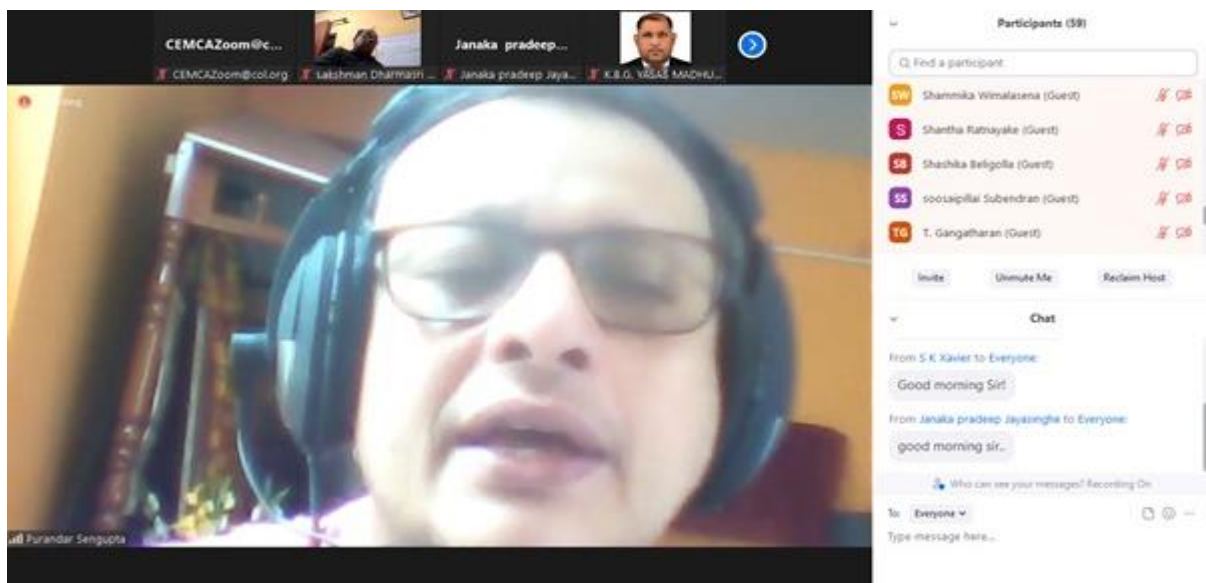
Facilitation Session by Mr. Purandar Sengupta

In the beginning, the facilitator enlightened the participants regarding the logical rationale of the session. He helped them acquire a clear understanding regarding the objective of the sessions, the topics that were to be dealt with and the expected outcome.

Then the focus shifted towards helping the participants understand the difference in approach between offline training and online training. The facilitator pointed out that in online sessions, the students are not in a captive state of mind like in an offline classroom. At any point of time, the students in online learning can deviate to other sources of information and entertainment as deemed appropriate by them. Hence, it is essential to ensure a deep psychological engagement of the learners with the learning activities of the online sessions.

After helping the participants in attaining conceptual clarity regarding the justification of psychological engagement in online learning, the facilitator introduced the learners to the *Screengrab of Mr. Purandar Sengupta's training session in progress*

principles of Andragogy (Adult Learning). Immediately after that, the facilitator enunciated the characteristic features of Facilitation and established the link between Andragogy (Adult learning) and Facilitation. The facilitator logically established how Facilitation with all its methods and psychosocial interventions can engage the adult learners, enlighten and empower them on both online and offline platforms. The facilitator specified how Facilitation differs from the conventional Lecture method. He also explained how Facilitation can foster



Participatory Learning, Collaborative-Learning, Experiential Learning and Discovery Learning.

Thereafter, the facilitator apprised the learners regarding the following psychosocial interventions that are deployed in Facilitation for engaging and empowering the learners:

- Achievement Motivation
- Positive Reinforcement
- Behavioural Modelling
- Active Listening & Paraphrasing
- Probing
- Appreciative Inquiry
- Design Thinking

The following table indicates the “Cause Effect Dynamics” between the learning inputs and effect upon of the learners

Topic/Learning Inputs	Theme	Effect
Andragogy	<p>The facilitator explained the four principles of Andragogy.</p> <ul style="list-style-type: none"> • Adult learning is more oriented towards problem solving than content–centric • Adults tend to learn from practical experiences • Adults prefer topics that are relevant to their professional life and personal life • Adults should be involved in the planning and implementation of their instruction. 	<p>The learners achieved conceptual clarity regarding the principles of Andragogy.</p> <p>Many of them endorsed the views of Experiential Learning & Learning through Problem Solving Many of the learners affirmed that for ensuring success in Online Learning & Blended Learning, it is necessary to engineer a paradigm shift from Pedagogy to Andragogy</p>
Facilitation	<p>The facilitator explained the features of Facilitation with major emphasis upon the following topics:</p> <ul style="list-style-type: none"> • It is characterized by continual dialogue between students and Facilitator • It facilitates the learners to introspect and unleash their hidden potential • It motivates the learners to ensure their active and spontaneous participation in the learning process. • It facilitates the learners to interact with each other and achieve the learning goal in a collaborative pattern 	<p>The learners could understand the role of Facilitation in fostering</p> <ul style="list-style-type: none"> • Collaborative Learning • Experiential Learning • Problem-Solving Based learning • Inquiry-based learning • Discovery Learning <p>The learners endorsed the instrumental role of Facilitation in online learning & blended learning</p>

	<ul style="list-style-type: none"> It facilitates the learners to incur experiences from the learning process and to learn from the incurred experiences 	
Achievement Motivation	<p>The facilitator explained the instrumental role of Achievement Motivation in satisfying the learning goals of an individual.</p> <p>He also highlighted the tools and techniques for triggering Achievement Motivation among the students</p>	<p>The learners developed a clear understanding regarding the role of Achievement Motivation</p> <p>The learners appreciated the tools and techniques for triggering Achievement Motivation within the learners</p> <p>Some of the learners were motivated by the facilitator and shared some tools administered by them for enhancing Achievement Motivation of the students</p>
Positive Reinforcement	<p>The facilitator explained Positive Reinforcement by citing examples.</p> <p>He apprised the learners to the fact that when the desired behaviour of a student gets appreciated/acknowledged/rewarded by an educator then the frequency of the desired behaviour gets increased.</p> <p>The appreciation or reward from the Educator acts as the stimulus of Positive Reinforcement which in turn encourages the repetition of the desired behaviour.</p>	<p>The learners achieved conceptual clarity regarding the behavioural dynamics in Positive Reinforcement.</p> <p>Many of them opined that appreciation and reward are the instrumental factors in engineering behavioural modification in the positive direction</p> <p>Some leaders narrated their occupational experiences and indicated how they had reinforced positive behaviour of their subordinates through rewards or financial incentives</p>

<p>Behavioural Modelling</p>	<p>The facilitator gave practical examples and demonstrated the concept</p> <p>He stated that if a facilitator appreciates or delivers rewards to a student for an appreciable behaviour, then the other students try to replicate the outcome-oriented behaviour of the successful students.</p> <p>The rewarded student becomes the role model for other students. They start modelling the behaviour of the rewarded students, with the intent of being rewarded.</p>	<p>The learners appreciated the concept of behavioural modelling</p> <p>Some senior learners opined that behavioural modelling becomes successful only when the other students are also motivated to achieve the rewards and appreciation.</p> <p>According to them, if the other students are not motivated to receive the reward that has been given to the successful student, then they will not replicate the outcome-oriented desired behaviour of the successful student.</p>
<p>Active Listening & Paraphrasing</p>	<p>A facilitator always encourages the students to narrate their feedback, views and opinions regarding the learnt content</p> <p>During the narration delivered by a student, the facilitator listens to it with full concentration</p> <p>After the completion of the narration of the student, the facilitator repeats the essence of the narration of the student but in a more polished, refined and sophisticated language. He also prunes the irrelevant part of the students' narration, replenishes the gaps and adds value to it. This is termed as Paraphrasing</p> <p>Thus, after completing Paraphrasing, the students can understand which of the topics he missed out on and what were the points which were erroneous. The students learn from the paraphrased statements.</p> <p>The students also feel confident, when they find that the facilitator is repeating the essence of his narration or idea before others remove the irrelevant parts.</p>	<p>The learners opined that Active Listening & Paraphrasing are immensely significant tools in Facilitation.</p> <p>Some of the learners affirmed that apart from replenishing conceptual gaps and communication gaps, Paraphrasing plays an instrumental role in building up congenial relationship and emotive solidarity between the students and educators.</p> <p>Some learners stated that when the facilitator paraphrases the essence of the narration of the students then they understand that the educator/facilitator must have listened to their narration actively. This in turn boosts up the morale of the students</p>

<p>Probing</p>	<p>While narrating, a student may stop suddenly due to certain gaps in the thought process or emotional distractions</p> <p>At this stage the facilitator asks probing questions to identify the cognitive and emotive challenges of the students.</p> <p>Probing questions facilitate the students to introspect, to execute critical thinking, to replenish the gaps in thought process, to recollect memories, to leverage recent memories etc.</p>	<p>The learners highly appreciated Probing and stated that Probing is an essential part of facilitation.</p> <p>They opined that Probing can play instrumental role in</p> <ul style="list-style-type: none"> • Appreciative Inquiry • Paraphrasing • Problem Based Learning • Discovery Learning
<p>Visioning</p>	<p>The facilitator asks the students to illustrate their vision</p>	<p>The learners opined that Visioning is an instrumental intervention which fosters and develops the ability to imaging and crystallize intuitive power of a student.</p> <p>They affirmed that Visioning builds up aspiration within students and motivates them to achieve aspired goals</p>
<p>Appreciative Inquiry</p>	<p>It is a strength focused intervention which aims at identifying the core strength and competence prevailing within the students. The facilitator utilizes this intervention especially for the students who are not aware of their core competence.</p> <p>In this intervention, the facilitator asks encouraging questions with the aim of tracing out the achievements of the students in the recent past. Once the student reveals his achievement, the facilitator can ascertain the causative strength factors, embedded within the students, that have fuelled the recent achievement</p>	<p>The learners achieved conceptual clarity regarding the mechanism of Appreciative Inquiry</p> <p>They stated that that this strength-focused intervention will be very useful for them in their occupational arena, for identifying the hidden potential of their students</p>

Design Thinking	<p>Design Thinking is a human-centred, creative approach for solving multifarious problems of target audience</p> <p>In the business world, it facilitates the process of designing the prototype of beneficial products and services that can satisfy the need and solve the problems of the customers</p> <p>In the educational arena, it facilitates the process of designing effective instructional materials for satisfying the needs and mitigating the problems of the students.</p> <p>Design Thinking is an entirely student-focused or customer-focused approach for solving the problems of students and customers.</p>	<p>The learners acquired competency on Design Thinking by solving a Problem based on the principles of Design Thinking</p> <p>The learners opined that Design Thinking has played an instrumental role in unveiling their creative and analytical competency.</p> <p>The learners affirmed that Design Thinking will significantly help the students of Vocational Education & Training in future to be empathetic upon their target customer and to generate customer friendly products and services that will solve the problems of the customer.</p>
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The following table indicates the participatory Learning methods that were administered by the Facilitator- Mr. Purandar Sengupta to explain each of the aforementioned Psychosocial Interventions

Psychosocial Interventions	Methods Deployed by the facilitator
Achievement Motivation	Explained by Role Play
Positive Reinforcement	Explained by Case Study & Group Discussion
Behavioural Modelling	Explained by Case Study & Group Discussion
Paraphrasing	Explained by Role Play
Probing	Explained by Role Play
Appreciative inquiry	Explained by Role Play
Design Thinking	Explained through Problem-Solving exercise
Visioning	Explained through Diagrammatic exercises

Thus, it is distinctly evident that learners were actively engaged during the discussion of each of the psychosocial interventions.

On the second day of the training sessions, the facilitator helped the learners achieve conceptual clarity regarding the different models of learning that are very much relevant for online learning.

The different models of learning explained by the facilitator and the impact it had on the participants are given below:

Learning Models	Main Theme	Output
Benjamin Bloom's Cognitive Taxonomy	<p>This theory deals with the six levels of a learner's cognition and understanding in a specific subject.</p> <p>The facilitator affirmed that the level is very much subject specific. A student who is in the highest level in one subject, may be in the lowest level at another subject</p>	The learners achieved conceptual clarity regarding the different Cognitive Levels of individuals in different subjects
Robert Gagne's Nine Steps of Instruction	<p>This model indicates that there are nine types of educational instructions arranged in a logical sequence.</p> <p>If an educator follows the nine instructions in the structured logical sequence, then the learners will achieve the desired learning goal and transfer their learnt inputs to others</p>	The learners were apprised about the logical sequence of activities that are to be executed by a trainer/facilitator in a learning session to ensure retention of the learnt content and developing within the learners the ability to transfer the learnt content to others
Edgar Dale's Model of retention of learning inputs	The model suggests that different types of academic activities lead to different levels of retention of learnt inputs	The learners learnt about the percentage of retention of learnt inputs under the influence of various sorts of teaching activities
Charles Reigeluth's Elaboration Model	The model suggests that an educator must present the learning materials in a sequential pattern viz. from the simplest level to the most complex level	The learners understood the significance of arranging and presenting the learning content through logical sequences
John Sweller's Cognitive Load Model	This model suggests that to ensure the retention of learning inputs in the long-term memory of students, the learning content should be delivered in a fragmented pattern, part by part.	The learners understood the significance of presenting a large volume of content in a fragmented pattern, instead of imposing a huge volume of content continually upon the learners.

	<p>If a large volume of content is foisted upon the learners, then the cognitive load will get enhanced to a large extent. As a consequence, the learnt inputs will not be retained in long term memory.</p>	
<p>John Keller's ARCS Model</p>	<p>This model reflects the linear sequence of four activities that are to be followed by educators for:</p> <ul style="list-style-type: none"> • Drawing attention of the students • Establish relevance of the learning materials to the prior knowledge or the occupational life of the students • Building up the confidence of the learners • Satisfying the learners by the achieved learning outcome 	<p>The learners understood how to draw the attention of the students, present relevant inputs to them, build up the confidence of the students and satisfy the students in learning sessions.</p>
<p>Jerome Bruner's Discovery Model</p>	<p>This model suggests that the probing inquiry from the educator facilitates the students to introspect and to unleash their latent creative and analytical competencies.</p>	<p>The learners understood the significance of Inquiry Based Instructions for discovering the hidden creative flair, insight, intuition as well as the analytical power of the students, embedded within themselves</p>
<p>Howard Barrows' Problem Based Learning Model</p>	<p>This model suggests that if the students are provided with problems to solve rather than content to memorize, then the creative and analytical competencies of the learners will get enhanced and unleashed.</p>	<p>The learners understood how problem-solving exercises can enhance critical thinking as well as creative thinking competency of the students</p>
<p>May & Doob's Collaborative Learning Model</p>	<p>This learning model indicates that cooperation and collaboration among a group of learners can</p>	<p>The learners comprehended how exchange of views, group discussion, task distribution, convergence of thoughts can play extremely significant roles in the learning process</p>

	lead to the achievement of learning outcome	
Michael Allen's Success Approximation Model (SAM)	<p>This model encourages student-centric learning. Here, primarily the prototype of the learning material and finally the prepared instructional material are evaluated by the students</p> <p>If the students suggest any changes, then to ensure their ease of learning, the changes are engineered accordingly both at the prototype as well as in the final material</p>	<p>The learners perceived the significance of customization /re-engineering of the prototype of learning materials as well as the final learning material based on the feedback of the students</p> <p>The learners understood the significance of Student-Centric Instructional Design</p>
Keller Plan's Individualized Instructional Model	<p>This model is mainly concerned with the heterogeneity of the learners.</p> <p>Since each learner differs from other learners in the learning capacity, style, pace and approach, the instructional material should be designed on the basis of the unique capacity, need, style, standard and pace of each learner.</p> <p>Within an allotted time-frame, each learner learns individually in his/her own way</p>	<p>The learners deciphered the importance of designing learning materials, and determining the methodology of facilitating the students on the basis of the intellectual standard, learning style and the learning pace of each student</p>

Case Studies Discussed

Case Study 1

Theme: Positive Reinforcement

A trainer was conducting a workshop on **Community Development**. After the completion of the workshop, the trainer gave a practical assignment to the students. He asked the students to leverage the rural women in a common developmental platform and generate awareness on the beneficial aspects of Micro-Finance.

It was found that 30% of the students were successful in mobilizing the rural women and generating awareness among them regarding the beneficial aspects of Micro-Finance.

The trainer continually appreciated those students who were successful in leveraging the rural women for getting involved in Micro-Finance Program. Moreover, he offered a financial incentive as reward to the successful students.

Result: It was noticed that after getting verbal appreciation and financial reward, the students conducted more Micro-Finance Management Programs for women with greater qualitative precision. The quantitative escalation was coupled with qualitative enhancement.

Case Study 2

Theme: - Behavioural Modelling

A trainer was conducting a session on Entrepreneurship Development. He narrated a short success-story on Entrepreneurial Motivation and Enterprise Development. The success-story revolved around an underprivileged woman. Despite severe situational challenges both at the domiciliary front and in the social arena, she achieved success in establishing a commercially viable bakery unit.

After hearing the success-story, many of the trainees considered the central character/protagonist as their role model and initiated Behavioral Modelling. To be precise, they started to replicate the outcome linked behavior of the central character.

Result: Eventually it was found that 75% of the trainees of that class who listened to the success-story, floated their own entrepreneurial initiative.

Description of Role Plays

Four role plays were used for both the first batch and second batch. The description of each of the four role-plays is as follows.

Role Play 1

Topic: Achievement Motivation

Description

The teacher has noticed that one of his students is attending theoretical classes but avoiding practical classes. The teacher at first appreciated the student for his theoretical depth and regular attendance in the theoretical classes; then, the teacher asked the student the reason for not attending the practical classes in the workshop. The student said that he does not like the ambience of the workshop.

The teacher started motivating him about the beneficial aspects of the practical classes. He encouraged the student by affirming that if he goes to the workshop, he will be able to acquire many new skills. The practical skills are essential for final certification. Moreover, without practical skill, one cannot survive in the real world. Finally, the teacher told the student that if he regularly attends the practical classes, he will be rewarded with a series of Practical E-Manuals.

Thus, by highlighting the beneficial outcome of the practical skills and by making a commitment of rewarding positive behaviour (viz. regular attendance in practical classes), the teacher motivated the student to achieve the learning goal in practical sessions.

Role of Teacher in First Workshop: Ajantha Ruman

Role of Teacher in First Workshop: Asanka Herath

Role of Teacher in Second Workshop: R C Desilva

Role of Teacher in Second Workshop: Mohammed Imam

Role Play 2

Topic: Appreciative Inquiry

Description

The teacher asks a student to specify his competency factors. The student replies that he is ignorant of his own competency. In fact, he is not sure whether he is competent or not. The teacher understands that the student is a victim of Resource Myopia, although there prevail resources within him.

The teacher adopts an alternative strategy. He continues to inquire about some incidents in the life of the student in the recent past for which he got appreciated by others. The student recounts a few incidents that he was appreciated for. The teacher continues to inquire and solicit more informative inputs about the incidents.

The teacher identified the achievements as the reasons for appreciation. Then, by analysing the achievements, he traced out the causative competency factors which are responsible for the achievements.

Role of Teacher in First Workshop: Purandar Sengupta

Role of Teacher in First Workshop: K Xavier

Role of Teacher in Second Workshop: Purandar Sengupta

Role of Teacher in Second Workshop: Mohammed Shah

Role Play 3

Topic: Probing

Description

The teacher at first explained the ARCS Model of John Keller vividly. Then, he asked a student to narrate the ARCS Model and its significance. While explaining the ARCS Model, the student stopped narration at a specific point. The teacher perceived that there is either a memory gap or thought process disruption within the cognitive framework of the student.

The teacher initiates Probing technique. He at first appreciated the previous performance of the student to boost up the morale of the student. Then, he floats gentle probing questions. The questions were asked not to check the knowledge of the student. The questions were framed strategically to facilitate the student in retrieving the link or getting some clue so that he can complete the remaining part of the narration.

Example: The student was not able to narrate the confidence (C) and satisfaction (S) component of ARCS Model.

Here the Probing questions of the facilitator were

1. Do you think that it is the responsibility of the teacher to build up the confidence of the students?
2. Do you believe that confidence can improve the performance of the students?
3. Is the ARCS Model of John Keller an appropriate mechanism for building up the confidence of the students?
4. According to the ARCS model, at which stage it is necessary to build up the confidence of the students? Do you feel that it is practically applicable?

These types of questions gave clues to the student and he/she could complete narrating the ARCS Model.

Role of Teacher in First Workshop: Purandar Sengupta

Role of Teacher in First Workshop: Madhu Shanka

Role of Teacher in Second Workshop: Purandar Sengupta

Role of Teacher in Second Workshop: Sagarika Peiris

Role Play 4

Topic: Active Listening & Paraphrasing

Description

The teacher asked the student to narrate his view on Behavioural Modelling. When the student starts narrating, the teacher listens to his narration with rapt attention and seamless concentration. After that, the teacher narrates the content of the student but in more sophisticated language and replenishing the gaps in the narration of the student.

Example

Student (Samaratharange): Behavioural Modelling is copying the behaviour of another student

Teacher: Okay. So, Mr. Samaratharange wants to imply that Behavioural Modelling by a student is the replication of an outcome-oriented behaviour of a highly successful student in the class, with the motivational intention to achieve the outcome.

Role of Teacher in First Workshop: Purandar Sengupta

Role of Teacher in First Workshop: Samaratharange

Role of Teacher in Second Workshop: Purandar Sengupta

Role of Teacher in Second Workshop: Manjula Ratnayake

Learning Input, Output and Outcomes

The following are the major learning inputs and outcomes of the integrated Teaching Methodology training sessions.

Critical Success Factors (CSF)

Participation of the Learners	The facilitator encouraged the active participation of the learners
Interaction among the Learners	<p>Conscious effort was made by the facilitator to ensure group discussion and dialogue-driven interaction among the students.</p> <p>In some cases, a complex theme was explained by one learner to others. The learners were given the opportunity of share their real experiences with others in the form of stories</p>
Role Play for demonstration and explication	Role Plays were administered to demonstrate and explain complex thematic issues.
Linguistic Interpretation	Some of the learners were unable to decipher the English language. Mr. Ajantha Ruaman translated the learning inputs into Sinhalese and Mr. Xavier translated the learning inputs into Tamil, for them.
Participatory Evaluation of Learning Materials	<p>The facilitator asked the learners to evaluate each of the learning inputs, in terms of effectiveness from the students' perspective.</p> <p>Thus, there was a conscious effort on behalf of the Facilitator to ensure the engagement, enlightenment and empowerment of the learners.</p>

Output	Outcome	Impact
The learners got apprised about the participatory training methods and psychosocial interventions that are deployed by a facilitator to ensure engagement, enlightenment and empowerment of the learners	<p>It is expected that the learners will be able to conduct effective facilitation on any online platform.</p> <p>It is also expected that the as facilitators, the learners will be capable enough to draw the attention of their students, reinforce their concentration, enhance their motivation and ensure their psychological engagement in the learning sessions</p>	<p>It is expected that a greater number of youths can be accommodated in the online vocational training programs</p> <p>It is expected that the youth from remote rural areas will also get the opportunity of learning various skills from their home</p> <p>It is expected that the students will get deeply engaged in the online vocational training programs aimed at skill acquisition</p> <p>It is expected a large number of trained skilled</p>

		professionals will emerge and contribute significantly towards the industrial growth and economic development of Sri Lanka
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Reflections and Observations

Reflection of the participants in the first workshop

Name of the participants	Contemplative Reflections
Mr. Xavier	He affirmed that Positive Reinforcement is an instrumental strategic tool for ensuring the repetition of desirable behaviour. He has shared the story of a girl student whose ability to solve mathematical problems gradually increased due to verbal motivation and physical reward in the form of candies.
Mr. Imam	He appreciated Paraphrasing and opined that it instils confidence within the students when they find that their teacher is narrating the concept in a more sophisticated language. It boosts the morale of the students.
Mr. Ajantha Ruman	He stated that if a teacher facilitates the students in solving various academic problems relevant to the curriculum as well as the emotional problems pestering the students, then a conducive relationship gets crystallized between the teacher and the student.
Ms. Sagarika Peiris	She stated that ARCS Model is very useful in motivating the students, reinforcing their confidence level and ultimately steering them towards a tangible learning outcome

Reflection of the participants in the second workshop

Name of the participants	Contemplative Reflections
Mr. R P C De Silva	He stated that demonstrated Motivational Interview and Constructive Feedback in his training sessions and that it was effective.
Ms. Rashmi	Punishment is not an appropriate strategy for the undisciplined students; rather they should be

	handled with care and support. Eventually they should be motivated to achieve their learning goals.
Mr. Manjula Ratnayake	He stated that Role Play is an extremely effective training method for demonstrating complex topics and explaining the essence of such complex topics.

Conclusion

The Workshops were successfully organised by CEMCA in association with BSDU and WTC, Sri Lanka. A total of more than 400 participants joined the Workshops. The planning, build-up and execution was impeccable to the last bit. Such an online event in these times is important to apprise the vocational trainers about the developments in the respective fields as it upskills them according to the evolving technologies.

All the stakeholders including experts, mentors, officials, staff and the participants essayed salient roles in contributing to the success of these Workshops.