

# TVET Technology Development and Transfer Effort for Combating COVID-19 in Addis Ababa City, Ethiopia

Asmamaw Tegegne Abebe, Kidu Gebrecherkos Weldeanenia, Gurumurthy B. Ramaiah, Bahiru Melese, Gizeshwork Tadesse

Ethiopian Technical University, Addis Ababa, Ethiopia

Email: tegegne.asmamaw@gmail.com

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## Abstract

**Purpose** –The main purpose of this research work is to evaluate the efforts of TVET efforts' in developing and transferring useful technologies in Addis-Ababa, Ethiopia. TVET Institutions are engaged in developing and transferring technologies like hand washing devices, sanitizer sprayers, ventilators, beds, disinfection devices, sanitizers, antiviral finish fabrics, masks and hand-free devices that is used to prevent contamination of the human body while working with materials of different kinds. These equipment's posse's characteristic simple operational and quality properties like usability, functionality, efficiency, etc. The evaluation of these developed and transferred technologies help to prevent transmission of COVID-19 at community level.

**Design/methodology/approach** – The methodology used in this research was descriptive and purposive sampling type. The sample pool consisted of 5 TVET institutions. 40 respondents participated in this questionnaire study. The response was recorded through interview questionnaires based on the 5-point Likert Scale. Data analysis and Cronbach's alpha reliability tests were computed using SPSS and Minitab software.

**Practical Implications:** The coronavirus is the deadly pandemic and highly contagious disease the human mankind has witnessed since 1918 flue pandemic. However, the coronavirus spread in Ethiopia at the community level has prompted many TVET (Technical Vocational and Education Training) institutions and universities to ramp up their efforts to develop and transfer technologies. Hence TVET organizations need therefore to develop and transfer technologies that are useful to prevent the spread of COVID-19. This research will help to gather the technical information pertaining to design, quality and performance of Hand washing equipment's, face masks, Hand sanitizers and other equipment's.

**Findings** - The results prove TVET Institutions' efforts were successful in developing and transferring the technologies required to combating COVID-19. Cronbach's alpha (reliability test) value is 0.77 for the TVET colleges, indicating the data is excellent, unique and consistent. The position of the TVET institution is excellent as regards to the efforts put in developing and transferring technologies used for combating COVID-19 in and around Addis Ababa. The responses received were unique in nature.

**Originality/value** – COVID-19 has posed many challenges to public and has resulted in many deaths in Addis Ababa and entire Ethiopia. This work is unique and would make valuable contribution and gather information on the design and technical aspects of developed and transferred technologies by TVET Institutions used for combating COVID-19.

**Keywords:** Corona Virus, Reliability Test, Technology Transfer, Contagious Disease, Technology Development.

## INTRODUCTION

According to the world health organization (WHO), corona viruses belong to a family of viruses that cause illnesses such as Sever Acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS). The novel corona virus is a deadly infectious disease, identified by the Chinese authorities on January 7, 2020. This virus, as named SARS-CoV -2 virus is a new strain that had not been previously identified in humans. This virus infection is transmitted not only through nasal droplets, cough, and saliva, but also thrives for days on different material and human surfaces. Ethiopia has been intensifying its effort to combat the virus. In this case, isolation centers, hospitals, laboratories, preventing devices, medical facilities for patients have been prepared. The focus of this work is to evaluate the efforts put by Technical and Vocational Education and Training (TVET) Institutions to develop and transfer technologies used to prevent the spread of COVID-19 in Addis Ababa. Many of the higher education institutions in Ethiopia, including Technical Universities and TVET Institutions have been engaging in developing technologies of various types including hand washing devices, sanitizer sprayers, ventilators, etc., so that the shortage in technologies and devices required to fight corona virus is overcome. The evaluation of different parameters of these technologies is important as the need for technological improvement to meet the requirements of society are essential

in this pandemic timing.

The evaluation of the efforts made by TVET Institutions in and around Addis Ababa is being carried out since there is no such activity being reported or carried out in TVET Institutions. The research utilizes responses received from skilled technical people on various aspects of technologies that are being so far developed and transferred to society which is discussed in the coming section. The questionnaire was designed using 5-point Likert scale parameters which included questions related to design, usefulness, and timely delivery of the developed technologies. The questionnaire also covered various aspects of technologies like their ergonomic and cost effectiveness. The efforts, initiative and skill of the trainers involved in developing and transferring these technologies were also included in the questionnaire. Finally, the questionnaire also focused on assessing the commitment, knowledge, and efforts of the technical personnel involved in developing the technologies. The received responses from TVET Institutions were analyzed for its frequency, descriptive statistical parameters, and estimate reliability and internal consistency of the responses (Cronbach's alpha value) using SPSS software.

According to TVET Institutes and Addis Ababa city administration, the evaluation of efforts made by TVET institutions in developing and transferring technologies for combating the spread of this virus was one of the essential tasks and hence focusing on this issue was the main concern of this research work. The study is significantly important keeping in mind the improvements, quality and demand that is one of the identified gaps in the present pandemic situation.

Technologies developed so far to combat COVID-19 and its assessment methods

Hugo Garcia Tonioli et.al (2021) has conducted a study on identifying the factors that are responsible for the accelerated vaccine development. In their study, they conclude the technology and research development factors are purely responsible for accelerating the development of vaccines. The use of local technologies like handwash machine, Face Masks, Ventilators, etc. coupled with digital technology has helped to control the transmission of the Corona virus( Daniel et.al,2020: Stephen et.al, 2020; Steven et.al,2020).

Elliot Mbunge, et.al (2021) reviewed the evolution of modern technologies like Artificial Intelligence (AI), Internet Medical of Things (IoMT), etc for monitoring the progress and spread of COVID-19 disease (Elliot et.al, 2021). They also conclude the requirement for further research to close the gap in the development of technologies both digital and analog ones. Kaur et.al (2020) conducted more detailed work on the transformation of offline business to online ones. Their review focused on analyzing the gains in business by online companies like Amazon Prime, Netflix, Hotstar, etc., which is now running their over-the-top platforms to deliver their products to the consumers online due to the pandemic(Navleen.et.al,2020).

Jane Lee et.al (2020) conducted experiments on the efficacy of hand sanitizers, particularly alcohol-based hand sanitizers, which are mainly used as hand hygiene technology coupled with anti-microbial soaps and disinfectants ( Jane lee et.al, 2020; kebede et.al,2020). They conclude the success in the use of hand sanitizers mainly depends on the formulation of the hand sanitizers. Jane Lee et.al (2020) and Samuel Omojola Ejiko (2020) also conducted experiments on the efficacy of hand sanitizers and hand washing machines, particularly alcohol-based hand sanitizers, which are mainly used as hand hygiene technology coupled with anti-microbial soaps and disinfectants. The locally designed hand washing machines also contributed to effective control and spread of the virus. They conclude the success in the use of hand sanitizers and hand washing machines mainly depends on the formulation of the hand sanitizers and the functionality of the hand washing-machine. (Robert et.al, 2014; Shing-On et.al, 2011; Xuyu et.al, 2020).

Ankur Barua (2013) and Shing-On Leung (2011) suggest the use of Likert scales is practiced commonly in many health care assessment works. The use of 5-point scale questionnaires has been very effective to capture and assess the responses related to knowledge, practice, and attitude of the users of health care services. A similar approach to design the questionnaire to assess the efforts of TVET Institutions and measure the effectiveness of the technologies being developed and transferred would strengthen the present research work. Robert Warmbrod (2014) conducted a study on Likert scale response analysis methods to conduct and estimate the reliability and internal consistency using Cronbach's alpha values for the responses.

## METHODOLOGY

### Sample Size, Liker Scale rating and Description

A research design included formulation of research instrument for data collection. The research work objectives were attained by the application of descriptive research methodology. A non-probabilistic, purposive sampling technique was used in this work. The design and analysis of research questions were systematically carried keeping the objectives of research in mind. The data analysis was carried out on Likert -scale responses. In this paper, the Likert scale question data responses are analyzed and presented. Descriptive statistical parameters like count, median, and mode of each response was tabulated and discussed. Five TVET institutions (Ethiopian Technical University) affiliated with the Federal Government of Ethiopia were selected as sample institutions to conduct the research. Eight (8) professionals participated from TVET Institutions. The research questionnaire focused importantly on collecting detailed descriptions on how the existing technologies were serving the purpose, assessment of the working plan of TVET Institutions and how they were intercepting COVID-19 transmissions to meet the demand of technologies from the society. The chosen method is robust in approach and is justified by many authors who have successfully used for evaluation of responses received from society.

Table 1 Issues Related to TVET Institutions' Effort in Combating COVID -19 through Technology Development and Transfer in Addis Ababa City Administration

Item	Description
Question 1 (Q1)	Technologies used for combating COVID-19 have been developed
Question 2 (Q2)	The developed technologies have been designed and manufactured by TVET trainers
Question 3 (Q3)	The developed technologies are timely, important for combating COVID-19
Question 4 (Q4)	Developed technologies have been transferred to the society
Question 5 (Q5)	Developed and transferred technologies are cost effective
Question 6 (Q6)	Developed and transferred technologies are ergonomically standard and comfortable
Question 7 (Q7)	Transferred technologies have been developed using standard materials
Question 8 (Q8)	Initiative for developing and transferring technologies in combating COVID-19 comes from trainers
Question 9 (Q9)	Initiative for developing and transferring technologies in combating COVID-19 comes from TVET college management
Question 10 (Q10)	Transferred technologies were developed from available materials
Question 11 (Q11)	The effort of developing and transferring technologies to the society to combat COVID-19 is high
Question 12 (Q12)	Trainers who developed and transferred technologies need materials-based motivation
Question 13 (Q13)	Level of skill and knowledge of trainers who develops and transfers technologies is high
Question 14 (Q14)	The response of the transferred technologies of the society is high
Question 15 (Q15)	The commitment of the staff to develop and transfer technologies to the society to combat COVID-19 is very high
Question 16 (Q16)	The continuous effort and future plans of TVET colleges to develop and transfer technology to the society to combat COVID -19 is very high

Response Rate and Reliability tests

Questionnaires were prepared based on information gathered from literature reviews, consulting and incorporating suggestions given by existing experienced technical staff in TVET Institutions and utilizing the experience of researchers. Content validity was further ensured by checking the administered questionnaires with few participants before actually sending out to the respondents (Table 1). All questionnaires were distributed to respondents by one representative and the researchers personally. The questionnaires were formulated in the simple English language for clarity and ease of understanding. To carry out the research, a total number of forty (40) questionnaires were distributed to the selected TVET Institutions. 100 % response was received from TVET institutions. In this case it is possible to underline that the response rate was high enough for further analysis (Table 2). The reliability test was carried on the responses received from different TVET institutions so as to estimate the reliability and internal consistency of the responses received. The questionnaire was considered to be more reliable and the responses showed good internal consistency since the Cronbach's Coefficient alpha values obtained by feeding the coded responses in SPSS software was 0.77 which lies between 0.60 and near to 1. Higher the Cronbach's Coefficient alpha, the greater consistency for each measurement, and these measurements are reliable.

Table 2 Frequency response rating data

Questions	Respondents	Respondents (frequency/percentage) rating							
		Very (VA)	Agree	Agree (A)	Not (ND)	Decided	Disagree (D)	Very (VD)	Disagree
Q1	40	17(42.5%)		23(57.5%)	0%		0%		0%
Q2	40	24(60%)		16(40%)	0%		0%		0%
Q3	40	20(50%)		20(50%)	0%		0%		0%
Q4	40	10(25%)		30(75%)	0%		0%		0%
Q5	40	21(52.5%)		19(47.5%)	0%		0%		0%
Q6	40	9(22.5%)		31(77.5%)	0%		0%		0%
Q7	40	15(37.5%)		25(62.5%)	0%		0%		0%
Q8	40	15(37.5%)		17(42.5%)	3(7.5%)		5 (12.5%)		0%
Q9	40	16(40%)		24(60%)	0%		0%		0%
Q10	40	0%		40(100%)	0%		0%		0%

Q11	40	9(22.5%)	31(77.5) %	0%	0%	0%
Q12	40	0%	40(100%)	0%	0%	0%
Q13	40	19(47.5%)	21(52.5%)	0%	0%	0%
Q14	40	19(47.5%)	21(52.5%)	0%	0%	0%
Q15	40	24(60%)	16(40%)	0%	0%	0%
Q16	40	25(62.5%)	15(37.5%)	0%	0%	0%

## RESULTS AND DISCUSSION

Likert scale rating frequencies for questions (Q1, Q2 & Q3), responded by the invited TVET Institution participants are shown in Figure 1. The question was mainly stressed about whether technologies have been developed for combating COVID-19. Out of the total number of participants, (the respondents) 17 (42.5%) rated as “Very Agree” and 23 (57.5%) rated as “Agree”. This implies that technologies have been developed for combating COVID-19 in a sufficient number and types. Since this % is not so high, there is still a need to continue to develop more technologies for combating COVID-19. However, the overall result is positive, indicating high efforts are put by TVET institutions for combating the COVID-19 spread in the Addis Ababa city.

The second question focused on whether the developed technologies were designed by TVET trainers. In this case, 24 (60%) gave a rating as “Very Agree” and 16 (40%) rated as “Agree”. The overall rating shows that the participants who were invited from the TVET Institutions were very satisfied due to the fact that so many technologies have been developed for combating COVID-19. As regards to timely importance of developed technologies, half of the respondents (50%) rated “Very Agree” and “Agree” respectively.

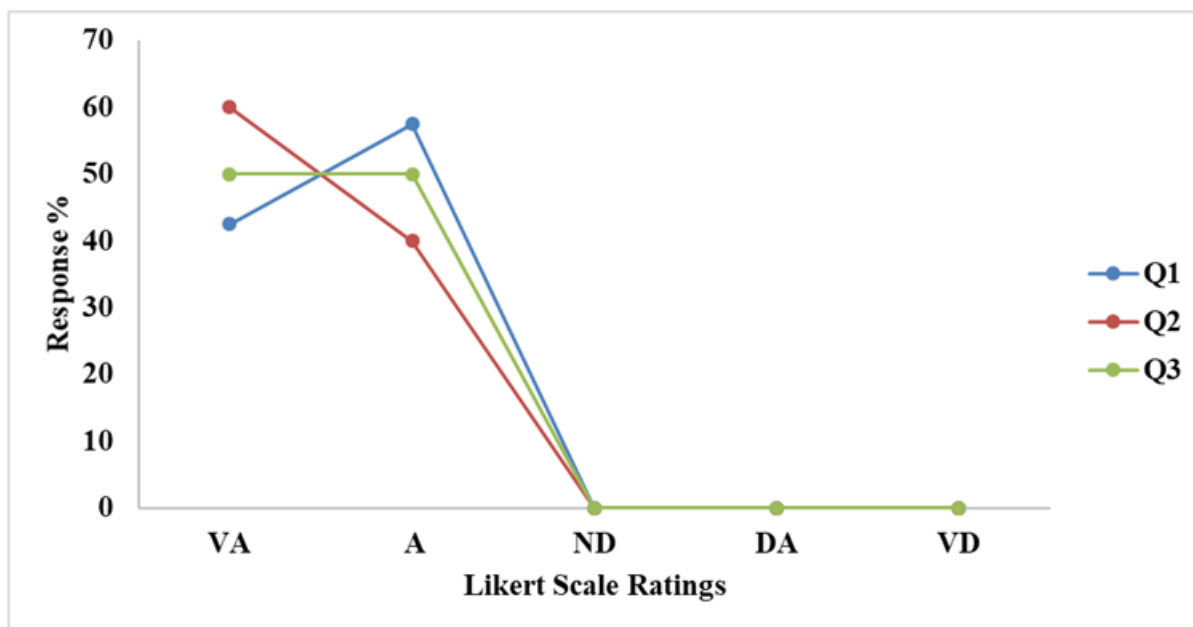


Figure 1: Response rates related to develop technologies for combating COVID-19

In Figure 2 (Q4, 5, 6, 7, 10) responses to the issues raised about the transferring status of the developed technology to the society is displayed. For question (Q4), 10 (25%) and 30 (75 %) respondents favored as “Very Agree” and “Agree” respectively. The overall results show that the majority of the respondents who participated in this research activity were satisfied. This may be due to the fact that all the TVET Institutions developed technologies and transferred to the society fully (100%) and many were in the process of transferring. The delay may be attributed to certain constraints like material availability, financial problems, delay of the purchasing process and other issues related to management. However, from the result, it is also possible to underline that the TVET Institutions are in good status and have put forward their high effort in transferring the developed technologies to the users on time.

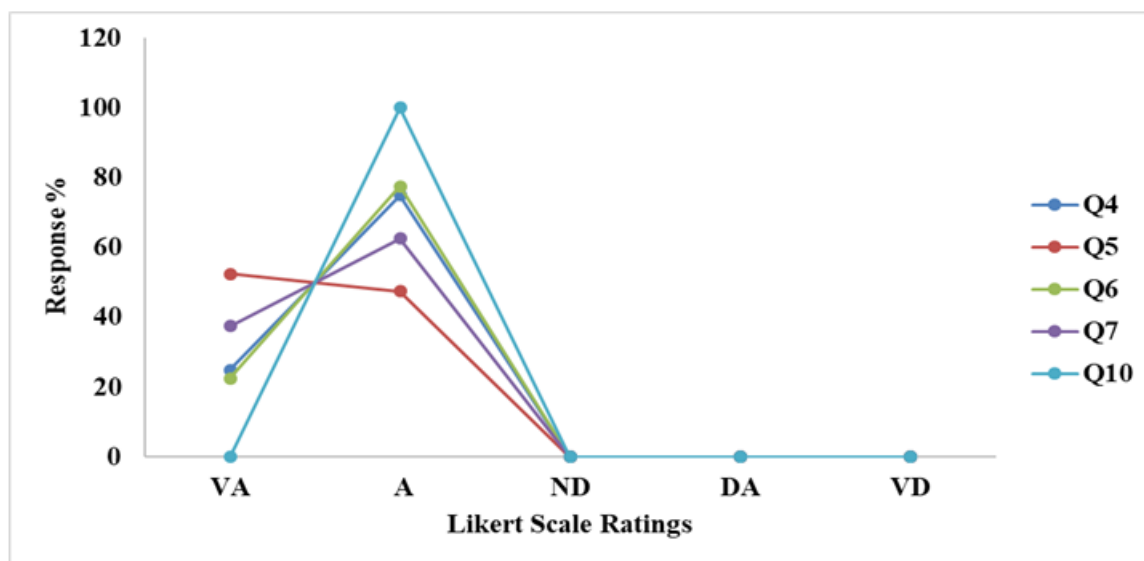


Figure.2: Responses to the issues related to developed technology

In figure 2, for question (Q5), 21 (52.5%) respondents and 19 (47.5%) respondents rated as “Very Agree” and “Agree” respectively on aspects related to cost effectiveness of the developed and transferred technologies. This response shows the level of satisfaction in the quality the technologies developed by the TVET Institutions. Again, in Figure 2, for question (Q6), 9 (22.5%) respondents and 31 (77.5%) respondents rated as “Very Agree” and “Agree” respectively, for the query that developed and transferred technologies to the society were ergonomically safe, comfortable to manipulate to suit specific usage by the community.

In order to assess the response of materials related issues as indicated in figure 2 (Q7), 15 (37.5%) respondents and 25 (62.5%) respondents rated as “Very Agree” and “Agree” respectively. This shows the materials used for developing the technologies are good and standard once. Certain issues were also raised (Q10) to know if the TVET institutions used the available materials for developing technologies rapidly, effectively and using the materials economy. All of the respondents (100%) rated as “Agree”. As regards to issues related to cost-effectiveness of the technologies, 21 (52.5%) respondents rated “Very Agree” and 19 (47.5%) respondents rated as “Agree”. The ratings indicate that the TVET Institutions were fully agreed regarding the cost-effectiveness of the technologies that have been developed and transferred to the society.

The assessment of the efforts shown by staff and managements of TVET Institutions is indicated in figure 3 (Q8, 9, 11 & 12).

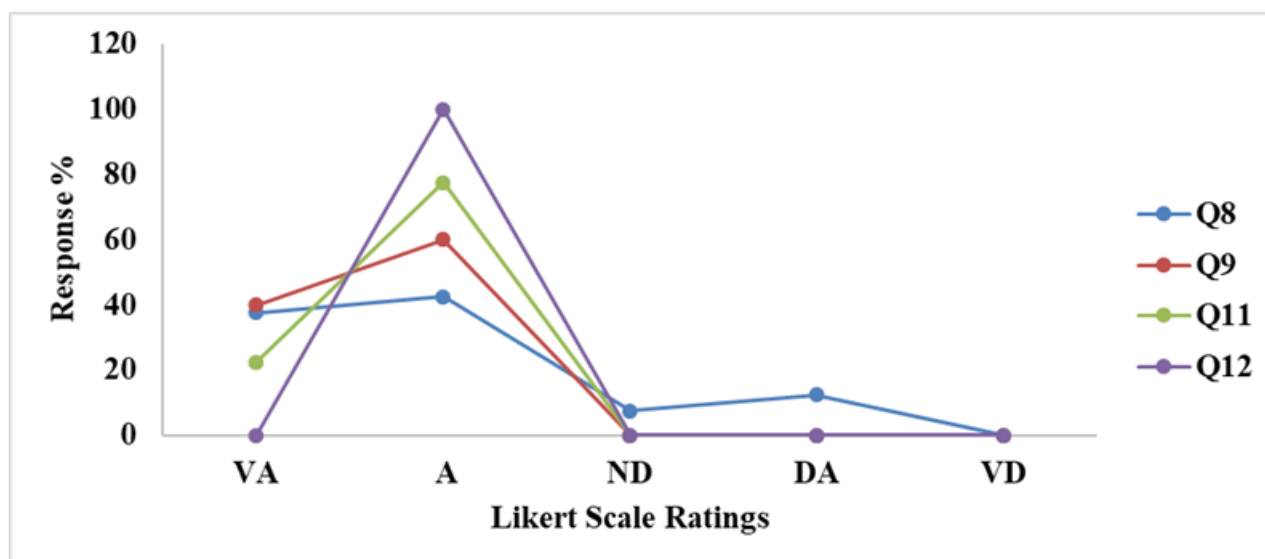


Figure 3: Responses on the issues related to the commitment of staff and Management of TVET Institute

As regards to initiative taken by TVET Institutions (Q8) for developing and transferring technologies in combating-COVID-19, 15 (37.5%) respondents rated as “Very Agree”, other 17 (42.5%) respondents rated as “Agree”, 3 (7.5%) respondents rated as “Not decided” and 5 (12.5%) respondents rated as “Disagree”. Most of the responses were agreed. However, Q8 shows 12.5 % of the responses disagreeing. Q8 statement is about the initiative taken by TVET institutions for developing and transferring technologies in combating COVID-19 came from trainers. The responses are scattered with 12.5 % response, choosing disagree as most of the TVET technologies developed and transferred by TVET institutions is initiated by top management

officials. The response also prove the fact about some cases the initiative also come from the trainers. The responses are in line with the assessment. The reliability estimates and Cronbach alpha value for the responses received was 0.77. This indicates good internal consistency in the responses received.

The result has shown that the majority of the TVET initiations for developing and transferring of technologies for combating COVID-19 has come from the trainers themselves. For question (Q9), the initiative taken by the TVET Institutions' management team to develop and transfer technologies to combat COVID-19, 16 (40%) respondents and 24 (60%) respondents responded as "Very Agree" and as "Agree" respectively. Based on the ratings, the developing and transferring of the technologies for combating-COVID-19 were initiated by the managements of the selected Institutes. Regarding the issues (Q11) on the effort made on developing and transferring technologies to the society to combat COVID-19 is high, 9 (22.5%) respondents rated as "Very Agree" and 31 (77.5%) were rated as "Agree" respectively.

In the research, question (Q12), emphasis was also placed on whether the trainers needed financial or materials motivation when developing technologies to combat COVID-19. It is visible in figure 3 that all the respondents or 40 (100%) rated as "Agree". Therefore, as trainers who developed and transferred those technologies need materials (financial) motivations, additional financial resources were required to motivate the trainers engaged in developing technologies that were transferred to combat COVID-19.

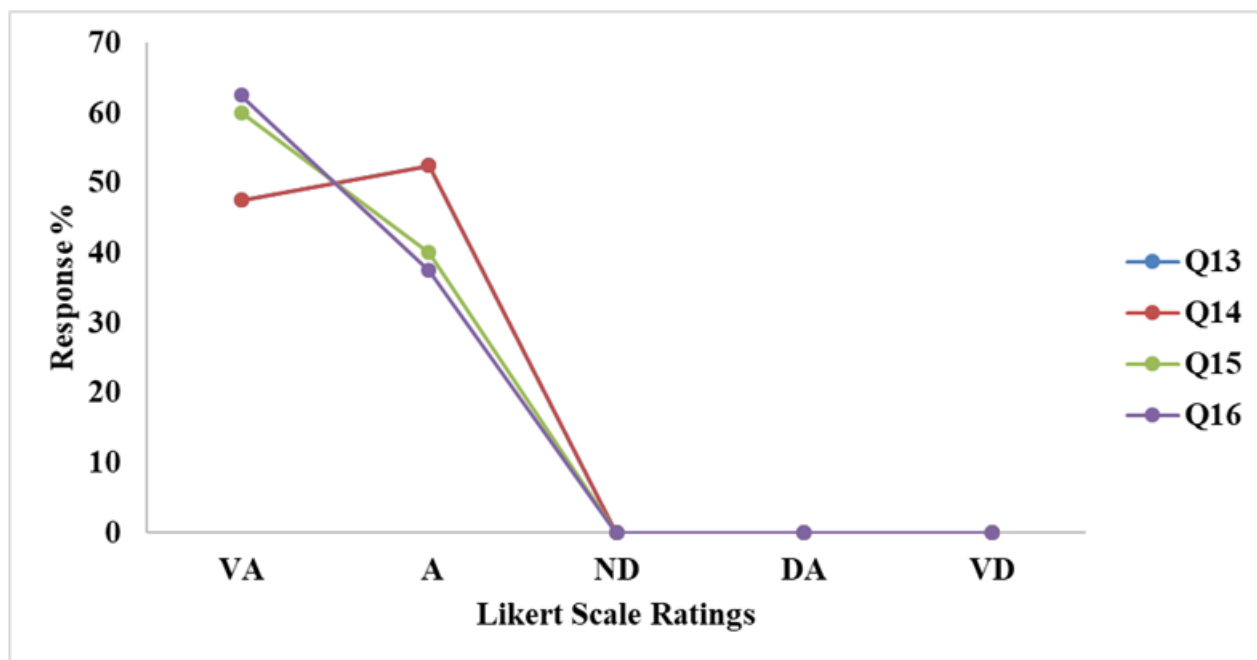


Figure 4: Responses on commitment related issues in developing and transferring technologies

The responses on the commitment and attitude of the TVET institutions towards the development and transfer of technologies are shown in figure 4 (Q13, 14, 15 and 16). Accordingly, the question (Q13) focused on the level of skill and knowledge of trainers, 19 (47.5%) respondents rated as "Very Agree" whereas 21 (52.5%) were rated as "Agree". The result shows the trainers have a sufficiently high level of skill and knowledge to develop technologies and transfer them to combat COVID-19. Again, from figure 4 question (Q14) reviewing the response from society, 19 (47.5%) respondents and 21 (52.5%) respondents rated as "Very agree" and "Agree" respectively. This indicates the transferred technologies were serving high in preventing COVID-19 transmission and follow-up by institutions is in a good stand. In figure 4 question (Q15) demonstrates that 24 (60%) respondents rated as "Very Agree" and 16 (40%) respondents rated as "Agree". In this case, the overall ratings of respondents confirmed the high degree of commitment of the staffs to develop and transfer technologies to the society to combat COVID-19 spread. Finally, for question (Q16) on continuous effort and future plans of TVET Institutions in developing and transferring technologies to combat COVID-19 received a response of 25 (62.5%) and "15 (37.5%) respondents as "Very agree" and "Agree" respectively. It is possible to conclude that the overall effort and commitment of the TVET Institutions in the city was very high and well-prepared to combat COVID-19 through the development of various technologies and transferring them to the society.

## CONCLUSION

The effort of TVET Institutions' in developing and transferring technologies for combating COVID-19 is highly commendable. In General, the research indicates that, technologies being developed and transferred were also ergonomically good and easy for a common user to use the technology even without any pre-training required. The developed technologies were being delivered to society in time, easily, so as to combat the spread of COVID-19 disease TVET Institutions were

making technologies using standard and available materials, and guided by well-educated trainers of TVET Institutions. TVET management was also supporting and taking initiatives to develop technologies for combating COVID-19. The efforts put by TVET Institutions to develop and transfer the technologies to the society were high. The trainers of TVET institutions are good and skilled ones. Finally, the continuous efforts and future plans to develop and transfer technologies to the society for combating COVID-19 are highly satisfying and prove the great effort put by the institution. TVET Institutions should start focusing on developing digital based technologies that can be used effectively for control of COVID-19. The reliability estimates and Cronbach alpha value of 0.77 indicated the results were excellent and showed good internal consistency.

Table 3 Abbreviations

COVID-19	Corona virus - 2019
TVET	Technical and Vocational Education Training
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization
SARS	Severe acute respiratory syndrome
MERS	Middle East Respiratory Syndrome

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