

The Study on the Impact of Enriched Virtual Mode of Learning among Medical Technology Interns of University Of Santo Tomas

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Abstract: Face-to-face learning in a traditional classroom setting is the golden standard for instructional delivery. COVID-19 pandemic and its impact on the education system forced Higher Education Institutions offering health allied courses' shift to Enriched Virtual Mode of Learning (EVM) as an alternative modality. In evaluating the impacts of the approach in correlation to the eight (8) learning outcomes stipulated in CHED Memorandum Order no. 13 series of 2017, a descriptive quantitative research design was used, and participants were selected through purposive sampling technique. A total of 162 responses from the University of Santo Tomas (UST) medical technology interns' batch 2021 were gathered and subjected to WarpPLS for correlation and linear regression analyses. The result showed implementation of EVM in terms of the facilities used has an insignificant impact ($p = >0.05$) on the achievement of learning outcomes 1 to 7. This reflects the use of online platforms as currently new and still poses various benefits and limitations. EVM facilities for the achievement of learning outcome 8 presented a negative impact ($\beta = -0.155$, $p = 0.022$) due to the interns' lack of opportunity for communication, teamwork, and interaction with their colleagues and patients. EVM through its manner of delivery presented a positive impact ($p = <0.05$) across all eight (8) program learning outcomes, which can be attributed to the sufficient delivery of appropriate learning materials. The result of the study provides an overview of the current trend of online learning in medical education and may be utilized as a basis for implementing adjustments in the curricula and considerations for full implementation.

Keywords: — *Enriched Virtual Mode of Learning (EVM), Medical Technology, Interns, Learning outcomes, Traditional learning.*

I. INTRODUCTION

Traditional learning is characterized by a face-to-face interaction among students and an instructor in a physical setting. The flow of instruction maintains a passive attitude, where the teacher directs the course of learning. It follows a fixed schedule, promoting a disciplined, focused and productive environment in the classroom. According to Arora *et al.* (2020), even though traditional learning was employed in most educational institutions and was proven effective, various E-learning or electronic learning platforms began to emerge as early as the 1990s [1].

Most students currently utilize laptops for the purpose of paper writing, research, browsing educational videos, and making presentations. Books, videos, and other learning materials and assessments were also made available to students through websites like Edmodo, Google Classroom and Canvas. The concept of blended learning started to become embraced by various schools. In a study by Brockman *et al.* (2019), while the students strongly appreciated online platforms due to its pacing and flexibility, most of the students still expressed their preference for a blend of in person and virtual laboratory activities [2]. However, due to the challenges in education posted by the COVID-19 pandemic, the world faced one of the most appalling challenges that drastically affected not just global education but also the education system in the local sectors and institutions. During the affected months, the COVID-19 health crisis had not only wedged the 'normal' but also brought forth the introduction of alternative learning

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modes in all levels of education. As stated by Agarwal and Kaushik (2020), the situation forced the educational institutions, most especially, medical institutions to partake in the notion of introducing online learning to education and practice [4]. The Enriched Virtual Mode of Learning (EVM) was employed full-time by higher education in response to the health crisis brought about by COVID-19 and the suspension of actual face-to-face classes brought about by this pandemic.

The primary objective of a Medical Technology internship is for the interns to be able to apply knowledge and basic skills acquired from professional courses (originally separated into Lecture and laboratory units for optimization of learning) which comprise the scope of the licensure examination for Medical Technology, as well as basic knowledge from prerequisite courses. According to Imamwerdi (2012), an early clinical exposure for medical technology students boosts their confidence during the internship program [3]. It allows them to put into practice all the theoretical knowledge acquired in their academic proper and be able to fully comprehend the methods and realize the importance of processes to the health of their patients. Due to the inevitable occurrence and impact to the education system brought by the COVID-19 pandemic, Higher Education Institutions made use of other modes of instructional delivery, one of which is the Enriched Virtual Mode as an alternative strategy to continue learning. Enriched Virtual Mode of Learning or EVM is a type of learning where facilitators employ online and offline remote learning strategies for continuous learning.

The Commission on Higher Education (CHED) is the Philippine government's agency who promotes relevant and quality higher education and ensures access to quality higher education. CHED Memorandum Order (CMO) 13 s. 2017 manifests the policies, standards, and guidelines for the Bachelor of Science in Medical Technology or Medical Laboratory Science program. Section 6.3, article IV of CMO 13 s. 2017 enumerates the program learning outcomes specific to Bachelor of Science in Medical Technology or Medical Laboratory Science and Section 7, article IV of CMO 13 s. 2017, which describes the performance indicators used for measuring whether or not the program learning outcomes of the course have been attained by the graduate. The performance indicators serve as an objective standard to which students enrolled in Bachelor of Science in Medical Technology must aspire to achieve. The learning outcomes serve as a basis to

determine the impact of the current Enriched Virtual Mode of Learning specifically in terms of its facilities and manner of delivery as implemented in the said academic period.

This study was conducted to determine the extent, relationship and impact of the Enriched Virtual Mode of Learning to the achievement of the structured learning outcomes among fourth-year medical technology interns of University of Santo Tomas that undergo virtual internship in the Academic Year 2020 to 2021. The study determined the impact of EVM through the institutional facilities and the manner of online learning delivery. The facilities consist of the online learning platforms provided by the institution such as Zoom, Blackboard and Google classroom, while delivery consists of the nature of the online learning materials provided by the institution such as its content, relevance, sufficiency and accessibility.

The researchers hypothesized that the implementation of EVM has an impact on each of the eight (8) learning outcomes stated in the CHED Memorandum Order 13 s. 17 learning outcomes.

The conceptual framework in Figure 1 presents the learning outcomes that served as a basis to determine the impact of the current Enriched Virtual Mode of Learning, specifically in terms of its facilities and manner of delivery as implemented in the said academic period.

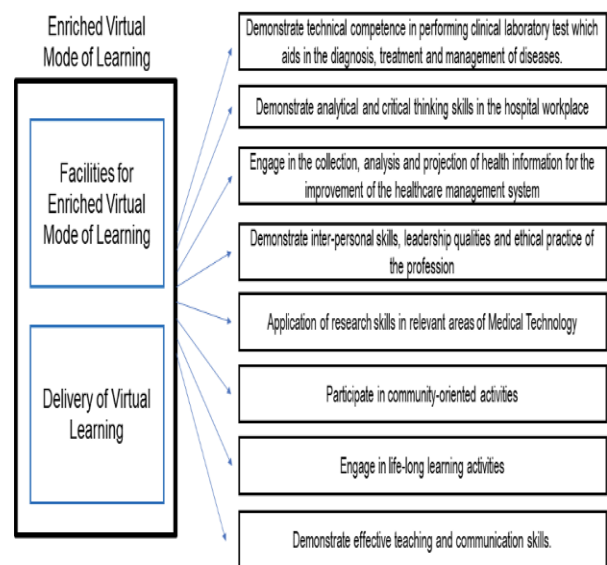


Fig.1. Conceptual Framework

An overview on the current trend of employing Enriched Virtual Mode of Learning in the fourth year Medical Technology internship for the Academic Year 2020-2021 was provided by this study, as well as implications of how the transitional phase in education and unconventional process affected the extent of achieving the desired, pre-determined learning outcomes for the program. Furthermore, the data gathered may be utilized as a basis for the Department of Education (DepEd) and the Commission on Higher Education (CHED) in assessing the impact of online learning on skill-based courses such as Medical Laboratory Science. This may also help provide new techniques in the concept of online learning in order for institutions to have more effective, alternative methods to face-to-face learning in the case of limited time and instructor availability.

The limitations of the study were the lack of access to face-to-face interview and interaction between the respondents and the researchers due to safety restrictions set in response to COVID-19 pandemic. This excluded the participation of first to third year Medical Technology students that are still not qualified to participate in the internship program. Medical Technology interns of any qualified institution not enrolled in the University of Santo Tomas employing the same alternative online mode of learning as part of the academic curriculum were also not involved in the study.

II. METHODOLOGY

A. Research Design

The study utilized a descriptive quantitative approach in order to deduce a conclusive pattern revealing the extent to which learning outcomes were achieved for the Medical Technology interns of the University of Santo Tomas and the impacts brought about by implementation of EVM. The respondents answered a detailed questionnaire with utmost honesty. The answers were provided for through the given range of scores to cater to varying degrees of the responses. The software WarpPLS was used to interpret results based on the statistical techniques chosen for the study.

B. Research Locale

University of Santo Tomas (UST) is the oldest university in Asia, bearing the titles: Pontifical, Royal and Catholic University of the Philippines. One of the 22 colleges is the

Faculty of Pharmacy, which branches out to three different health-allied departments: Biochemistry, Pharmacy, and Medical Technology. UST is recognized as one of the top performing schools of Medical Technology, showing consistent performance in the Medical Technology Licensure Examinations. The Enriched Virtual Mode of Learning was utilized to allow competence, commitment, and compassion to succeed over the COVID-19 pandemic.

C. Research Participants of the Study

The purpose sampling technique was used in the study as the participants were already specified as the academic year 2020-2021 interns of Medical Technology from the University of Santo Tomas. The medical technology interns of batch 2021, with a population of 268, were obliged to adapt to the Enriched Virtual Mode of Learning as a form of learning alternative to the traditional instructional delivery intended for internship. Applying Slovin's formula in the acquisition of the sample size, a minimum of 159 fourth-year UST medical technology interns were invited to participate in the study.

D. Research Tool

The researchers used a platform called Google Forms; a survey administration software launched by the Google Company. The responses of the participants were automatically collated and transmitted by the platform into a spreadsheet for easier analysis.

The 61-item questionnaire consisted of four major parts: demographic profile, facilities for Enriched Virtual Mode of Learning, delivery of virtual learning, and the impact on the program learning outcomes. The questions followed a 1-6 rating scale, with 6 being the highest or always observed and 1 being the lowest or never observed. There were no open-ended questions except for the demographic profile.

The demographic profile included the name (optional), age, gender, block, and duration of class hours and days of the respondent. Other contributing features that influenced the quality of Enriched Virtual Mode of Learning were identified to be the institution's role in the implementation and provision of accessible, well-functioning online facilities for the students. The delivery of virtual learning was addressed to determine the impact of online learning in terms of the content, relevance, availability and accessibility of learning resources,

communication of the lessons as well as collaboration between students and professors. The instructors are directed to provide comprehensive lectures and maintain an interactive learning environment despite being in remote locations.

The final part of the questionnaire was based on the CHED Memorandum Order No.13 Series of 17, entitled Policies, Standards, and Guidelines for the Bachelor of Science in Medical Technology or Medical Laboratory Science (BSMT/MLS) Program. Section 7 highlighted the performance indicators used to identify the learning outcomes that the medical technology interns must achieve by the end of the course.

There was a total of eight (8) learning outcomes which include the following: the demonstration of technical competence in performing laboratory test, demonstration of analytical and critical thinking skills, engagement in the collection and analysis of health information, demonstration of interpersonal skills, leadership qualities and ethical practice, application of research skills, participation in community-related activities, engagement in lifelong learning activities, and the demonstration of effective communication and teaching skills.

E. Data Gathering Procedure

Prior to data gathering, pilot testing was performed to assess the validity and reliability of the questionnaire. Through Google Forms, the survey was distributed to a minimum of 30 respondents. The third-year medical technology students of batch 2022 were chosen as the respondents for the pilot testing as they have taken the pre-requisite subjects prior to the internship program. This preserved the number of target samples of the interns for the study. The results of the pilot testing on the 38 third-year medical technology students using the Cronbach's alpha across all questions had an alpha value of greater than 0.7. This indicated that the questions in the statistical tool used were valid and reliable.

The researchers contacted representatives of the different sections who were willing to participate in the study. The link for the questionnaire was disseminated to the fourth-year medical technology interns through the representatives of their class. Facebook messenger, a widely used online platform primarily designed for communication, was chosen due its usefulness and popularity for data gathering. The period of data collection occurred during the months of February and March 2021. The duration that the participants were involved in the study was around 10-15 minutes depending on the time taken

to answer the survey. Emails were sent as confirmation for their participation.

F. Ethical Aspect of the study

The research proposal was submitted to the Ethics Review Committee for approval to ensure that this study involving human participation and data gathering are within the agreed local and international ethical guidelines. The participants were asked to read and agree to a consent form that expounds on the nature, objectives, importance of participation in the study and their contribution to the field of research. There was emphasis on the voluntary participation of the respondents as they have the right to withdraw without explanation, inclusive of any correlated consequences, upholding their rights to privacy, confidentiality, anonymity, and autonomy. The gathered data were accessed only by the members of the group, the research adviser and research panelists. The researchers abided by the Data Privacy Act of 2012 (Republic Act No. 10173), ensuring the protection of gathered information from public use. There will be no financial cost in the participation of the interns in the study nor compensation or insurance in case of study-related injuries, for this study has ensured to project no direct and deliberate harm towards its respondents.

G. Data Analysis and Interpretation of Results

The analysis and interpretation of data was performed using a software known as WarpPLS. This is a structural equation-based modelling software based on the partial least square (PLS) algorithm. It is known for its enhanced ability to present nonlinear relationships in graphs and tabulations, allowing the researchers to process the critical data gathered with different statistical tests to ensure accuracy and precision in the analysis of data. The statistical analysis of the data has included the computation of mean, standard deviation, and linear regression.

COMPUTING FOR THE MEAN

$$\bar{X} = \frac{\sum X}{N}$$

Where X represents the samples

N represents the sample size

The mean was used as a representation of the answers given by the respondents and was useful for getting a general

idea of the data set. It permitted symmetrical distribution of the samples, provided that there are little to no outliers among the respondents. The calculated mean was used in the performance indicators of each learning outcome to determine the extent to which these learning outcomes were achieved.

STANDARD DEVIATION

$$s = \sqrt{\frac{\sum(X - \bar{x})^2}{N - 1}}$$

Where X represents the sample
 \bar{x} represents the sample mean
 N represents the sample size

The standard deviation measured the degree of dispersion of the given set of values from the mean. A high standard deviation indicated a higher degree of dispersion from the mean. It was essential to determine the shape or wideness of the resulting normal curve. The calculated standard deviation is used for the performance indicators of each learning outcome.

Table.1. Grouping Ranges and Respective Interpretations

Grouping of Ranges		Interpretation
1	1.83	Never Observed
1.84	2.66	Rarely Observed
2.67	3.49	Sometimes Observed
3.5	4.32	Often Observed
4.33	5.15	Generally Observed
5.16	6.00	Always Observed

Table.1 shows the interpretations of the mean. This was done by using a six (6) point Likert scale. An interval of 0.83 was used per Likert scale starting from the lowest. To get the class size of 0.83, the highest score (6) was subtracted by the lowest score (1), this was then divided by the amount of six responses (6) that can be chosen in the questionnaire. The means of each learning outcome were interpreted using the Likert scale, while the standard deviation was used to visualize the variability of the data collected.

PARTIAL LEAST SQUARE (PLS) REGRESSION

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_iX_i$$

Where β_0 represents the intercept

β_i represents the slope for X_i

The slope derived from the linear regression formula demonstrates the relationship between the independent variable and the dependent variable through Pearson Correlation, r . The slope, whether positive, negative, or undefined, signifies whether the dependent variable significantly affects the subject. The linear regression was used to determine the impact of Enriched Virtual Mode of Learning specifically on the institutional facilities and manner of delivery of virtual learning on each learning outcome.

Table.2. Interpretation of Pearson Correlation, r .

Value of r	Interpretation
0.90 to 1.00	Very high positive correlation
0.70 to 0.89	High positive correlation
0.40 to 0.69	Moderate positive correlation
0.20 to 0.39	Small positive correlation
-0.20 to 0.19	Insignificant/Negligible
-0.40 to -0.21	Small negative correlation
-0.70 to -0.41	Moderate negative correlation
-0.90 to -0.71	High negative correlation
-1.00 to -0.91	Very high negative correlation

Table.2 presents the interpretation for Pearson correlation, r . These values were used in measuring the statistical relationship and association between the variables.

III. RESULTS AND DISCUSSION

A. Demographic Profile of the Respondents

The demographic profile of the respondents consisted of their backgrounds and characteristics limited to those significant to the study. It included their genders - either male, female, or unspecified, respective sections - from 4AMT to 4FMT or 4SPMT, average class days/ internship days per week, and average class hours/ internship hours per day.

Table.3. Demographic Profile of the Respondents

Gender of the Respondents		
Variables	Frequency	Percentage (%)
Female	96	59.26
Male	61	37.65

Preferred not to say	5	3.09
Contributing Sections of Interns		
Variables	Frequency	Percentage (%)
4AMT	28	17.28
4BMT	37	22.84
4CMT	24	14.81
4DMT	29	17.90
4EMT	19	11.73
4SPMT	18	11.11
Blank	7	4.32
Average Class Days/Internship Days per Week		
Variables	Frequency	Percentage (%)
4 days/week	33	20.37
5 days/week	111	68.52
6 days/week	14	8.64
Others	4	2.48
Average Class Hours/Internship Hours per Day		
Variables	Frequency	Percentage (%)
2 to 4 hours/day	4	2.47
4 to 6 hours/day	53	32.72
6 to 8 hours/day	78	48.15
8 to 10 hours/day	21	12.96
>10 hours/day	6	3.70

Table.3 presents the demographic profile of the respondents of the study. A total of 162 out of the total population of 268 medical technology interns responded in the survey. Majority of the respondents were female (59.26%); most of them belonged to block 4BMT (22.84%), having average internship days of 5 days/week (68.52%), and average internship hours of 6 to 8 hours/day (48.15%).

The information presented an overview on the response dispersion among the interns, allowing accurate description of respondent characteristics.

Extent of the Achievement of Learning Outcomes through the Enriched Virtual Mode of Learning

The extent of achievement of the program learning outcomes among the medical technology interns were calculated using the computed mean values of each learning outcome alongside with its respective interpretation based on the frequency of how often each of the variables were observed to be achieved by the interns.

Table.4. Extent of the Achievement of Learning Outcomes through the Enriched Virtual Mode of Learning

Learning Outcomes	Mean	Frequency
LO1: Demonstrate technical competence in performing clinical laboratory test which aids in the diagnosis, treatment, and management of diseases	4.27	Often Observed
LO2: Demonstrate analytical and critical thinking skills in the hospital workplace	4.28	Often Observed
LO3: Engage in the collection, analysis, and projection of health information for the improvement of the health care management system	4.53	Generally Observed
LO4: Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession	5.16	Always Observed
LO5: Apply research skills in relevant areas of and for the advancement of the medical technology profession.	5.03	Generally Observed
LO6: Participate in community-oriented activities	4.64	Generally Observed
LO7: Engage in lifelong learning activities.	4.42	Generally Observed
LO8: Demonstrate effective teaching and communication skills	4.94	Generally Observed

Table.4 contains the 8 program learning outcomes, their means, and its interpretations based on Table 1. It can be depicted above that Learning Outcome 1: *Demonstrate technical competence in performing clinical laboratory tests which aids in the diagnosis, treatment, and management of diseases* has the lowest mean (mean = 4.27) among the eight learning outcomes, interpreted as often observed. This is in accordance with the study by Brinson (2015) which states that the lesser degree of attainment is due to the limited amount of experience the interns were able to attain under Enriched Virtual Mode of Learning; laboratory activities require skills and experience of

performing the procedure [5]. Without a laboratory environment to reinforce the theories learned, absolute confidence in the skills described by Learning Outcome 1 is difficult to achieve.

Learning Outcome 4: *Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession*, on the other hand, has the highest mean (mean = 5.16), and is interpreted as ‘always observed’. Hands-on experience is not entirely required to attain the skills described in Learning Outcome 4. These learning outcomes can be applied conceptually and can be learned theoretically. According to Chen *et al.* (2020), considering that Learning Outcome 4 contains concepts of confidentiality, ethical behavior, communication, and leadership, online lecture courses thoroughly helped in improving the students’ understanding of concepts [6].

B. The Correlation of Facilities for EVM and Delivery of EVM to Learning Outcomes

In assessing the relationship between the Enriched Virtual Mode of Learning and the eight (8) program learning outcomes for the Medical Technology Internship Program, the Enriched Virtual Mode was classified into facilities provided by the institution (Zoom, Blackboard, Google etc.) and manner of delivery. The P-values calculated were used in measuring the degree of statistical relationship and association between the variables. The interpretation of results is found on Table 2.

Table.5.A. Correlation of Facilities for EVM to Learning Outcomes

Facilities for EVM		
Learning Outcome	Pearson Correlation, <i>r</i>	P-value
LO1: Demonstrate technical competence in performing clinical laboratory test which aids in the diagnosis, treatment and management of diseases	0.400*	<0.001
LO2: Demonstrate analytical and critical thinking skills in the hospital workplace	0.281*	<0.001

LO3: Engage in the collection, analysis, and projection of health information for the improvement of the health care management system	0.189*	0.016
LO4: Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession	0.229*	0.003
LO5: Apply research skills in relevant areas of and for the advancement of the medical technology profession.	0.206*	0.009
LO6: Participate in community-oriented activities	0.234*	0.003
LO7: Engage in lifelong learning activities.	0.187*	0.017
LO8: Demonstrate effective teaching and communication skills	0.151	0.055

Note: Asterisk (*) - Represents a statistically significant value with P value of less than 0.05 Significance level or alpha level = 0.05

Table.5.B. Correlation of Delivery for EVM to Learning Outcomes

Delivery of EVM		
Learning Outcome	Pearson Correlation, <i>r</i>	P-value
LO1: Demonstrate technical competence in performing clinical laboratory test which aids in the diagnosis, treatment and management of diseases	0.516*	<0.001
LO2: Demonstrate analytical and critical thinking skills in the hospital workplace	0.433*	<0.001
LO3: Engage in the	0.344*	<0.001

collection, analysis, and projection of health information for the improvement of the health care management system		
LO4: Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession	0.320*	<0.001
LO5: Apply research skills in relevant areas of and for the advancement of the medical technology profession.	0.350*	<0.001
LO6: Participate in community-oriented activities	0.364*	<0.001
LO7: Engage in lifelong learning activities.	0.331*	<0.001
LO8: Demonstrate effective teaching and communication skills	0.304*	<0.001

Note: Asterisk (*) - Represents a statistically significant value with P value of less than 0.05 Significance level or alpha level = 0.05

Learning Outcome 1 has a moderate positive relationship with both facilities ($r = 0.400$, $p = <0.001$) and delivery (0.516, $p = <0.001$) of Enriched Virtual Mode of Learning. The moderate positive relationship existing between EVM, and the intern's demonstration of the skills described in Learning Outcome 1 reflects the sudden transition of the university to online learning. According to Sandhu and De Wolf (2020), with the number of medical schools suspending its clinical placements to mitigate the transmission of COVID-19, online learning has been proven essential in continuing medical education through the commonly utilized online platforms [7].

Learning Outcome 2 has a small positive relationship with EVM facilities ($r = 0.281$, $p = <0.001$), and a moderate positive relationship for the delivery of EVM ($r = 0.433$, $p = <0.001$). The small positive relationship between facilities for EVM and Learning Outcome 2 presents the essentiality of analytical and critical skills in practice as skills needed to be acquired by the interns. In a study by Huynh (2017), E-learning platforms may

only function as partial alternatives that can enhance the theoretical skills since clinical skills involving actual analysis still require actual laboratory practice [8]. The moderate positive relationship between delivery of EVM and Learning Outcome 2, on the other hand, reflects the appropriateness of activities such as case studies in instilling application of lecture concepts. According to Donkin, Askew and Stevenson (2019), students responded more positively when presented with activities that allow expert feedback for the initial learning as these activities served to be an effective approach to online classroom engagement [9].

Learning Outcome 3 has a very low relationship which can be considered as negligible with facilities ($r = 0.189$, $p = 0.016$) for EVM. On the other hand, it has a small positive relationship with delivery ($r = 0.344$, $p = <0.001$) for EVM. Engagement to collection and analysis was limited by the current online learning modality, leaving the interns to attend their classes virtually. In a study by Alsoufi *et al.* (2020), with the interns' rotation in the actual setting suspended, the students are restricted from actual patient care and opportunity to practice [10]. Moreover, according to Joaquin, Biana and Dacela. (2020), Enriched Virtual Mode of Learning has its own limitations and may be inapplicable for execution of certain modified activities. As an alternative mode, limitations of these E-learning strategies must be thoroughly understood [11]. Contrarily, the small positive relationship between delivery of EVM and Learning Outcome 3 indicates that this mode still allows learning of the concepts and skills required by the Learning Outcome despite the virtuality of the platform. Powell, Roberts and Patrick (2015) stated that Enriched Virtual Mode of Learning still allows the students to maximize the function of technology [12].

Learning Outcome 4 presents a small positive relationship with facilities ($r = 0.229$, $p = 0.003$) and delivery ($r = 0.320$, $p = <0.001$) of EVM. The small positive relationship indicates the success of the introduction of E-platforms in the medical field as it paved the way for communication to be effectively enhanced. In relation to this, Zacharia (2015) stated that interpersonal skills, leadership, and practices of the profession can still be observed in group studies, case analysis, report presentation, and other activities delivered to the students [13]. Application of the ethical practices in the profession is possible through integration of medical ethics and bioethics principle in the said activities.

Both facilities ($r = 0.206$, $p = 0.009$) and delivery ($r = 0.350$, $p = <0.001$) of EVM have a small positive relationship with Learning Outcome 5. These findings may be due to technology as being widely accessible to students as a means of acquiring journals, study references, and research materials. This claim is supported by a study by Tzu-Chien Liu *et al.* (2015) stating that students utilize laptops for the purpose of paper writing, research, browsing educational videos, and presentations. According to Hakimi *et al.* (2016), these educational activities have been carried out with the use of internet and computer communications [15]. However, archives owned by the university do not contain all the needed information; the pandemic has halted the application of experimental research. Thus, limitations of the approach in research-making can still be observed.

Both facilities ($r = 0.234$, $p = 0.003$) and the delivery of EVM ($r = 0.364$, $p = <0.001$) have a small positive relationship with learning outcome 6. Despite the implementation of EVM, absence of immersion, and practicum, the students were still able to take up a Public Health course which involves community awareness development through integration of demographic assessment, epidemiology, and biostatistics into community-centered outputs. In relation to this, Isabel (2016) stated that clinical education is centered on experiential learning [16]. Despite the inadequate laboratory simulations, online learning still permits students to reinforce knowledge on public health through the course Community and Public Health.

Facilities for EVM have a very low relationship e ($r = 0.187$, $p = 0.017$) considered to be negligible, whereas delivery of EVM ($r = 0.331$, $p = <0.001$) has a small positive relationship with Learning Outcome 7. Interns, during their undergraduate years, have already developed the essential learning principles and foundation of medical technology education prior to the implementation of EVM. As stated by Matthews (2016), reinforcement of knowledge is still possible through accessibility and digitalization of learning [17]. Regardless of the facilities used, the lectures delivered are considered effective reinforcement for theoretical and conceptual learning. Thus, in a study by Powell, Roberts and Patrick (2015), they stated that this allowed the students to fully understand the lectures given within the context of effective learning [12].

The achievement of Learning Outcome 8 has an insignificant relationship since the P -value ($p=0.055$) is greater than 0.05. In the first three years of the undergraduate program,

students are taught thoroughly to develop confidence in communicating and reporting. Medical technology units are introduced for those who will embark in the teaching profession. However, actual patient and colleague interaction are limited in this mode. According to Alsoufi *et al.* (2020), activities done by the interns matter most in actual practice [10]. Moreover, Matthews (2016) stated that current challenges halted the patient care and clinical practice, however, interns' teaching and communicating skills are still possible in this mode since Enriched Virtual Mode of Learning is interactive in its nature and is accessible to the majority [17].

C. Impact of Enriched Virtual Mode of Learning to the Achievement of the Learning Outcomes

The achievement of the medical technology learning outcomes through EVM relies on the facilities provided by the institution and the delivery of the core curriculum. The facilities focus on the accessible, and effective use of the online educational platforms chosen by the institution such as Zoom, Blackboard, and YouTube and the delivery of the learning materials provided, such as theoretical case studies.

The partial least square algorithm (PLS) was used to determine the impact of the EVM towards the eight (8) learning outcomes stated in the CMO 13 series of 2017. The facilities and delivery of EVM can produce a positive, negative or insignificant impact.

Table.6 indicates the partial least squares result that is composed of the beta coefficient and the P -value. The beta coefficient is defined as the degree of change in the outcome variable for every 1-unit change of the predictor variable. For this study, the outcome is the achievement of the learning outcome while the predictor is the facility or the delivery of EVM. The P -value determines whether the beta coefficient value is significant or insignificant. The beta coefficient value is significant if the P -value is less than 0.05 while an insignificant beta coefficient value is determined with a P value that is more than 0.05. An insignificant beta value indicates that the specific variable does not significantly predict the outcome. A significant beta value, whether positive or negative, shows that the variable can serve as a prediction of the outcome.

The interpretation for a positive beta coefficient is that for every increase of 1 unit in the predictor variable whether it would be the facilities or delivery of EVM, there is an increase

in the corresponding beta coefficient value of the learning outcome variable. This signifies that the EVM has an impact on enhancing the achievement specific learning outcome. On the other hand, the interpretation for a negative beta coefficient is that: for every increase of 1 unit in the predictor variable whether it be the facilities or the delivery of EVM, there is a decrease in the corresponding beta coefficient value of the learning outcome variable. This manifests that the EVM has an impact of decreasing the achievement of the specific learning outcome.

D. Impact of Facilities of Enriched Virtual Mode of Learning to the Achievement of the Learning Outcomes

Table.6.A. Partial Least Squares Regression results of Enriched Virtual Mode of Learning in terms of Facilities towards its impact on each learning outcome

Facilities of EVM		
Learning Outcome	β coefficient	P-value
LO1: Demonstrate technical competence in performing clinical laboratory test which aids in the diagnosis, treatment and management of diseases	-0.044	0.285
LO2: Demonstrate analytical and critical thinking skills in the hospital workplace	-0.031	0.345
LO3: Engage in the collection, analysis and projection of health information for the improvement of the health care management system	-0.017	0.412
LO4: Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession	-0.026	0.37
LO5: Apply research skills in relevant areas of and for the advancement of the medical technology profession.	-0.123	0.056
LO6: Participate in community-	-0.053	0.249

oriented activities		
LO7: Engage in lifelong learning activities.	0.034	0.331
LO8: Demonstrate effective teaching and communication skills	-0.155*	0.022

Note: Asterisk (*) - Represents a statistically significant value with P value of less than 0.05

Significance level or alpha level = 0.05

Learning outcome 1 focuses on the *interns' demonstration of technical competence in performing clinical laboratory tests which aids in the diagnosis, treatment and management of diseases* indicates that an increase in facilities by 1 will decrease the learning outcome by 0.044. This suggests a negative impact. However, it is insignificant since the P-value obtained was 0.285, which is greater than 0.05.

The insignificant impact indicates that the facilities have a very small to unnoticeable impact on the attainment of learning outcome 1. The introduction of a full virtual experience for skills-based courses is still deemed to be new in the field of medicine, however, it can be a suitable alternative during a crisis. According to Al-Balas *et al.* (2020), the availability of necessary infrastructures that are suitable in demonstration of hands-on skills, such as laboratory procedures, represents a major challenge in medical education [18]. Included in the demonstration of technical competence is the ability of the interns to properly handle biological specimens. The interns of batch 2021 participated in various infection control webinars, such as the Infection Prevention Control Conference, which was held through Zoom. Additionally, laboratory safety and regulation are taught and tested to the students through short quizzes and lectures via Blackboard and Google forms. Distance learning and its facilities are aimed at effective construction of knowledge. However, Al-Balas *et al.* (2020) stated that there is no single modality that could provide suitability and appropriateness towards achievement of skills-based training [18]. Each platform has varied differences, advantages, and disadvantages which may reflect the insignificant impact the EVM has for the attainment of learning outcome 1.

Learning outcome 2 focuses on the *interns' demonstration of analytical and critical thinking skills in the hospital workplace* indicates that an increase in facilities by 1 will decrease this learning outcome by 0.031, suggesting a

negative impact. However, this value is insignificant since the obtained P-value of 0.345 is greater than 0.05.

The insignificant beta coefficient acquired from this specific learning outcome manifests low to unobservable impact with the use of online platforms towards the attainment of learning outcomes 2. The analytical and critical thinking skills of the interns were tested through their ability to evaluate the validity and reliability of the laboratory results and identify the root cause and course of action of errors during the situational analysis assessments. According to Alsoufi *et al.* (2020), the use of online platforms has given medical students access to evaluating and analyzing different patient histories and laboratory findings [10]. However, there are technical issues with these online platforms, such as the use of cameras, microphones to prevent any disruption during lectures, and recitations that can affect the assessment of the skills of these students. The sudden full implementation of online platforms with their different advantages and disadvantages can cause the impact of EVM to be unnoticeable towards the achievement of learning outcome 2.

Learning outcome 3 focuses on the *interns' engagement in the collection, analysis and projection of health information for the improvement of the health care management system* indicates that an increase in facilities by 1 will decrease this learning outcome by 0.017, suggesting a negative impact. However, this value is insignificant since the obtained P-value of 0.412 is greater than 0.05.

There is an insignificant impact between the facilities and the attainment learning outcome 3 since the facilities for EVM cannot determine the resulting engagement of students in the collection, analysis, and projection of health information into available health care management systems. As a result of continuing development in information technology, Finch *et al.* (2012) stated that online platforms continuously evolve in its format and system. Thus, this requires users to be constantly updated to be proficient users of such materials [19]. In addition, the medium used for delivery, and regardless of the efficacy of a platform, in the absence of quality education through active, and qualified instructors will by no means elicit effective learning processes.

Learning outcome 4 focuses on the *demonstration of interpersonal skills, leadership qualities, and ethical practice of the profession* indicates that an increase in facilities by 1 will

decrease this learning outcome by 0.026, suggesting a negative impact. However, this value is insignificant since the obtained P-value of 0.37 is greater than 0.05.

There is an insignificant impact present between EVM in terms of facilities and the attainment of learning outcome 4. The emergence of social networking has created websites that allow people to interact and provide feedback, whether via video calls or group messaging or breakout rooms allowing group discussions and simultaneous presentation-making. Despite being in remote locations, the instructors were still able to maintain contact with the interns through Zoom and Blackboard. This allowed the interns to practice their professionalism in terms of speaking to their educators and co-interns. In connection to this, a study by Perron *et al.* (2020) showed that both students and instructors stated that online communication helped them with their skills in telephone consultations since this format mirrored the skills needed. However, the study also concluded it does not replace in-person learning. It requires a specific set of rules for interactivity and the effective enhancement of such skills [20]. Given these advantages and disadvantages, the demonstration of interpersonal skills, leadership qualities, and ethical practice of the profession of the interns is not recognizably affected by the implementation of EVM as this method can only enhance these skills to a certain extent. There are certain challenges that oppose the potential benefits in developing these skills online, hence making the impact unnoticeable.

Learning outcome 5 focuses on the *application of the interns' research skills in relevant areas of and for the advancement of the medical technology profession* indicates that an increase in facilities by 1 will decrease this specific learning outcome by 0.123, suggesting a negative impact. However, this value is insignificant since the obtained P-value of 0.056 is greater than 0.05.

The impact of the facilities of EVM shows no noticeable or minimal impact towards the attainments of learning outcome 5 manifesting its insignificance. Research in the medical field is often done using laboratory equipment within the laboratory, both of which are lacking in an online learning setup brought by the COVID-19 pandemic. Facilities for online research were utilized, however, this did not impact merely the students' skills in online research. A particular platform will not determine the successful application of research skills related to the advancement of the profession. The students of UST have

exclusive access to the university's Miguel de Benavides Library where E-resources are available for use in their research. However, despite the vast amount of research materials available in this library, not all relevant literature may be found only through this platform. Students are not limited to this platform, as well as those scientific journals that are provided supplemental to the syllabus of courses within the program. As stated by Hakimi *et al.* (2016), education and research are made possible using the internet. Technological platforms permitted the dissemination of up-to-date information to keep up with the rapid growth and constant increase in scientific knowledge [15]. Students have access to online publishers such as ResearchGate, and the worldwide web which allows researchers to transcend further from different resources to further educate themselves. The facilities merely contain the valuable information that is utilized for research, but the application of research skills will not depend on the medium with its own limitations, but the findings of the studies.

Learning outcome 6 focuses on the *participation of the interns in community-oriented activities* indicates that an increase in facilities by 1 will decrease this learning outcome by 0.053, suggesting that there is a negative impact. However, this value is insignificant since the obtained P-value of 0.249 is greater than 0.05.

The online platforms used manifest insignificant or no noticeable impact on the achievement of learning outcome 6. Community health is one of the course subjects taken by the interns on disease prevalence, prevention, awareness of communicable and non-communicable diseases, and the engagement with disadvantaged communities. Despite the lack of interaction with the communities, the interns were able to assess the needs of the population and the factors that may have caused a disease outbreak. The online platforms allowed the interns to present their findings such as virtual, self-made maps of the assigned communities, pie charts for the demographics, main cause of the outbreak, and possible remedies through PowerPoint presentations.

However, due to the limitation of online setting, interns were unable to have the full experience of engaging in community-health oriented activities due to their lack of exposure. Finch *et al.* (2012) stated that technologies have been advancing rapidly and that improved online platforms do not necessarily bring improved instruction on public health [19].

Learning is more dependent on the quality of the contents of the learning materials and not on the medium to which these contents are being delivered.

Learning outcome 7 focuses on the *engagement of the interns in lifelong learning activities* indicates that an increase in facilities by 1 will increase this specific learning outcome by 0.034, suggesting a positive impact. However, this value is insignificant since the obtained P-value of 0.331 is greater than 0.05.

The insignificant beta coefficient indicates that facilities have no noticeable impact on the achievement of learning outcome 7. Any platform may be utilized by the students in the retention of a lesson. Kaisare, Parab, and Thakker (2020) stated that most platforms are sufficient for learning. However, the retainment of knowledge for lifelong learning is based upon the instructions, concepts and theories provided in the learning materials given [21]. Knowledge retention should be highly valued as it allows students to apply the knowledge and/or learn something new. Moreover, Kumar (2017) stated that retained knowledge enables a process of sorting, categorizing, and organizational sensemaking which creates the potential to apply existing knowledge in new strategic ways in the future [22]. Case studies, new technologies, diagnostic techniques, and other relevant information to the medical technology profession keep the students updated with the trends in the medical field, keeping them interested in learning new topics which gives them opportunities to apply their knowledge regardless of what platform is used.

Learning outcome 8 focuses on the *interns' demonstration of effective teaching and communication skills* indicates that an increase in facilities by 1 will decrease this learning outcome by 0.155, suggesting a negative impact. This value is considered statistically significant since the obtained P value is 0.022, which is less than 0.05.

The negative beta value obtained for learning outcome 8 suggests that the facilities used in EVM are not effective in improving the interns' demonstration of effective teaching and communication skills. One of the performance indicators for learning outcome 8 is the ability to provide proper information and instruction to patients. According to a study conducted by Valdez (2010), one of the indicators for the demonstration of communication, teamwork, and interactive skills is the ability of the intern to exhibit care and compassion in direct contact

with the patients. The facilities used in the online mode of learning do not provide the interns an opportunity to interact with real patients. Although case studies are assigned to the interns, this does not give them the chance to practice proper communication and interaction with patients [23].

E. Impact of Manner of Delivery of Enriched Virtual Mode of Learning to the Achievement of the Learning Outcomes

Table.6.B. Partial Least Squares Regression results of Enriched Virtual Mode of Learning specifically in terms of Delivery towards its impact on each learning outcome

Delivery of EVM		
Learning Outcome	β coefficient	P-value
LO1: Demonstrate technical competence in performing clinical laboratory test which aids in the diagnosis, treatment and management of diseases	0.482*	<0.001
LO2: Demonstrate analytical and critical thinking skills in the hospital workplace	0.413*	<0.001
LO3: Engage in the collection, analysis and projection of health information for the improvement of the health care management system	0.336*	<0.001
LO4: Demonstrate interpersonal skills, leadership qualities, and ethical practice of the profession	0.323*	<0.001
LO5: Apply research skills in relevant areas of and for the advancement of the medical technology profession.	0.283*	<0.001
LO6: Participate in community-oriented activities	0.333*	<0.001

LO7: Engage in lifelong learning activities.	0.365*	<0.001
LO8: Demonstrate effective teaching and communication skills	0.235*	<0.001

Note: Asterisk (*) - Represents a statistically significant value with P value of less than 0.05

Significance level or alpha level = 0.05

Learning outcome 1 focuses on the *intern's demonstration of technical competence in performing clinical laboratory tests which aids in the diagnosis, treatment and management of diseases*, indicating that for every increase in delivery, learning outcome 1 will increase by 0.482. This implies that there is a positive impact in achieving the learning outcome. This is significant as it is supported by a P-value that is less than 0.001.

The manner of delivery of EVM through video recordings has a positive impact which signifies the enhancement of the achievement of learning outcome 1. The transition to online learning maximized the use of online platforms. In a study by Faulconer and Gruss (2018), the educational institutions in the medical field were forced to adapt in utilizing virtual laboratories that allows the students to virtually explore the software interface similarly as to that of an actual laboratory experiment [24]. In addition, different types of learning materials are presented to the interns such as pre-recorded lectures, and video demonstrations of the various laboratory procedures and tests which allows them to visualize and correlate their theoretical knowledge on the topics. According to Donkin, Askew and Stevenson (2019), the use of video recordings, recorded demonstrations, and virtual microscopy with expert feedback engages and motivates medical students in performing well in laboratory practical examinations [9]. The students are exposed to video recordings in a first-person point-of-view which entail display of different technical skills, demonstration of safety awareness, and use of histology equipment. As stated by Rowe *et al.* (2017), virtual laboratory activities allowed students to perform experiments and visualize and analyze chemical reactions using different laboratory equipment such as a spectroscopy in an interactive computer-based simulation program [25]. This has given the students the idea on how to collect and analyze the data gathered, write laboratory reports and answer assessment questions.

Learning outcome 2 focuses on the *intern's demonstration of analytical and critical thinking skills in the hospital workplace* indicates that for every increase in delivery, learning outcome 2 will increase by 0.413 which manifests a positive impact. The impact is significant since the P-value is less than 0.001.

There is a significant positive impact on delivering online learning by providing case analysis in enhancing the achievement of learning outcome 2. The alternative use of online learning through case analysis and problem solving has given these interns the opportunity to improve these skills in the meantime. In due time, these interns will be able to master such skills as long constant practice with different types of situational analysis. This would allow interns' preparation for actual face-to-face internship or clinical duty. According to Lunney *et al.* (2015) critical thinking is an important skill for making clinical judgement [26]. Despite the traditional way of teaching critical thinking in the clinical setting, teaching this skill online permits students in reviewing and rereviewing the lectures and discussions. This has enabled additional thinking time and enhances the ability to learn, reflect and solve problems through critical thinking.

Learning outcome 3 focuses on the *engagement in the collection, analysis and projection of health information for the improvement of the health care management system* indicates that for every increase in delivery, learning outcome 3 will increase by 0.336 which suggests a positive impact. This is significant as the P-value obtained is less than 0.05.

The significance of a positive impact of providing different software and community health information has increased the achievement of learning outcome 3. The utilization of online learning has equipped interns on obtaining several information on the current health trends using a simulated laboratory information system. According to Thomas (2017), the use of a simulated laboratory information system has allowed students to manually input results in the software and easily identify the patients as well as their results with the generated codes and labels [27]. This has provided an avenue for interns to determine the different laboratory tests and allow inputting of the results to the software. The students were able to develop the knowledge and skill in easily assessing different health information of patients which can help in the proper health care management system. Moreover, Al-Balas *et al.* (2020) stated that EVM is only a partial alternative to the traditional methods as this does enhance the theoretical skills of

students in performing laboratory procedures however it does not enhance the clinical skills in practice [18].

Learning outcome 4 focuses on the *intern's demonstration of interpersonal skills, leadership qualities, and ethical practice of the profession* indicates that for every increase in delivery, learning outcome 4 will increase by 0.323 which manifests a positive impact. The P-value gathered is less than 0.001 which indicates that the impact of the delivery is significant.

The positive impact of delivery is significant in increasing the achievement of learning outcome 4. Online learning can enhance the interpersonal skills, leadership skills and practice of ethics, which require group work and communication. Medical technology interns must develop these skills for effective collaboration with different healthcare professionals in the laboratory or hospital since communication is also one of the key points in patient care. According to Bahceleri *et al.* (2016), online learning has allowed students to enhance their prior knowledge, skills in connecting different ideas and concepts, decision making through the learning process and collaboration with peers within the online environment. It has also increased the leadership skills of students by developing skills in thinking, researching, taking responsibilities, including problem-solving [28]. As stated previously by Zacharia (2015), these skills can be seen in certain online activities such as case analysis, group activities and report, presentation, and peer journal reviews [13].

Learning outcome 5 focuses on the *application of the interns' research skills in relevant areas of and for the advancement of the medical technology profession* indicates for every increase in delivery, learning outcome 5 will increase by 0.283 which shows a positive impact. The positive impact obtained from the delivery is significant as the P-value is less than 0.001. 85

The positive impact of the manner of delivering outputs and contents for research purposes has enhanced the achievement of learning outcome 5. The intervention and communication of professors to their students is part of the manner of delivery in EVM. According to Alamettälä and Sormunen (2020), an easier collaboration of professors and students occurs online that allows better monitoring of every phase of the online research process. The use of online learning and their increased exposure to different resources on the

internet allows the students to access research-based reports which further support their own research [29].

Learning outcome 6 focuses on the *participation of the interns in community-oriented activities* indicates that for every increase in delivery, learning outcome 6 will increase by 0.333 which indicates a positive impact. The positive impact obtained from the delivery is significant as the P-value is less than 0.001.

The significance of the positive impact observed in the delivery of EVM of community based online learning enhances the achievement of learning outcome 6. Stated by Cavanaugh *et al.* (2015), community-oriented activities allow collaborative engagement of students in order to provide a real-world perspective and learning that enhances the student's learning, civic involvement and contribution towards the enrichment and well-being of the local community [30]. The use of online learning towards community-based education has allowed the use of a well student-centered learning design for community projects and provides opportunities for in-depth investigation of students. It has given an avenue to students to integrate their own learning strengths and construct meaningful artifacts that represent their personal learning. Online educators were able to present virtual communities such as interactive maps that allowed them to broaden the perspective of the students and further develop communication skills among the groups.

Learning outcome 7 focuses on the *engagement of the interns in lifelong learning activities* indicates that for every increase in delivery, learning outcome 7 will increase by 0.365, suggesting that there is a positive impact. This impact is significant because the P-value is less than 0.001.

The positive impact of the delivery in terms of providing resources and information on current events and development in the field of healthcare has increased the achievement of learning outcome 7. According to Mouzakitis and Tuncay (2011), globalization has increased technological developments and has dramatically changed the educational sector allowing educational institutions to introduce and deliver learning materials online. This has provided a means for students to explore and engage in lifelong learning activities with the exposure of different current trends in the development of the medical technology profession [31]. Moreover, Fox and Felkey (2016) stated that it is a significant professional responsibility of a healthcare professional in keeping up with the latest advancements and testing, specifically the health information technology [32]. This is highly applicable in the field of

medical technology, as this has a potential impact to patient care.

Learning outcome 8 focuses on the *interns' demonstration of effective teaching and communication skills* indicates that for every increase in delivery, learning outcome 8 will increase by 0.235, suggesting that there is a positive impact. The value obtained is significant as it is supported by the P-value that is less than 0.001.

The positive impact of the delivery in terms of providing feedback for effective teaching and communication skills has increased the achievement of learning outcome 8. Based on the study conducted by Debnath (2020), clinical reasoning and communication skills can be attained in the virtual classroom if the sessions that are conducted are well-planned and supervised properly. This specifically includes the constructive feedback of the course facilitators. This allows students to prepare for effective communication in the future hospital workplace [33]. This is supported by Marton *et al.* (2015) stating that teaching skill is an important aspect for medical students as these students have the future role of teaching as residents or faculty members [34]. Online learning allows the development of effective communication skills which can improve healthcare professionals and patient interaction as well as enhance the understanding of certain teaching strategies that eventually may become better learners themselves.

IV. CONCLUSION

Due to the COVID-19 pandemic, tertiary institutions were compelled to immediately shift to an online mode of instruction and learning to continue education. This posed a problem especially with skill-based programs including Medical Technology which specializes in hands-on laboratory work. The Enriched Virtual Mode of Learning was employed full-time as a temporary alternative to face-to-face classes. This study provided an overview on the current trends and effects of EVM on fourth year Medical Technology interns for the Academic Year 2020-2021 based on their achievement of the eight (8) learning outcomes stipulated in CMO 13 s. 2017. A six-point Likert scale was used to assess the extent of achievement of learning outcomes. Learning outcomes 1 and 2 were only often observed due to lack of hand-on practice. Learning outcomes 3, 5, 6, 7 and 8 were generally observed. Learning outcome 4 was always observed since hands-on practice was not necessary to attain these skills. There was a

positive relationship between the facilities and attainment of learning outcomes 1, 2, 4, 5, 6 and 7. An increase or decrease in utilization of facilities will result in an increase or decrease in the attainment of the learning outcomes. An insignificant relationship occurred between facilities and learning outcomes 3 and 8. There was a positive relationship between the delivery of EVM and all the eight (8) learning outcomes. The facilities have no significant impact on the achievement of all except learning outcome 8 who's P-value was below 0.05 showing statistical significance. EVM decreased the likelihood of students to develop teaching and communication skills in the absence of physical interaction with colleagues and patients. The manner of delivery showed a positive impact on all eight (8) learning outcomes. This demonstrates sufficient delivery of online materials with respect to their accessibility, content, and relevance. EVM serves as a good alternative to the traditional mode of instruction and learning particularly for skill-based programs and those that integrate internship in their standard curriculum. EVM can enhance theoretical knowledge while tertiary institutions use online platforms to continue education while mitigating the transmission of the virus.

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