

“Online Learning” Technology Solutions During the COVID-19 Pandemic: An Empirical Study of Medical Technology and Allied Healthcare Student Perceptions

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ABSTRACT

The COVID-19 outbreak has greatly forced the education systems around the world to undergo rapid change. Given today’s uncertainty, it is essential to understand students’ online learning experiences during the COVID-19 pandemic. Despite the fact that many studies were investigated in this area, there is limited available information about the barriers, challenges, and the difficulties students face during online learning. This paper studies the online learning platforms’ utilization during the COVID-19 pandemic for students’ engagement in the Medical Technology and Allied Healthcare education. This paper looks at studying the various benefits of imparting education through e-learning, identifying the challenges faced by learners, and measures the satisfaction levels of learners. From the study, it emerged that students’ satisfaction index in using e-learning technologies is high for courses in Medical Technology and Allied Healthcare education.

KEYWORDS

Allied Healthcare Education, Asynchronous Learning, Blended Learning, E-Learning, Medical Technology, Online Learning, Students’ Satisfaction, User Experience

INTRODUCTION

Conventional Medical Technology and Allied healthcare education was imparted through ‘face to face’ didactic mode of academic delivery whereby the teacher or facilitator interactions with students were at the same time and at the same location on - campus. The academic delivery of theory- based learning, simulation - based training and practical training was thus imparted in real time.

The COVID-19 pandemic has prompted an unexpected void in the field of clinical training because of the nullification of conventional study methods and clinical practical teaching (Kui et al., 2020).

During the COVID-19 pandemic, online mode of learning has become the main education tool across all faculties. This research analyzed the various tools of imparting training to Medical Technology and Allied Healthcare education students in an online mode, thus fostering a continuum of learning, despite the stringent social distancing norms mobilized by the Government of India, preventing students from returning to campuses during the pandemic.

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Medical Technologists and Allied health professionals work in various healthcare environments from hospital departments, wellness industry to diagnostic centers', research laboratories and the medical equipment industry, whereby they are required to exercise technical and scientific functions in the hi-tech healthcare space. They are categorized under various specializations according to their functioning departments in their respective fields.

Digital learning styles that are currently available in Medical Technology and Allied healthcare education is very heterogeneous. Additionally to the well-known classic styles, social media platforms, AV-based media, and interactive electronics enrich the environment for learning for these Allied healthcare students. Many technocrats are building digital learning experiences as assessment tools to promote learning through online exams (Kuhn et al., 2017).

Mobile & customized platforms are the current developments in digital learning services. Video conferencing has been utilized as a methodology of online clinical education by different organizations (Patel et al., 2021).

Furthermore, didactic customized modules has made it possible to assess measurement of learning outcome. (Coman et al., 2020). This study aims to evaluate whether online learning is of any benefit and can help Medical Technology and Allied Healthcare program students study more effectively

REVIEW OF LITERATURE

Medical Education

A virtual learning platform provides a reliable and excellent educational set-up that nurtures participation and association of the learners in Medical Education and can be a valuable solution for physical isolations. (Pei & Wu, 2019). The main obstacles to implementing online learning in medical education are negative attitudes and absence of strategies (O'Doherty et al., 2018).

“User experience (UE)” is an important parameter to assess the effectiveness of online learning products and modules. The parameter assesses the learning module based on its attractiveness, friendliness, operating speed, precision, understandability and good design (Hinderks. et al., 2019). Other than user experience, quality of learning can be improvised by providing robust administrative support and improvisation in the course content being delivered (Agarwal & Kaushik, 2020).

The advanced e-learning technology should not only engage the learner but also increase the interaction time with the peers & teachers (Caramihai et al., 2020). Advocates in the education sector feel that quality of learning(QoL) gets enhanced, if the learning system caters to spatial, behavioral and temporal cognitive properties of the learners (Challa et al., 2014)

Online learning during the COVID-19 situation obligated many teachers to be trained in the hardware & software aspect of essential computer skills (Cook et al., 2010). Multimedia platform can be used to impart computer skill training to the medical students (Del Arco et al., 2021). For medical students, online assessments through objective structured clinical & practical examinations (OSPE/OSCE) can be realized (Dutta et al., 2021).

A study on faculty perception revealed medical students are not attentive and they lose interest over period of time in online teaching technology (Elumalai & Sankar, 2020). This problem can be improved by devising strategies to optimize the curriculum and pedagogical delivery of the course content delivery (Jang & Kim, 2014). Although there are many benefits of online learning, there are a few weaknesses as well like lack of internet bandwidth, limited skill and computer literacy amongst the allied healthcare professionals (Jiang. et al., 2020; Khan et al., 2020). Also, there should be improved incentive policy and reward for the online resource material developed by the faculty (Langenau et al., 2014; Li et al., 2019). Finally a feedback mechanism to continuously monitor and upgrade the online system must be incorporated (Ng et al., 2021; Pinheiro et al., 2019).

Learners in medical education require simulation of a virtual patient for role play studies and medical skill practicing (Qiu et al., 2022). Social skills of the students can be honed by incorporating

remote standardized patient simulation (Rowhani-Farid et al., 2017). To boost interactivity in online learning, implementation of pictorial slides, graphical data, gamification of content delivery, online discussion forums and collaborative learning through apps like Twitter, WhatsApp is required (Sandhu & de Wolf, 2020; Urresti-Gundlach et al., 2017). Lastly, short video reels and teaching through running picture is more helpful than conventional teaching styles (Urresti-Gundlach et al., 2017; Bączek et al., 2020).

Nursing Education

Existing evidence shows that online learning to teach clinical skills are as effective as traditional methods. The review highlights the lack of evidence on blended learning methods to teach clinical skills to nursing education. It is essential to combine the courses with the new teaching technologies in order to improve the flexibility and responsiveness of learners (McCutcheon et al., 2014)

Medical Laboratory Technology

A systematic review comparing online learning versus face-to-face learning revealed that online mode of learning is more effective than the traditional conventional teaching pattern. The survey results are integrated in the following parameters: performance, knowledge, and self-efficacy and user satisfaction. The e-learning interventions used in the research vary in all the research studies (Buch et al., 2014).

However, there are very few studies on e-learning mode of education during COVID-19 for students pursuing Allied Healthcare Programs. Furthermore, Allied Healthcare students' perception and attitudes have not been studied with regards to online education. These are studies limited to the utilization of online and blended platforms for students pursuing Medical education. Thus to bridge this gap the study identifies key factors affecting the attitudes and perceptions of Allied Healthcare Program students towards online learning.

OBJECTIVES

- Recognize the significance of online learning during the COVID-19 pandemic for Allied Healthcare Programs.
- To understand the perception of students on online learning:
 - Utility
 - Self-efficacy
 - Ease of use
 - Attitude
- Analysis of the perspective outcomes towards online learning during the pandemic.

RESEARCH METHODOLOGY

Students pursuing Medical Technology & Allied healthcare programs were identified for the study. These students were pursuing various specializations viz Cardiac Care Technology, Respiratory Therapy, Imaging Sciences, Clinical Laboratory Technology, Dialysis Technology, Operation & Anesthesia Technology, Neurosciences Technology, Laparoscopy & Endoscopy and Ophthalmic Sciences. They were pursuing their education in Medical Technology & Allied healthcare program in the 3rd semester and they were exposed to online technologies used by trained faculty conducting various healthcare courses. The courses taught to students were core subjects in the curriculum, which were conducted online for all students. Hence, all the students pursuing Medical Technology & Allied Healthcare programs were included in the study. The institute faculty took the initiative to impart teaching through active and interactive technologies like video conferencing platforms (Active technologies-ZOOM, Google Meet, Microsoft Teams and CISCO WebEx, Interactive technologies

-Padlet, Mind map, Direct Poll and Kahoot). Online assessments were conducted through Google classroom, Microsoft Teams, Maharashtra Knowledge Corporation Limited (MKCL platform- A prototype Learning Management System) and email submission of assignments.

A questionnaire was designed in three sections, the first section had questions on the personal information details of the participants, the second section was based on assessment of benefits of online learning & the third being students perspective on utility of online learning, use of online learning effectively, ease of utilization etc. The questionnaire was validated and checked for reliability by a previous study (Langenau et al., 2014). Composite Reliability for each latent construct was more than 0.7 the acceptable limit. Even the Average Variance Extracted (AVE) of each latent exceeds the threshold limit of 0.5 suggesting the Confirmatory Factor Analysis (CFA) model has strong convergent validity. The questionnaire was framed and modified from a previous study (Kui et al., 2020; Langenau et al, 2014).

To know whether the learning platform is advantageous or not, the study questionnaire measurement variables were time management, availability, comprehensive interaction methods, feedback system, ease of access, updated content information & access to higher education system. The perception questionnaire measures mainly 4 parameters i.e., perceived usefulness, perceived self-efficacy, perceived ease of use and behavioral intentions of using online learning mode. Usefulness of eLearning is implied by measuring the variables- Time flexibility, locational flexibility, ease for taking assessments and availability of interactive tools. Self-efficacy can be measured by knowing the confidence level, knowledge about operational functions and understanding of the content. Perceived ease of usage can be measured by knowing the users friendliness, searching capability, simplified learning procedure and compatibility with the learning style of the learner. The variable behavioral intentions towards eLearning can be assessed by knowing how much the tool is assisting the user in learning, how it keeps the learner up-to-date with the subject specific knowledge and whether the tool is freely available or the learner need to pay amount to avail the services.

The questionnaire was circulated amongst allied healthcare program students. The participants of the study were asked to respond on a five-pointer Likert scale. Other authors can benefit from the study by using the questionnaire & data obtained on significance & perspective of online learning. This data can be used as a building block for further studies into user friendliness, self-efficacy and students' attitudes towards online learning.

RESULTS

Primary data was collected by circulating research questionnaires through Google Form. Various social networking platforms and sources were used to communicate the link. 197 valid responses obtained, quantified for data analysis. The demographic profile, advantages of e-Learning, students' perception in regard to online learning is presented in Table 1.

Table 1 illustrates the respondents' personal information, which is sorted by gender, age group, educational qualifications, academic year and status. As per the Table 1, the majority of the sample respondents (65.5%) were females, while the remaining 34.5% were males. 37.6% of respondents are between the ages of 19 and 20, 42.1% are between the ages of 21 and 22, and 4.6% are below 18 years age. None of the respondents was beyond the age of 44, while just 5.1% were between the ages of 25 and 44. Respondents aged 19 to 22 years old represent the voice of the adolescence. 20.3% of respondents are in their 1st year, 32.5% are in their 2nd year, 47.2% are in their 3rd year (Table 1).

As a result of the survey, 77.2% of the replies were from full-time student, 2.5% from students on study leave, and 20.3% from students who are both working. It was decided to involve students from several different backgrounds in the study so that their opinions might be heard. Regarding sample data, the study used students from a number of programs in Medical Technology education, such as B.Sc. Medical Technology, B.Sc. Radiotherapy and M.Sc. Medical Technology program.

Table 1. Personal information of the respondents (N=197)

Points	Category	Distribution	Cumulative Frequency	Percent (%)
Gender	Male	68	68	34.5
	Female	129	197	65.5
Age Group	18 years & below	9	9	4.6
	19-20 years	74	83	37.6
	21-22 years	83	166	42.1
	23-24 years	21	187	10.7
	25 years & above	10	197	5.1

Seventy-two % of students were studying in B.Sc. Medical Technology, followed by M.Sc. Medical Technology program (22.8%) and B.Sc. Radiotherapy program (5.1%) batch of students (Table 1).

Advantages of E-Learning

The study investigates the advantages of online learning at different levels of educational programs. To assess the benefits of online learning, questions listed in Table 2 were asked having a Likert scale from 1 to 5 where 1 = “Strongly Disagree”, 2=“Disagree”, 3=“Neutral”, 4=“Agree” and 5=“Strongly Agree” are combined to make a single affirmative response of “Agree.”

In the case of “Strongly Disagree” and “Disagree,” the same technique is used, and the two responses are merged to yield one response: “Disagree”.

As can be seen from Table 2, “Ease of availability of educational material” had the highest response rate at 45.2%. Instructors and students can readily and rapidly communicate educational materials via e-learning, whereas just 18.3% of the responses depict e-learning is not useful in sharing resources, educational materials, instructional manuals, etc.

There was a 52.2% positive response percentage for “Updated learning material”. 31% of students believe that web-based learning material does not help the development of new course or teaching

Table 2. Advantages of online learning (N=197)

Variables	SD (1)	D (2)	Total (1+2)	N (3)	A (4)	SA(5)	Total (4+5)
Time Management	1.5	7.1	8.6	36	34	42	76
Ease of availability of educational material	5.1	13.2	18.3	36.5	27.9	17.3	45.2
Improved interaction amongst students	11.7	18.8	30.5	35	21.8	12.7	34.5
Immediate feedback by facilitator	3	14.2	17.2	38.1	24.4	20.3	44.7
Possibility of pursuing working while e-Learning	4.6	12.2	16.8	35.5	26.9	20.8	47.7
Adaptability of various learning styles	4.1	12.7	16.8	34.5	27.4	21.3	48.7
Comprehensive and diverse interactions	3	13.7	16.7	39.1	28.9	15.2	44.1
Access to study resources (ppt, videos, case studies, pdf)	2	8.1	10.1	27.4	34.5	27.9	62.4
Updated learning material	3	13.2	16.2	31.5	29.9	22.3	52.2
Access to higher education	3.6	11.2	14.8	31	32.5	21.8	54.3

Note: Point score range from 1 to 5 depict “Strongly Disagree”, “Disagree”, “Neutral”, “Agree” & “Strongly Agree” respectively.

methodologies, while 14.8% believe that they are not able to obtain study resources through the web system (Table 2).

For “Access to study resources”, 62.4% of students rated it as a good factor in the survey. Conclusion: With the use of e-learning systems, scholars can conveniently access various study resources. It goes without saying that, in order to gain worldwide recognition; it is necessary to have structured course material in online mode available for the end user (Table 2).

“Flexibility in Time” had a 76% positive response rate. This illustrates that e-Learning has become a popular alternative for students who need flexibility in terms of time. It is possible to think of flexible learning as a method of learning in which teaching and learning are independent.

When it comes to possibility of pursuing working with e-learning, 47.7% of respondents said yes. Because the e-learning platform is user-friendly, most students can take advantage of it (Table 2).

There has been a 44.7% positive reaction to the variable “Immediate feedback by facilitator”. Because timely and prompt responses encourage students to participate in discussion forums, swift feedback is crucial in the context of online learning (Table 2).

There was a 48.7% positive response rate for the variable “Adaptability of various learning styles” indicating that most students like the e-learning platform’s ability to accommodate a variety of learning styles (Table 2).

A 44.1% positive response rate was recorded for the variable “Comprehensive and diverse interactions”. According to the survey results, more than half of the respondents feel comfortable learning through online mode, despite the fact that they are away from physical communication (Table 2).

The field “Access to higher education” illustrates 54.3% of those polled were in favor of increasing the number of students who can enroll in higher education through online mode (Table 2).

The “Improved interaction amongst students” question received the lowest response rate of 34.5%. As a result of its fundamental nature of knowledge sharing, collaboration is becoming increasingly crucial in today’s world. However, the responses that have been received are a mix of agree, disagree and neutrality scores. It shows that there is a tremendous need of collaboration for information sharing (Table 2).

Perceptions on E-Learning

The four sub-constructs of the “Students’ Perception” are as follows: utility, use of online platform effectively, ease of utilization and attitude. This section of the questionnaire uses a Likert scale to collect information about students’ attitudes toward e-Learning. The study examines student perceptions since they are critical for course design, development, and delivery that is based on the perceptions and needs of students. The responders shared their opinion on the e-learning platform as well as their own abilities to use it.

According to the results, 53.3% of respondents are comfortable using an e-learning platform (Table 3). Furthermore, 61.4% have confidence in using the new features and 56.9% have expressed confidence in studying the online study content (Table 3). As a result, the majority of students are at ease and confident when using learning methods. The purpose of this study is to look into e-learners’ intentions in terms of using e-learning technologies.

According to the findings, 61.4% of respondents use e-Learning as a learning tool; 46.7% use it to update their subject knowledge; and 49.3% of responders use it as free learning tool (Table 3).

The study’s main findings show that students’ e-learning intentions are encouraging and positive. Through interactive e-Learning, it is envisaged that students’ perceptions would favorably affect their satisfaction.

Studying via e-learning mode, according to 54.8% of respondents, allows to learn at own pace, whilst 32% chose to remain neutral. Regardless of the location, 74.7% feel assignment submission has become easier through the e-Learning tool. The final variable depict excellent communication possibility even when there is no face-to-face interaction, while 28.9% disagreed (Table 3).

Table 3. Students' perception of online learning (N=197)

Variables	SD (1)	D (2)	Total (1+2)	N (3)	A (4)	SA(5)	Total (4+5)
Students perspective of Utility of Online Learning (PUE)							
E-Learning provides the flexibility of time convenient to the learner.	3	10.2	13.2	32	29.4	25.4	54.8
E-Learning enables the learner to continue education from any location in the world.	2.5	3	5.5	19.8	30.5	44.2	74.7
Online examination to take tests and submit assignments electronically	4.1	3	7.1	21.8	31.5	39.6	71.1
Availability of e-Learning platforms to enable effective communication between the facilitator and learner	6.6	12.2	18.8	28.9	28.9	23.4	52.3
Students perspective on perceived self-perception (PSE)							
I feel confident of learning through online platform.	9.1	10.7	19.8	26.9	31.5	21.8	53.3
I feel confident of using the online learning applications	5.6	11.7	17.3	21.3	29.9	31.5	61.4
I feel confident of using online resource material and learning contents.	5.1	8.6	13.7	29.4	32.5	24.4	56.9
I believe online learning platforms are "user-friendly"	7.6	9.1	16.7	23.9	32.5	26.9	59.4
Students perspective on the Ease of utilization of e-Learning (PEE)							
There's ease of access to find study information required for academic learning when using online learning platforms.	4.1	8.1	12.2	33.5	31	23.4	54.4
I believe online learning simplifies the learning	10.2	12.7	22.9	27.9	28.9	20.3	49.2
The mode of delivery of online learning systems is well-suited for my learning process.	12.2	11.2	23.4	33	23.9	19.8	43.7
Students perspective on the attitude of using e-Learning (BIE)							
I utilize e-Learning to aid my learning	8.1	9.6	17.7	35.5	22.8	23.9	46.7
I use e-Learning to stay updated	4.6	10.2	14.8	34.5	25.4	25.4	50.8
I use E-learning as an additional learning tool	5.1	10.7	15.8	35	24.9	24.4	49.3

In terms of "Perceived Ease of Use", 54.4% believed e-learning is user friendly, while 12.2% population were neutral about it (Table 3).

The Chi-square analysis shows significant association between "Program Studying" for PSE, PEE & BIE parameters (Table 4). Difficulty index for agreement revealed a low score of 0.47 for BIE which indicates unhealthy attitudes towards online learning & a negative item discrimination indexing was obtained (Table 4). Thus, online learning is an effective substitute for Allied Health Program education and cannot be considered as a complete replacement for imparting teaching skill based learning.

DISCUSSION

Allied Healthcare Professionals are trained in practical & didactic aspects of Medical Technology learnings (Milanese et al., 2013). The teaching-learning process consists of didactic as well as practical skill based training (Milanese et al., 2013). During the pandemic, as per Government of India directives, students were not able to attend on campus training (Jena, 2020). This study focuses on Allied Health Professionals since no prior study investigated the attitudes and perceptions regarding e-learning. The prior studies were focused on e-learning perception among medical students (Kui et al., 2020; Huynh, 2017) but this specialized paramedical branch in health care has not been examined to date. The significance of this study is related to the high levels of experiential learning & practical training in the syllabus that differentiates the Allied Healthcare Education program from other basic sciences or liberal arts programs (Levy et al., 2009). Thus, investigating their attitudes and perspectives would

Table 4. Chi-square test analysis used to depict associations of “Agreement” percent amongst the student perception & demographic information

Variables		PUE			PSE			PEE			BIE		
		%	Chi-square	p-value									
Gender	Female	71.3	0.303	0.860	56.6	1.009	0.604	53.5	0.127	0.939	45.0	2.285	0.319
	Male	70.6			58.8			55.9			52.9		
Age	18	55.6	20.526	0.766	44.4	21.760	0.702	22.2	36.306	0.086	22.2	32.858	0.166
	19	52.0			44			36.0			32.0		
	20	79.6			55.1			53.1			51.0		
	21	65.3			61.2			47.1			42.9		
	22	67.6			47.1			84.6			38.2		
	23	84.6			76.9			75.0			76.9		
Program Studying	B.Sc. Medical Technology	65.5	8.603	0.072	50.7	10.566	0.032	42.2	12.216	0.016	40.8	11.097	0.025
	B.Sc. Radiotherapy	80.0			90.0			70.0			60.0		
	M.Sc. Medical Technology	86.7			71.1			73.3			66.7		
Academic Year for Study pursuing	1 st Year	70.0	1.801	0.772	55.0	6.317	0.177	55.0	5.359	0.252	42.5	3.705	0.447
	2 nd Year	73.4			62.5			57.8			54.7		
	3 rd Year	69.9			54.8			51.6			45.2		
Current Status	Full time student	68.4	4.870	0.301	52.0	8.630	0.071	50.7	3.946	0.413	44.7	4.77	0.311
	On leave	60.0			60.0			60.0			40.0		
	Work & education at the same time	82.5			77.5			67.5			60.0		

give new insight into how new pedagogical techniques are planned for effective online training of these healthcare professionals. This study investigates utility, self-perspective, ease of use & behavioral intentions of Allied Healthcare program students towards online learning.

In this study, the advantages of online teaching were the ‘ease of access to resource material’ and ‘effective time management’. Similarly, the Polish medical student study also showed similar outcomes (Bączek et al., 2020). This could be due to the content being uploaded on Learning Management systems or other portals that are accessible at all times to students. Besides the content being available, the students could plan their daily schedules to learn and revise content in a flexible manner. The disadvantages of online teaching according to these professionals were the interaction between the application and the participants (Parameter-‘Improved interaction amongst students’ & ‘Comprehensive and diverse interactions’) and feedback on the submissions and assignments (Parameter-‘Immediate feedback by facilitator’). In comparison, previous studies in Polish medical students have shown that ‘class interactivity’ is only 4%, which is in consonance with our study (Bączek et al., 2020). The rest of the variables measured in this study were not perceived as advantageous or disadvantageous to Allied Healthcare Professionals (45-55%).

Strong perceptions were observed in utility domain in terms of continuing education from any location in the world and the manner in which assessment and tests are conducted electronically. This is conceivable given that students in any geographical location can acquire the knowledge and skill sets, and moreover be assessed in a relatively easy online format. These outcomes have echoed in previous studies (Jiang et al., 2020; Langenau et al., 2014). However, perceptions in the other domains such as self-perspective, ease of use and behavioral intention of e-learning didn’t show significant

relation but the other studies for these particular study variables within the domain of behavioral intention of e-learning have a significant impact for student perspectives (Jiang et al., 2020; Langenau et al., 2014; Jena, 2020).

CONCLUSION

This study reveals that synchronous and asynchronous modes of teaching are in demand in an online mode (Amiti, 2020). Medical Technology & Allied Healthcare education can be supported by imparting education in an online mode. Students pursuing such Health Sciences programs effectively engage in learning, it simplifies the learning delivery, provides flexibility of time and location & hence it is recommended that faculty use various online tools during the academic sessions. The study confirms the significance of e-Learning as a supportive substitute over the conventional didactic learning methodologies.

One of the main reasons why students choose online learning is the user friendliness. According to the findings, the technology facilitates easy access to the knowledge database on the value of e-learning, self-efficacy, convenience of use, and student attitude towards online learning.

The pandemic situation has been a blessing in disguise for introducing online teaching as a tool for effective learning for Allied Healthcare programs education.

Limitation of the survey: Only individuals with internet access could participate in the survey. The survey questionnaire was in English language. The sample was taken from students who could understand English language. If the survey was conducted in a colloquial language, the results could have differed. Additionally, the study neglected to ask the nonverbal indicators regarding online learning acceptance by the participants. Future studies may address these crucial concerns to identify the other aspects impacting online education.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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