

# Impact of online teaching learning process of chemistry during COVID-19: A case study of Government City College in Hyderabad, Telangana

Dr. Viplav Duth Shukla

Asst. Professor of Chemistry, Government City College, Nayapul, Hyderabad

## **Abstract**

*During the covid-19 pandemic online learning has gained importance in countries like India. Access to internet has facilitated online learning and on the other hand different apps opened the arena of teaching-learning process. Questionnaire administrated through online to 202 regular under graduate students studying chemistry as one of the optional subject and involved in the chemistry online teaching course conducted by Department of Chemistry, Government City College, Hyderabad, Telangana, India. Students expressed that online learning is extension to traditional teaching. Participants felt that, training to lecturers must be given for tackling online classes effectively. This study found that, lack of electronic gadgets and internet connectivity are the major problems faced by the students during the training period. Other important factors include, better support from parents and peer group, good interactive sessions, positive faculty messages, other factors like flexibility of time, access to video lessons, usage of different supporting teaching aid for better understanding, online test and examinations were well managed. Certain other factors such as family support during classes, interaction with peer, usage of electronic gadgets, understanding and application of new technology were highlighted by participants. Students strongly emphasized on electronic gadgets, internet connectivity, one hour duration of class, need of orientation training for lecturers, multiple choice questions for assignment. All of them voted for hand on experience of chemistry practicals. All the students preferred combined teaching which comprises of traditional teaching combined with online teaching.*

*Key words: Traditional teaching, online teaching, internet, Electronic gadgets*

## **1. Introduction**

Face-to-face learning versus distance education learning outcomes has comparative history since 1920. During the covid-19 pandemic online learning has gained importance in countries like India. Access to internet has facilitated online learning and on the other hand different apps opened the arena of teaching-learning process. The influence of internet availability is clearly evident on personal life, professional life, economy, information, science and technology, education etc., more precisely all walks of life.

All other than traditional classroom learning platforms come under one roof and can be considered as “distance learning”. In today’s distance education platform, online learning has gained utmost importance. Online learning and “e-learning” are used as synonyms.

There are several types distance learning’s available today, including:

- Correspondence Courses: conducted through regular mail with little interaction.
- Tele-courses: where content is delivered via radio or television broadcast.
- CD-ROM Courses: where the student interacts with static computer content.
- Online Learning: Internet-based courses offered synchronously and/or asynchronously.
- Mobile Learning: by means of devices such as cellular phones, PDAs and digital audio players (iPods, MP3 players).

## **2. Review of literature**

Lot research work has been carried out on online learning throughout the world. Factors like role of distance education as an alternative to traditional learning, different alternative of learning, Advantages of e-learning, financial issues, learning opportunities to dropouts, impact on instructional design and delivery, online examinations and assessment are certain issues focused by the researchers from different fields from the globe.

According to United States department of education report “A systematic search of the research literature from 1996 through July 2008 identified more than a thousand empirical studies of online learning. Analysts screened these studies to find those that a) contrasted an online to a face-to-face condition, b) measured student learning outcomes, c) used a rigorous research design, and d) provided adequate information to calculate an effect size”. (U.S. Department of Education 2010)

Different methods of teachings are in practice throughout the world. Traditional learning, distance learning, pure online learning, blended learning, combined learning etc. are vogue. According to Mark, "Online learning consists of classes that are fully delivered via the internet, or a combination of internet delivered classes and periodic meetings in a traditional classroom". (Mark R. Domenic, University of Arizona South)

Financial burden on both end i.e on institution and student reduced to a good extent. Tucker (2003) emphasizes that "distance learning classes reach a broader student audience, better address student needs, save money (for both the school and student) and more importantly use the principles of modern learning pedagogy".

Nowadays importance of online teaching gaining priority with time particularly during pandemic period. "Online learning is a form of distance learning or distance education, which has long been a part of the American education system, and it has become the largest sector of distance learning in recent years" (Bartley & Golek, 2004; Evans & Haase, 2001). Country like India has adopted online teaching long back but, implementation in total to education system throughout the country happened during COVID-19 period. "National online education platforms that were recently established in many countries, including China (XuetangX, WEMOOC, and CNMOOC), India (Swayam), and Russia [National Platform of Open Education (OpenEdu)] to address challenges associated with the shortage of qualified instructors and growing demand for higher education". (Igor Chirikov 2020)

Neuhauser (2002) published a paper comparing two sections of the same course—one section was online and asynchronous; the other was face-to-face. He has considered gender, age, learning references and styles, media familiarity, effectiveness of tasks, course effectiveness, tests grades, and final grades to study. The two sections were made to teach by the same instructor and used the same instructional materials. The results revealed that, there was no significant differences in test scores, assignments, participation grades, and final grades, although the online group's averages were slightly higher. Neuhauser concluded that, equivalent learning activities can be equally effective for online and face-to-face learners.

Moore and Kearsley (2012) in their study asked to answer the question "Why do we need distance education?" and identifying the following reasons for the need of distance education:

- increase access to learning and training as a matter of equity
- provide opportunities for updating skills of the workforce
- improve the cost effectiveness of educational resources
- improve the quality of existing educational structures
- enhance the capacity of the educational system
- balance inequalities between age groups
- deliver educational campaigns to specific target audiences
- provide emergency training for key target areas
- expand the capacity for education in new subject areas
- offer combination of education with work and family life
- add an international dimension to the educational experience

With changing time along with traditional education online learning has snow ball effect.

### 3. Method

This study is based on primary data only. The primary data was obtained through the questionnaire which consists of both optional type and statements in Likert 5 point scale. Questionnaire was administrated through online surveying using "Google Forms". Feedback /opinion forms were randomly sent to more than two hundred bonafied under graduate students studying chemistry as one of the optional subject and involved in the chemistry online teaching course conducted by Department of Chemistry, Government City College, Hyderabad, Telangana, India. The students asked to submit their responses electronically, through gadgets like a smartphone, tablet, laptop or a desktop. Survey form consisting of different type of questions like fill in the blanks, one word answer, yes or no type, multiple choice answers and five point grading were provided to get data.

This study was designed to analyze the advantages and disadvantages of online learning of chemistry and also to know the opinions of students, especially problems faced by students for giving a better online learning environment in future. The basic method used to collect the data was survey only. Questions asked were pertaining to the online chemistry course work, comfort with electronic gadgets, support of family and competence of teacher to deal with chemistry online classes etc. Only percentage of students response to total responses were considered for analysis and discussion.

## 4. Findings

### 4.1 Gender:

Online chemistry classes were conducted during COVID-19 for 934 chemistry studying undergraduate students of Government City College. Among randomly selected students attending online classes, 202 volunteered respond. Out of 202 total sample 97 female (48%) and 105 male (52%) were participated in study. Representation of students is from covering all groups viz. Semester 2 (42.5%), Semester 4 (39%) and Semester 6 (18.5%).

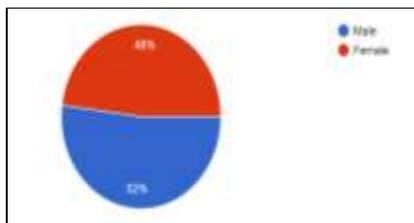


Figure1: Diagram showing Gender ratios

### 4.2 Social Status

Out of 202 total sample 118 (59%) were from backward class, 19 (9.5%) were from Scheduled Tribes, 40 (20%) were from Scheduled Caste and rest of the 23 (11.5%) were from forward cast, 2 participants have not disclosed their caste in the selected population of the study.

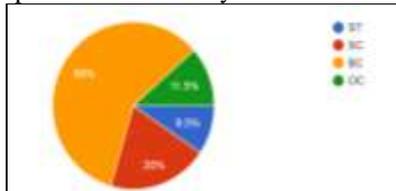


Figure2: Diagram showing social status ratios

### 4.3 Parents education

It is clearly evident from the data that majority of the parents were educated 125 (63.1%). Parents educational levels as follows, illiterates 73 (36.9%), followed by 37 (18.7%) secondary, 32 (16.2%) read and write, 31 (15.7%) graduates, 10 (5.1%) post graduates and rest of the population 15 (7.6%) were primary. This parameter helps in understanding the support system give to the students by the parents.

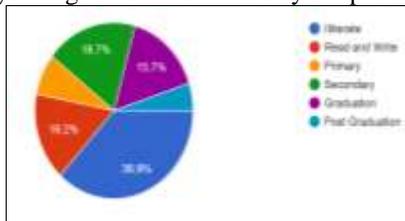


Figure3: Diagram showing parents education ratios

### 4.4 Parents Occupation

Profession of the parents is indirectly indicates the economic condition of the parents. Data shows 96 (47.8%) parents were labor and 44 (21.9%) were self-employed. Approximately 70% of the parents were below poverty line. Rest of the population includes 28 (13.9%) professional jobs and 21 (10.4%) business. Nominal amounts were government job holders and private job holders.

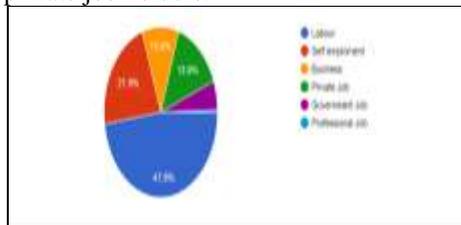


Figure4: Diagram showing parents occupation ratios

#### 4.5 Place of Birth

105 (53.6%) students were from rural background and 61 (31.1%) urban background. 14 (7.1%) represented tribal area. Rest of them was from semi urban.

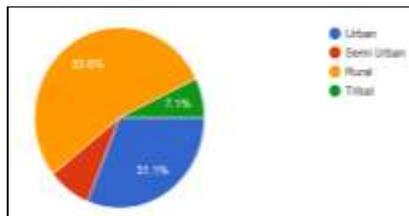


Figure5: Diagram showing place of birth ratios

#### 4.6 Gadget used for attending online classes

Most of the students used cell phone as basic gadget to attend thwe classes 191 (94.1%). Socio-economical conditions of the parents may the reason for thistreand.Marginal number of students, 5 (2.5%) colud use laptops.

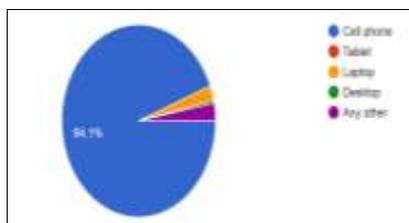


Figure6: Diagram showing ratios of Gadget used for attending online classes

#### 4.7 Average number of classes attended in a day (All subjects)

Considering six to eight classes of all optional subjects per day during the training period, among 202 respondents only 65 students attended one or two classes per day and 44 students could attend four to six classes per day. On the average 46% (93) students attended four to six classes per day.

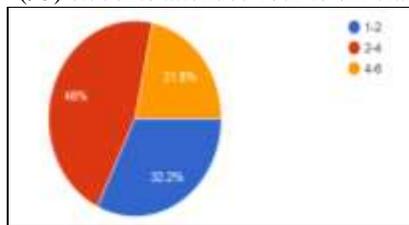


Figure7: Diagram showing ratios of average number of classes attended in a day

#### 4.8 Average number of CHEMISTRY classes attended per day

When only chemistry classes were considered out of six to eight classes of all optional subjects taught per day during the training period, on the average 55.5% (111) students attended one or two chemistry classes per day. Only 40 (20%) students could attend two to four chemistry classes per day and some students could attend one class per day and some could not attend one class were sum up to 49 (24.5%) students out of 200 responded.

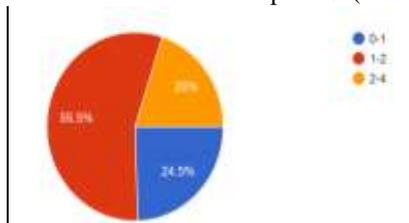


Figure8: Diagram showing ratios of average number of chemistry classes attended in a day

**4.9 Optimum duration for class according to you**

Duration of class in traditional system is 50 minutes to one hour. Where settling down, attendance etc will take out some time. 70% of the students felt 40 minutes of duration per class is sufficient.

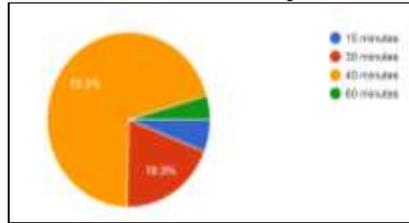


Figure9: Diagram showing ratios of optimum duration of class

**4.10 Type of content presented during the class**

Lecturer while presenting their lecture will use different tool and material to make the effective and fruitful. Mostly they use Notes, Text material, Power Point Presentation, videos along with direct teaching. Each teaching aid has got its own impotence and impact. Data received from 200 students shows, 118 (59%) students voted for direct teaching, 94 (47%) students preferred for running notes, 84 (42%) students demanded for text material, 83 (41.5%) students expressed positivity towards video lessons. For this question an open option was given to choose more than on choice. These responses were in combination of two or more options.

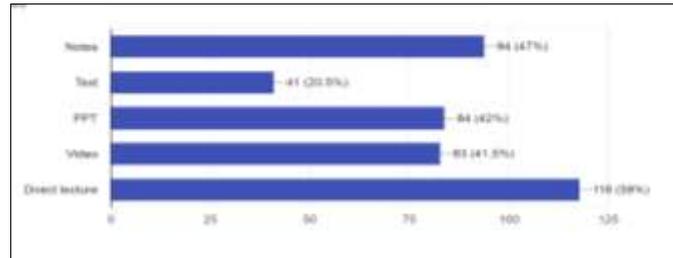


Figure10: Diagram showing ratio of type of content presented during the class

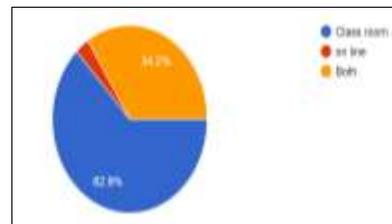


Figure11: Diagram showing ratios of preference of teaching method

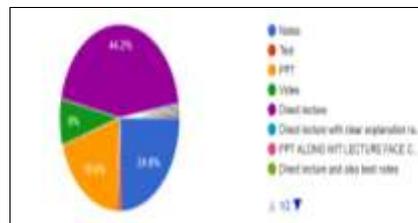


Figure12: Diagram showing ratios of type of learning material preferred

62.9% respondents preferred class room teaching and 34.2% supported for combination of face to face teaching blended with online teaching. Most of the students optioned for Notes, PPTs, and videos along with direct teaching.

**4.11 Time spent on electronic Gadgets during online classes:**

160 out of 199 responses accepted that time spent on phone has increase during online classes. Rest of the 20% refuted the opinion.

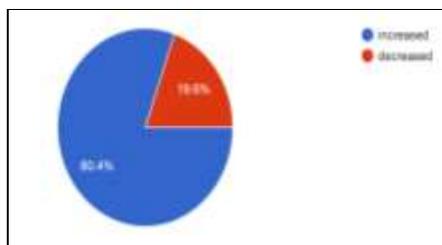


Figure13: Diagram showing ratios of time spent on electronic gadgets during online classes

#### 4.12 Interaction with the Lecturer during the class or after the class

The probability of students interacting with teacher is moderate compare to traditional teaching. But data shows 70%(140) could interact from differ means.

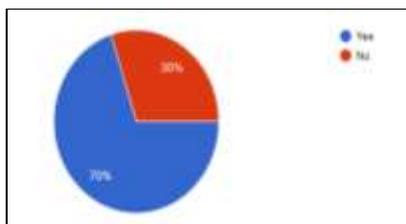


Figure14: Diagram showing ratios of interaction with the lecturer during the class or after the classes

#### 4.13 Downloading the material / PPT / videos from Google classroom

With regard to downloading from Google classroom, 142 (70.3%) had downloaded the material/PPT/ videos from Google classroom. Remaining 60 (29.7%) could not down load the soft information due to various reasons.

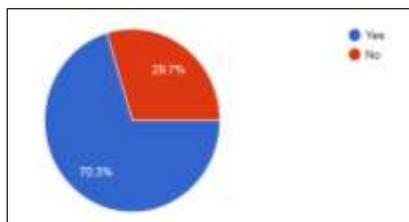


Figure15: Diagram showing ratios of downloading the material/PPT/ videos from Google class room

#### 4.14 Preferential type of online test

Tests and assignments are conducted along with final examinations. When a question was given to the respondents with regard to test most of them opted for multiple choice answer type questions the preferable i. e. by 119 (58.9%) respondents. Interestingly long answer questions stands next preferable with 44 (21.8%) majority followed by short answer type, one word and fill in the blanks.

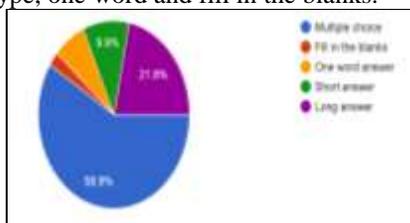


Figure16: Diagram showing ratios of preferential type of online test

Along with close ended questions nine open ended questions were asked to know the opinions of the respondent with regard to chemistry online classes. The feedback given by student denotes the degrees of opinion, which comforts in conducting online classes in a better way.

## 5. Discussion

“The expansive nature of the Internet and the accessibility of technology have generated a surge in the demand for web based teaching and learning.”(Chaney 2001).

Undergraduate students (Number 202) studying Chemistry at Government City College situated in Hyderabad of Telangana state, India has been selected for the study the impact of online chemistry classes during COVID-19 period. Approximately equal sample of 105 male (52%) and female (48%) selected randomly. Care has been taken to have representation from all semesters and all groups like Semester 2 (42.5%), Semester 4 (39%), and Semester 6 (18.5%). Socio-economic conditions of the sample showed that, majority of the students were from downtrodden.

118 (59%) were from backward class followed by Scheduled Caste and Scheduled Tribes. “Students tend to be relatively similar when comparing race, gender, socioeconomic status, and course of study from the college”. (Stephanie 2012)

“Online course construction is as diverse as traditional classroom settings. Developing and teaching an online course that benefits students and yields positive learning outcomes is a complex undertaking. Attempting to recreate the traditional classroom in an online setting may not necessarily be the wisest course of action. Thomson advises course creators “to capitalize on the benefits that the online environment can offer” and “to minimize the challenges specific to the environment” (Thomson, 2010).

The data showed that, most of the parents were educated 125 (63.1%), but in total 50% of the sample were partially education i.e. illiterates 73 (36.9%), 32 (16.2%) read and write. Profession wise parents were below poverty line. Numbers of the data says 96 (47.8%) of parents were labor and 44 (21.9%) were self-employed, this clearly says about 70% of the parents poor. As the selected college is a government institution, students were mostly below poverty line and lower middle class representation can be seen. No doubt 30% of the sample had upper middle class and rich. Place of birth also strengthens that, about 60% sample was from rural background comprising 105 (53.6%) rural students and 14 (7.1%) represented tribal area. “As online learning continues to grow, it is important to investigate students’ overall experiences in online learning environments. Understanding students’ perspectives on their online classes or programs moves beyond the sole question of student satisfaction to more nuanced questions about how factors inside and outside of the classroom impact the online classroom”. (Igor Chirikov 2020)

Low socio-economic conditions of the parents made 191 (94.1%) students used cell phone as basic gadget to attend the classes. Laptops were used by 5 (2.5%) of the students. College time table has been given scope for six to eight classes per day, with each class of forty minutes duration. As different subjects and different timing are maintained for classes due to availability of students, internet connectivity issue and lag in joining time of the student. On the average 93 (46%) students attended four to six classes per day. This shows not all students could attend all the classes. Among 202 respondents only 65 students attended one or two classes per day and 44 students could attend four to six classes per day.

“Online courses have been found to be conducive to students who favor self-regulated learning. Self-regulated learners have a tendency to use various “cognitive and metacognitive strategies to accomplish their learning goal”. Learners who are able to hone in on their self-regulated learning skills frequently utilized time management, reviewed material regularly, sought help from professors or peers, meet deadlines, and had the skill of metacognition in order to reflect upon their own learning” (You & Kang, 2014).

When it comes to the chemistry classes (Four per day), the number students attending the chemistry classes were not encouraging. 111 (55.5%) students attended one or two chemistry classes per day. Only 40 (20%) students could attend two to four chemistry classes per day. This might be due to various reasons like high number of classes per day, Lack of telephone charging, Poor internet connectivity.

Students strongly supported and mentioned in the suggestions that, duration of each class must be not more than forty minutes. In traditional method the length of the class is 50 minutes to one hour. Traditional classes will eat away time in organizing, maintaining discipline and taking attendance.

Audio- visual teaching aids play a pivotal role in teaching-learning process. It is a general practice by most of the science teachers to use this type of material for making understand the student difficult concepts. Science teachers generally make use Notes, Text material, models, Power Point Presentation, videos along with chalk-board teaching. Same holds good with online teaching also. When enquired about the most preferential modes of audio-visual aids 118

(59%) students voted for direct teaching, 94 (47%) students preferred for running notes, 84 (42%) students demanded for text material, 83 (41.5%) students expressed positivity towards video lessons. For this question an open option was given to choose more than one choice of answer and the responses received were in combination of two or more answers. Data emphasizes face to face teaching with notes only, anyhow videos were their next preferential order. Class room teaching was preferred 127 and 69 supported for combination of face to face teaching blended with online teaching. Lack good phones with continues internet connectivity may be the reason for opting traditional way.

Assignments, Tests, Quiz and examinations are part of the teaching. Information regarding mode of tests was asked with participants. Majority of students opted for multiple choice answers type questions with number respondents 119 (58.9%). Interestingly long answer questions stands next preferable with 44 (21.8%) majority followed by short answer type, one word and fill in the blanks.

The prime difference between online teaching and traditional teaching is direct interaction of students with teacher. Student's interaction with teacher was moderate compare to Traditional teaching interactions. But data shows 70% (140) could interact during the class or after the class.

“Online learning allows for students to work at a time and a place that is compatible with their learning needs. Participants involved in the study expressed their ability to focus more of their attention on the content of the course and less on issues such as parking, traffic, and other problems that may arise when attending a traditional class environment” (Thomson, 2010).

Open ended type questions (9) asked to assess the opinion of the respondent with regard to chemistry online classes. This rating scale questions gives degrees of opinion that could make a real difference in understanding the students opinions. This also helps in pinpointing the areas where one can improve services.

Question	1	2	3	4	5
Online teaching from next semester	58 (29%)	42 (21%)	44 (22%)	35 (17.5%)	21 (10.5%)
Family support to attend online classes	22 (10.9%)	29 (14.4%)	32 (15.9%)	64 (31.8%)	54 (26.9%)
Access to internet is available	48 (24.1%)	49 (24.6%)	47 (23.6%)	36 (18.1%)	19 (9.5%)
financial burden	36 (18.4%)	33 (16.8%)	66 (33.7%)	44 (22.4%)	17 (8.7%)
No stress due to online classes	37 (18.7%)	42 (21.2%)	40 (20.2%)	48 (24.2%)	31 (15.7%)
Syllabus can be completed through online classes	30 (15.3%)	21 (10.7%)	42 (21.4%)	65 (33.2%)	38 (19.4%)
Lecturers are competent for online teaching	20 (10.4%)	18 (9.3%)	38 (19.7%)	70 (36.3%)	47 (24.4%)
Online Practical classes	72 (36.5%)	42 (21.3%)	37 (18.8%)	34 (17.3%)	12 (6.1%)
Online Assignments and Examinations	46 (23.4%)	45 (22.8%)	31 (15.7%)	51 (25.9%)	24 (12.2%)
(rating scale 1= Strongly disagree, 2= Disagree, 3= Can not say, 4= Agree, 5= Strongly agree)					

Table I. Responses to open ended with regard to chemistry online classes

As for the first time students were exposed to online chemistry classes due to pandemic COVID-19, students were new to the system. When asked for their opinion on online teaching from next academic year, half of the students expressed their willingness to attend online classes from next semester and rest of the 50% students showed unwillingness.

For the question, 'Family support to attend online classes', about 58% of respondents said positive and 25.3% respondents had given negative answer. 16% respondents were biased. Stephanie research work shows that, "Several factors over which the students themselves had control influenced their experiences. Ability to Balance between Educational Access and Family Life Several students were grateful for the opportunities that online learning presented them for access to higher education. Interestingly, the most common potential barrier to educational attainment that students mentioned was family, and that also was the factor that made them most grateful for the opportunity and the experience". (Stephanie 2012)

Internet connectivity is available on payment. Depending upon the provider and package variation in internet access and data limits is given. Out of 200 responses received about 'internet access', 100 students do not have availability of internet access. 47 (23.7%) did not say anything, rest of the respondents could get internet access. This might be one of the reasons for not attending all chemistry classes and all the other subject classes.

In response to 'financial burden', data shows a mixed response from the respondents like 69 (35.2%) expressed financial burden, 'can not say' was expressed by 66 (33.7%) and no burden was the opinion of 61 (31.1%). Students commented that, "if internet connectivity is provided, it will be easy to attend classes". On the other hand, some of them stated their inability to attend the classes due to lack of a smart phone. "Online Learning effectiveness in educating students, its use as professional development, its cost-effectiveness to combat the rising cost of postsecondary education, credit equivalency at the postsecondary level, and the possibility of providing a world class education to anyone with a broadband connection" (Tuan Nguyen 2015)

Another question was "whether students feel stress due to online classes or not?" 31 (15.7%) students "strongly agree" to "no stress due to online classes" and simply "agreed" by 48 (24.2%) students. 40 (20.2%) students said they "can not say" about stress. Contradictory to the statement 42 (21.2%) students "disagreed" and said they feel stressed. "Strongly disagree" by 37 students (18.7%) voted for against the statement and said they feel stressed. This clearly states that there is a strong need of counseling to the students and workout to ease such situations. "Cooper (2002) emphasized that, although technology can make social relations more abstract, the physical disconnect simultaneously can make for more intimate connections".

Due to COVID-19 colleges were completely closed and syllabus was incomplete. Telangana Government has taken a decision to conduct online classes. For the first time, the state government has issued orders for conducting online classes compulsory to all undergraduate students in order to complete the syllabus to complete the academic year. More than 50% accepted the fact that by teaching online syllabus can be completed. 21.4% were in doldrums, whereas rest refuted the opinion. "Online course work tends to be reading and writing intensive, deterring some learners. Students with low reading abilities may find the heavy text and writing curriculum to be cumbersome" (Donlevy 2003).

Lecturer's competence for online teaching was also questionable. Teacher perfect in traditional teaching may not be able to handle online classes effectively, as some technology is involved in the process. "Instructors also had a strong influence over student experience, in large part through their accessibility and through their efforts to provide opportunities to connect with peers. On the other hand, not all students had positive experiences with their instructors, and thus their online experiences suffered". (Stephanie 2012). Online teaching competence of lecturer is an important factor. 60.7% of the students felt that, lecturers are competent enough for online teaching and 19.7% disagreed this opinion. A respondent mentioned a suggestion, to have a training programme to lecturers on how to handle online classes effectively.

Conducting practical classes is the mandatory part of science curriculum. Opinion on conducting "online practical classes" was asked 114 respondents (57.8%) gave a negative opinion. Only 23.4% of the respondents accepted the opinion. This clearly shows students want to have hands-on experience of chemistry practical in the labs.

Online Assignments and Examinations were rejected by 91 respondents (46.2%), and accepted by 76 respondents (38.1%). In close-ended questions students opted for multiple choice answer type questions followed by long answer questions. Other choices were short answer type, one word and fill in the blanks. Igor Chirikov (2020) found that, "online and blended instruction produce similar learning outcomes as traditional in-person instruction at substantially lower costs".

## 6. Limitations

This study has several limitations. All the respondents are chemistry students studying under graduates of Government City College only. Therefore, data produced from this study may not fully represent the general population. On the other hand, this study is limited to chemistry subject only and impact of other subjects was not considered. Future recommendations would include participants from all colleges and all subjects for study. As students are from same college and same subject there may be replication of views. Data of non-participants of online chemistry learning process is not considered for study. Students answered partially to the questions asked in the questionnaire.

## 7. Conclusion

This study concludes that, during covid-19 pandemic crisis, chemistry online learning helped the students to a good extent. Students expressed a feeling that online learning is extension to traditional teaching. In addition, participants opinioned that, lecturers to be well trained to tackle online classes effectively. "The importance of feedback is an area that both instructors and students stressed as being vital to success in an online course" (Brittany Gilbert). This study found that, lack of electronic gadgets and internet connectivity are the major problems faced by the students during the training period. Other important factors include better support from parents and peer group, interactive sessions, positive faculty messages, provision of soft copies of material. On the other hand, learners felt major advantages of chemistry online learning as boon with respect to flexibility of time, available of material, access to video lessons, good rapport with faculty, use of various supporting teaching aid for better understanding, online test and examinations. Certain other factors such as family support during classes, interaction with peer, usage of electronic gadgets, understanding, and application of new technology was highlighted by participants. Students strongly emphasized on availability of electronic gadgets, internet connectivity, at least one hour duration of class, need of orientation training for lecturers, multiple choice questions for tests. All the students preferred combined teaching viz traditional teaching combined with online teaching.

## References

1. U.S. Department of Education, *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. <http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf> , 2010.
2. Mark R. Domenic, Evaluating the Effectiveness of Online Learning as Opposed to Traditional Classroom Delivered Instruction, *University of Arizona South*.
3. Tucker, S., Distance Education: Better, Worse, or As Good as Traditional Education? *Online Journal of Distance Learning*, IV. 2001
4. Bartley, S. J., & Golek, J. H., Evaluating the Cost Effectiveness of Online and Face-to-Face Instruction, *Educational Technology & Society*, 7(4), 167–175, 2004.
5. Evans, J. & Haase, I., Online business education in the twenty-first century: an analysis of potential target markets, *Internet Research*, 11(3), 246–260, 2001. (<http://doi.org/10.1108/10662240110396432>)
6. Igor Chirikov, Tatiana Semenova, Natalia Maloshonok, Eric Bettinger, and René F. Kizilcec , "Online education platforms scale college STEM instruction with equivalent learning outcomes at lower cost", <http://advances.sciencemag.org/> on May 16, 2020. ( *Science Advances* (ISSN 2375-2548) is published by the American Association for the Advancement of Science, York Avenue NW, Washington)
7. Neuhauser, C., Learning Style and Effectiveness of Online and Face-to-Face Instruction, *The American Journal of Distance Education*, 16(2), 2002.
8. Moore, M., & Kearsley, G., *Distance education: A systems view of online learning* (3rd ed.). Belmont, CA: Wadsworth, 2012.
9. Chaney E. G., Web-based instruction in a Rural High School: A Collaborative Inquiry into Its Effectiveness and Desirability. *NASSP Bulletin*, 85(628), 20-35, 2001.
10. Stephanie J. Blackmon and Claire Major, STUDENT EXPERIENCES IN ONLINE COURSES- A Qualitative Research Synthesis, *The University of Alabama, The Quarterly Review of Distance Education, Volume 13(2)*, pp. 77–85, 2012.
11. Thomson, L. D. (2010). Beyond the Classroom Walls: Teachers' and Students' Perspectives on How Online Learning Can Meet the Needs of Gifted Students. *Journal of Advanced Academics*, 21(4), 662-712.
12. You, J. W., & Kang, M., The role of academic emotions in the relationship between perceived academic control and self-regulated learning in online learning. *Computers & Education*, 77, 125-133, 2014.
13. Tuan Nguyen, The Effectiveness of Online Learning: Beyond No Significant Difference and Future Horizons, *MERLOT Journal of Online Learning and Teaching Vol. 11, No. 2, June 2015*.
14. Cooper, S., *Techno culture and critical theory: In the service of the machine?* London, England: Routledge, 2002.
15. Donlevy, J., Teachers, technology, and training: Online learning in virtual high school. *International Journal of Instructional Media*, 30(2), 117-121, 2003.
16. Brittany Gilbert, "Online Learning Revealing the Benefits and Challenges" St. John Fisher College , Fisher Digital Publications, 2015. ([https://fisherpub.sjfc.edu/education\\_ETD\\_masters/303](https://fisherpub.sjfc.edu/education_ETD_masters/303))