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Tools and Techniques of e-Education using ICT

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Abstract

In modern age, due to rapid development of emerging ICT (Information, Communication and Technology) tools for a synchronous and asynchronous mode of teaching and learning management in online as well as distance mode of education, Traditional education system is transformed into a modern learning and teaching management scheme with interactivity, flexibility and convenience. However, in this paper, we have classified the used ICT tools of e-Education system through different concepts and effective e-Education model for developing countries is also proposed. The objectives are to create a new framework of e-Education system, based on internet or intranet with contents for courses in all major disciplines as well as specialized and newly developing interdisciplinary subjects which can be easily adopted in pandemic situation where the student and teacher both are locked into their residence. There is very little academic expertise in schools, colleges and even universities to run the new e education system mainly from home environment. So, a special expert team or committee is firstly to be constituted for the execution of a programme to train the teacher and student community to cope up a new efficient e-Education methodology.

Keywords:*ICT tools, WebVCS, Google Classroom, Zoom, Webex, PowerSchool Unified Classrooml, AdobeConnect, SDH, NIB, Threats and countermeasures.*

Introduction

Teacher to learner transmission of a particular subject was started in ancient days only by one way lecture and listening method, where learner only listen the subject and memorize it verbally repeating the sentence. Then, came the most popular chalk and talk method. Here the teacher expresses the subject verbally first and then by using hard white chalk he explain the topic by writing and drawing in a black board. The learner copies the important points of the topic if required for further studies. This method goes on for years after year until computer technology came. Common class based chalk talk teaching methodology was the main stream education system throughout the world. But in some particular cases, e-Education technique e.g. virtual class room teaching and learning technology, was introduced where normal class based system is not available or students are not capable to go to school in time due to their force engagement in nominal labour works for maintaining their livelihood. Also, some specialized e-Education (Samanta, 2019; Samanta, 2016)

class was introduced for viewing class lecture in virtual reality by some dignified teacher from distance.

The present structure of schooling and learning, including teaching and assessment methodologies, were first affected by these COVID-19 closures. Only a handful of private schools could adopt online teaching methods. The low-income private and government school counterparts, on the other hand, have completely shut down for not having access to e-learning solutions. The students, in addition to the missed opportunities for learning, no longer have access to healthy meals during this time and are subject to economic and social stress. The pandemic has significantly disrupted the higher education sector as well, which is a critical determinant of a country's economic future. The bigger concern, however, on everybody's mind is the effect of the disease on the employment rate.

So, keeping in mind the present situation and to counter the great problem in education, a discrete and full proof alternate e-Education (Samanta, 2019; Samanta, 2016) system is required. The system should have some diversity for different type of students in different level. For example, audiences of the students are of (a) Infant and primary level, (b) School level, (c) College and University level and (d) Research level.

Use of Communication Media Technology: Utilization of latest transmission system (Samanta, 2019; Samanta, 2016) makes the e-Education network faster and almost in real time basis. In past transmission technology like carrier, coaxial and microwave based systems have some limitation in speed and channel strength. But now a day we are using ultra high speed optical system with a real time high speed and with enormous channel capacities. Even now we are using under sea water optical cable replacing the international satellite communication. End user media distribution will be by 4G/5G and FTH. All types of audio, video and telemetry/control data can be easily transmitted and received approximately in real time basis. A complete e-Education system can be made possible through out the globe where learner and teacher position will be at anywhere at any time utilizing these communication technology (Crowcroft, Handley & Wakeman, 1998).

Utilization of Computer Hardware and Software: Access to computers in home or virtual class room may improve outcomes of the students in several ways. Computer software has the potential to provide self-paced instruction that is typically difficult to achieve in group instruction. Likewise, the content of instruction may be individualized to the strengths and weaknesses of the student. Because students can use instructional programs without the direct supervision of a teacher, ICTs and computer aided instruction hold the promise of increasing the overall amount of instruction that students receive. It is also allowing parents and teachers to monitor student's progress. The Internet represents a potentially valuable resource for finding out information about a wide range of educational topics for reducing the coordination costs of group projects. Computers, Internet, software and other technologies, with their interactive nature, can engage students in ways that traditional methods cannot. Further, enhanced computer skills may alter the economic returns to education, especially in fields in which computers are used extensively. Decision to Invest in ICT and NIB (National Internet Backbone) in e-Education has a direct benefit to computer literate in work place, in developing society and in exploration of higher education and research.

Mini computers, I-Pad, Mac-books, Smart mobiles: Recent technology has resulted in development of Desktops, laptops, I - pads, Tablets, Mac-books which are been used extensively in

market. These devises have been contributed at large extent in learning. Paper based learning is now being replaced by E-learning. Computers and tablets allow students and teachers' access to websites and other programs, such as Microsoft Word, PowerPoint, Excel, PDF files, and images. These tools help learners to express their ideas. Excel helps the mathematical working of the study. PowerPoint helps the presentation of the study done by the learner. Graphs, Pie charts, diagrams, pictures helps learner to analyze the education contents which helps to give a better performance and result. Student teacher can communicate with each other both ways in audio video mode by these mobile devices anywhere and at any time basis.

Literature review: In this context, many researchers have contributed their ideas in order to make e-Education system more effective and secure. Some works are listed below.

(Dahal, Luitel and Pant, 2020) have presented several key strengths with the combination of emerging ICT tools, techniques and methodologies to make easier online and offline task(s) and assessment(s) of the learners, and trainees in a collaborative manner. (Ghavifekr, Kunjappan, Ramasamy and Anthony, n.d.) have analyzed teachers' perceptions of the issues and challenges regarding used ICT tools in classrooms through a quantitative research design. They have also plotted the key issues and challenges such as limited network connection, technical support problem, lack of effective training and teachers' competency, in proposed ICT tools of education system. (N.D., Salleh and Iahad, 2012) have discussed the e-learning methodologies and tools including informal and blending learning, network and work-based learning. They have also suggested an e-learning model for any time with the integration of synchronous tools and asynchronous ICT tools. (Allah Nawaz, 2013) has highlighted the opportunities of ICTs for the developing and poor states to initiate planning and implementing digital initiatives and addressed the associated problems with education. He recommended the e-learning technology which is the emerging as a remedy for the education related issues. However, our system structure as well as proposed model in respect of e-Education paradigm is more effective than the related existing works.

Classification of used ICT tools/concepts on e-Education system

The student's home, virtual class room, teacher's home, school, college university are to be connected by different transmission media in a very intelligent way so that each student either from their home or any community virtual classroom, can interact with their respective teacher and co-student, through their school college or university (Real or Virtual mode). This is the basic structure of e education. Now, let us understand how to construct the whole e-Education system through different ICT tools/concepts.

Virtual Classroom

Rural and economically poor student not having any digital equipment may be supplied with the communication handset to take part in the e-Education system from virtual class room. The virtual class room has a high speed internet link which is ultimately connected with the main e-Education network. Our Web-Based Virtual Classroom System (WebVCS) model is an integrated collaborative learning system based on the active learning approach which applies the experiential learning theory. According to our study, experiential learning method is very important to enhance the quality of web-based collaborative learning. That is convergent, divergent, assimilative and accommodative

learning style. We adopted the classical scheme where e-learning systems are divided into three logical units: users, knowledge database, and learning environments. These units are then connected and combined to deliver material and to offer optimal learning conditions. There are eight modules in the WebVCS which they are Course Room, Schedules, Media Centre, Learning, Profile, Assessments, Administrative and Database module.

The new WebVCS is a composite structure with activities in it layered over information/learning resources. Contents in the WebVCS are acquired through harvesting of resources from the databases and the WebVCS database acquires data through manual input from instructors, students and administrators and focused searching and retrieval from the web. The activities that are involved in the WebVCS include learning activities, groups formation, contributions/authoring, evaluation/assessments, browsing, creating and editing of user profile, all taking place in a web-based environment that make communication and the virtual classroom system available to all classes of persons e g physically challenged, the hospitalized, working class students and so on, irrespective of their geographical location as per the following block diagram (Adewale, Ibam and Alese, 2012).

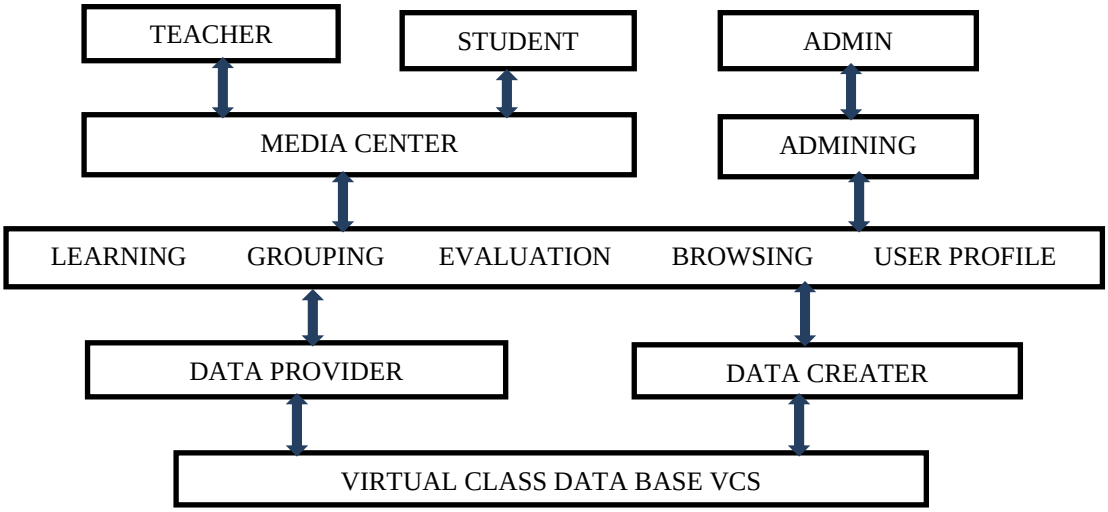

Figure-1: WebVCS

Google Classroom

Google Classroom is a free collaboration tool for teachers and students. Teachers can create an online classroom. He then invite students to the class then create and distribute assignments. Within the Google Classroom students and teachers can have conversations about the assignments and teachers can track the student's progress. Schools must register for a free Google Apps for Education account to use Classroom. Under the Classroom app, students and teachers have access to features that are not found in personal Google accounts. For example, in Forms, teachers can add images to questions or as multiple choice answers. Inbox by Gmail has Classroom messages grouped in Inbox, making it easy for teachers and students to find important updates and highlights. Also, the Classroom tool lets teachers organize the class stream by adding topics to posts, and teachers and students can filter the stream for specific topics (Sudarsana, Putra, Astawa and Yogantara, 2019).

Google Classroom also encourages parent participation. Teachers can invite parents to the Google Classroom to share summaries of student's work and to receive automated email summaries of student's work and class announcements.

Zoom

Zoom unifies cloud video conferencing, simple online meetings, and group messaging into one easy-to-use platform. Our solution offers the best video, audio, and screen-sharing experience across Windows, Mac, iOS, Android, Blackberry, Zoom Rooms, and H.323/SIP room systems. Zoom was founded in 2011 by experienced leaders and engineers from Cisco and WebEx. The Coronavirus pandemic has changed the world of education seemingly overnight, and making decisions about the software for remote working to create a virtual classroom which directly impacts our success as an educator during this time. Video conferencing software has replaced not only classroom learning, but also education administration, parent-teacher conferences, and staff and school board meetings (Education software, n.d.).

Zoom, the popular video conferencing software that has seen exponential increases in downloads within the past months. When creating effective virtual classrooms for the first time, educators will need to focus the possibilities and benefits video conferencing software provides as opposed to the limitations. The good news is that 85% of students say that learning online either replicated or exceeded classroom learning. College-aged students prefer a virtual classroom to a physical one (Breck, 2021).

After all, in a traditional learning environment, absent students would need to either attempt to decipher classroom notes accessible in Blackboard or borrow notes from another student. But with virtual learning, students can watch the recording of the class they missed and/or read the transcript. It will keep both students and teachers closely engaged with the subject.

There are some other distant education ICT software which may also be considered for making a more efficient and practical e-Education system for the students.

Blackboard Collaborate: It is a one click virtual classroom and online collaboration tool built specifically for institutions that need to deliver more engaging, personalized, and flexible learning options for students. It goes well beyond traditional web conferencing to meet the extensive and varied collaboration needs of today's educators and learners. Designed with the learner in mind, Blackboard Collaborate delivers a level of engagement that makes students forget they are not in a physical classroom. Blackboard Collaborate is helping thousands of higher education, professional, corporate, and government organizations worldwide to deliver a more effective learning experience online. It will help us to open new aspects of real-time or anytime learning.

Webex Meetings: We need a simple, powerful, scalable service that gets out of our way and lets us get to work. The new Cisco Webex Meetings builds on years of innovation with a brand new desktop app, new mobile experience, and a new line of integrated video devices, making it more powerful and intuitive than ever. It provides simple, modern video meetings with the easiest schedule and joins experiences on the market. Background noise detection, AR capabilities, and video call back features ensure top-quality meeting experiences, while essential tools like application and screen sharing and in-app white boarding help people around the world collaborate together as if they're in

the same room. It is built for more engagement and less enragement. Cisco Webex Meetings brings us a simple, consistent, modern video experience across all devices and integrates with the tools and video devices we already use. Participants can join meetings in just one click, accessing video, audio, polling, and sharing features without needing to download a single plug-in. Cisco Webex video devices are easy to setup and simple to manage, with far fewer management touch points than competing platforms. That means we can spend less time calling IT, and more time getting things done (Cisco, 2020).

PowerSchool Unified Classroom: For over a decade, Schoology Learning has supported all instructional models, including 100% online courses and blended learning environments. As part of PowerSchool Unified Classroom solution, Schoology continues to ensure that all students have access to the same quality of teaching and learning, regardless of their socio-economic status, special education needs, or any other circumstances. Schoology, as part of PowerSchool, creates the most comprehensive unified classroom solution to equip teachers with personalized learning functionality to improve education outcomes for all students. Every day, millions of students, parents, faculty, and administrators from nearly 2,000 K-12 school districts leverage Schoology to advance what is possible in education. No matter if they are in the classroom or at home, Schoology provides communication tools to connect the teacher and student. With it, teachers can collaborate on shared curriculum so high quality, engaging learning experiences can be delivered district-wide, increasing overall equity and access (PowerSchool, 2020).

AdobeConnect: Adobe Connect is the most secure, flexible, extensible and feature-rich web conferencing product on the market. The most regulated industries are using securely in mission critical operations online with Multi layered Security approach. It is customizable - design with vast immersive experiences with custom pods, images & layouts to personalize and brand our virtual room. Engaging - drive and measure audience engagement is unlike any other tool. It add interactivity to our sessions with multiple chat pods, polls, quizzes, simulations, breakout rooms, games and more. It has a powerful mode to allow presenters and hosts to collaborate behind the scene during live session. It also has limitless functionality and extensibility with custom apps (Adobe, 2021). We can easily create our virtual class room with the right layouts, pods and contents.

LearnCube: One of the biggest problems for online teachers and schools is they are stuck using web-conferencing software made for business meetings, rather than a tool made specifically teaching/tutoring online. LearnCube offers intuitive, seamless virtual classroom software that's perfect for teachers and online schools wanting purpose-built features, better insights into the class. LearnCube Virtual classroom includes: - Reliable live video + high quality audio - Interactive online whiteboard - Instant access to your saved lesson materials (PDF, video, Google docs, etc.) - Student access via link (i.e. download-free) - Teacher features (multi-tabs, pointer, highlight, video-sync, instant conjugation tables, etc.). Two main solutions are: (a) Instant virtual classroom made for independent teachers wanting the best online teaching experience possible. (b) Virtual classroom API for large online tutoring companies and language schools wanting better insights into their operations (LearnCube, 2021).

It engages and assesses learners from a far; engaging students in an online course can be a challenge for teachers, as students may lose interest during the session, such as during a lengthy presentation.

Virtual classroom products offer ways for instructors to make the learning more dynamic and more closely replicate the options they have available in a physical classroom. Many tools include digital whiteboards, polling functions, text chat features, and the ability to show videos.

In this lock at home situation all the above discussed on line plat forms are used vigorously by the students and clients from each corner of the country with a huge data transfer. So the software developer modifies their security policies and updating the ICT interfaces.

Indian spectrum on online education

As an immediate measure to stem the spread of Covid-19, most educational institutions have been shut since the end of March. It is still difficult to predict when schools, colleges and universities will reopen. There are few options other than to shift to digital platforms from the traditional face-to-face mode of classroom learning.

Teachers and school administrators have been advised to continue communication with students through virtual lectures or portals like Massive Open Online Courses. However, in the absence of physical classrooms and proper digital infrastructure, both teachers and students are facing unprecedented challenges.

Access to electricity is crucial for digital education, both for powering devices as well as for connecting to the internet. While the government's Saubhagya scheme to provide electricity to households shows that almost 99.9% of homes India have a power connection. But According to the 2017-'18 National Sample Survey report on education, only 24% of Indian households have an internet facility. In respect of India's population, 66% lives in villages, only a little over 15% of rural households have access to internet services. For urban households, the proportion is 42%. The survey shows that among respondents who use home broadband, over 3% face cable cuts, 53% face poor connectivity and 32% face signal issues. In case of mobile data, 40.2% face poor connectivity and 56.6% face signal issues (NSO, n.d.).

There are challenges for teachers too. Not only many of them are digitally inept, a large number of teachers have never used an online environment to teach. Teaching an online course ideally requires preparation, such as designing a lesson plan and preparing teaching materials such as audio and video contents. This has posed new challenges for many teachers.

Yet, some works are going on to continue virtual class program in the following way:

- In the city area some schools are taking educational program using Google classroom/zoom.
- In some area class lecture is arranged in different subject as per syllabus through some popular TV channels for a particular time slot and student assessment is done by some telephonic feedback with the student.
- Recently West Bengal and some other states Government are planning to take class with the individual student by a particular subject teacher using mobile telephone only. It is very much useful in rural and village area, where communication is possible through ordinary mobile phone only

Proposed Model for developing countries

The popular model, already discussed can be implemented only when the technological environment criteria around audiences are fully digitized with 3G/4G/5G systems. And also we are keeping in mind that teacher, learner, and administrators all are from the capable rich society.

But in all areas in India and similar developing countries are not covered by reliable and stable digital networks. So, all types of application like Google Classroom/ Zoom could not be utilized in those areas which are having limited communication facilities. Even in metro cities there are some areas where minimum public utility services are not present. And also poor people could not effort the applications even they are residing in metro cities. Besides, in small town and in villages due to lack of constant electric supply people could not participate the education programme always.

In these circumstances, the proposed model will be a modified application with multiple functionalities, which will covered every places and every classes in the developing society. The block diagram of the proposed model is shown on the Figure-3.

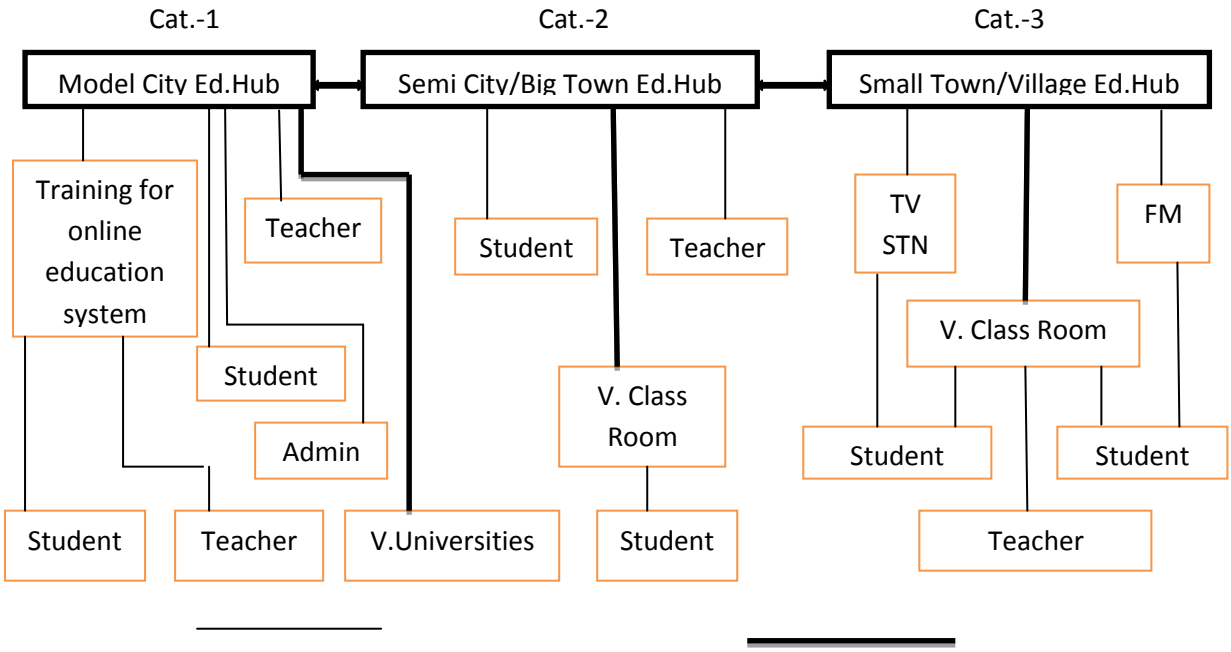

Figure-3: Proposed Model for E-Education with some extended version of Google Classroom/Zoom

In this model, all places are divided into three categories. Cat.-1 areas are model cities where everybody is connected with high speed un-interrupted internet. Here anywhere to anywhere and any teacher to any learner required learning procedure is possible using this model. There is no limitation for enjoying the whole education system even from home. Cat.-2 areas are normal cities and large towns, where internet is available in lesser speed to a major number of people. These peoples can participatein the education system from their home. But those who are not having proper internet and modern mobile gadgets, they have to utilize community virtual class room for their education with free of charge or a very nominal charges. Virtual class rooms in charge will be their teacher for helping them. Cat.-3 areas are most vital to this model because of that, these areas are mostly village

and road side small towns. These areas are not covered by reliable internet connection. Education from home is practically impossible. Here the model will use normal voice telephone, FM radio station and National Broadcast TV station for the education from home. One Education hub is to be constructed by some optical fiber communication (OFC) links with the Cat.-2 education hub. This hub is connected with some virtual classroom. The education processes are virtualized in nature but basically, they are like internet café, and thein-charge of that classroom are practically taking role of a teacher. They will assist students for their education from home using this model. They are also taking feedback from student by transmitting periodical education programmeorganized by this model administrator. A teacher can directly contact with individual student by voice telephone.

Advantage of this frame work is that it used all the latest media Technology for communication, even in small towns and villages. An efficient media or transmission technology means use of 3G, 4G, 5G, FM radio and TV wireless transmission and FTH(Fiber To Home), SDH (Synchronous digital hierarchy) wired by OFC transmission technique for sender to receiver reliable composite information exchange. 3G, 4G, 5G are 3rd, 4th, 5th, generation mobile system respectively with increasing capacity and bandwidth. FTH is proposed where customer student will get high bandwidth at home at a very low cost. SDH is OFC system having more or less infinite bandwidth and capacity.It is used mainly in between capital NIBs (National Internet Backbone) and international nodes through under water sea cables (OFC). Previously bandwidth requirement was limited due to specific data exchange for a particular service only. But when education and other service data and software are integrated with the specific mobile and audio video transmission services, we have to use these new transmission techniques, where the bandwidth can be increased as per actual requirement at that moment. Now a days FM radio and TV transmission improve its quality, bandwidth and also can be used in interactive way with students. Bandwidth can be dynamically stretched and strain as per data traffic position at that moment. The student audiences and no of connected schools can be increased as per need of that place at any time.

Advantage of this frame work is that it has used all the latest media for communication, even in small towns and villages. So that the student audience and no of connected schools can be increased as per requirement. Application-specific security services are embedded within the particular application. The advantage of this approach is that the service can be tailored to the specific needs of a given application. In the context of Web security, an important implementation is Secure Electronic Transaction (SET)(Stallings, 2005;Tanenbaum, 2003).

According to communication requirements, one tunnel is made through the internet connect bounded domains, tunneling is made more difficult through the use of firewalls, which need to be carefully configured in order to distinguish communication pattern is very difficult. Clients and executives talking to each other, the traffic may go through distribution centers. Inter-domain routing of multicast is to be configured according to security policy of the domain explicitly (Stallings, 2005).

Risks and threats with countermeasures in online class room platforms

The following vital risks and threats are occurred during online classes:

1. Through phishing websites designed to look like the legitimate platforms.

2. Wrong page are then exposed to malware or adware when anybody attempt to download what they believe is the genuine.
3. Phishing emails disguised as special offers or notifications from the platform.
4. Distributed denial of service (DDoS) attacks affecting the education industry.
5. Criminals might not even be after access to your account. They can use login credentials for various nefarious purposes: launching spam or phishing attacks, gaining access to your other accounts as people often reuse passwords, or collecting more personally identifiable information to be used in future attacks / attempts to steal funds.
6. Some attackers went so far as to target specific Universities by creating phishing pages for their individual academic login pages.

From January to June 2019, the number of unique users that encountered various threats distributed via the platforms specified in the following figure.

Figure-4: The number of users that encountered various threats disguised as popular online learning/video conferencing platforms, January – June 2019 (Kaspersky, 2020).

Besides the popular remedies/countermeasures like Secret-key algorithms, Digital Signature, etc., the following possible approaches may be taken (Barik and Karforma, 2012).

1. **Neural Cryptography**: It is once again a cryptosystem, which is based on biological ideas including artificial neural the network architecture.This technique is used to exchange of information among the intended students without any disclose of information to others who may have not authorized students.
2. **Elliptic Curve Cryptography (ECC):** It is a stronger option than any other cryptography techniques. It is tested a popular key size require for RSA is 2,048 bits where ECC requires 224 bits for same security.Hence,with ECC, e-Education techniques can use smaller keys to get the same levels of security where more and more cryptography is done on less powerful devices.
3. **Biometric Authentication:** Among all authentication techniques like passwords, smart card, Digital signature and digital certificate, there is no guarantee that dishonest Students will keep their password secret. So Thumb, face, or Iris recognition required for authentication.
4. **Digital Watermarking**: This technique allows an individual to add hidden copyright notices, audio, video, image. Educational contents may be protected by this technique.
5. **Steganography**: It is a technique of hiding secret data within an ordinary non secret file or message in order to avoid detection. The hidden information can be plain text, cipher text or even image (Tanenbaum, 2003). During online class, it greatly reduces the risk of information leakage.

6. **DRM:** Digital Rights Management is a way to protect copyrights for digital media. This approach includes the use of technology that limits the copying and illegal use of the intellectual property of others (Stallings, 2005) in respect of online education environment.

Power supply is an important issue for running smartphone for a continuous long time. It should be uniform particularly in areas (rural and urban) where constant electricity supply is not present. The virtual class program may continue for a long time for different subjects and interaction with different subject teachers. A constant power supply to the different electronic education tools is required. It is crucial particularly for taking some examination or assessment programme for students. Some equipment discovered now a days with uniform power supply with a limited capacity, sufficient to run smartphone etc. This equipment consists of some small solar panel, some lithium ion chargeable batteries and some inverter circuits. They can be used in any time anywhere, because, sun light is available everywhere. The basic idea of this equipment is that the lithium/Ferrous ion batteries are charged by some efficient solar panels and then some inverter circuits inverts the dc to required ac power. Integrated low cost solar charger units are available now and it can be procured in online.

6. CONCLUSION

The Coronavirus pandemic has changed the world of education seemingly overnight, and making decisions about the software for remote working. We use to create a virtual classroom which directly impacts our success as an educator during this time. Different Video conferencing software has replaced not only classroom learning, but also education administration, parent-teacher conferences, and staff and school board meetings.

Distance learning should replicate the traditional classroom as much as possible, especially for younger children who rely on a sense of routine to feel safe. This means, the software needs to create a collaborative environment where students can interact with themselves and the teacher does just as they would normally. Different type of virtual classroom concept discussed above need to be integrated with their advantages to make popular universal video conferencing software. Demand of that has seen exponential increases in downloads within the past months.

We have to remember that online learning and teaching is not just the new normal for students. Remote learning and video meetings for school boards, teachers, and education administrators are, too. In addition to choosing between Google Classroom, Zoom, Adobe Connect, Webex Meetings, PowerSchool, Learn Cube, Blackboard Collaborate, there are many alternatives and new comings. We should also look into using video chat and messaging tools to improve communication and collaboration even further.

After all of our tests and analyzing the present scenario of education from home we still are not sure which platform would be the best for our school. Another thing to think about is bandwidth issues that may arise from so many people trying to work from home. Is it even going to be feasible to run these live classroom sessions? We have to plan and discuss these findings with experts and researcher, and may be leave it up to them as to which platform would be best or should we use something different with integration to present software (discussed above) altogether?

No one can be certain about when the wholeworld will be able to return to traditional classroom learning. Zoom and the additional video conferencing tools we have discussed will help us and our students will quickly adjust to distance learning and will help us to make the most of the process. We may even find that these tools are so beneficial to our students that we will consider hybrid learning in the future, when students are back in a physical classroom or lecture hall.

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