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## Emerging Role of ICT in Chemical Sciences

Dr. Anita K. Sanap<sup>a</sup> and Dr. Kailas K. Sanap<sup>b\*</sup>

<sup>a</sup>Department of Chemistry, S.S.R. College of Arts, Commerce and Science, Sayli Road, Silvassa, UT of Dadra and Nagar Haveli, India 396230.

<sup>b\*</sup>Department of Chemistry, N. B. Mehta Science College, Bordi, Taluka-Dahanu, District-Palghar, Maharashtra, India 396155

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### Abstract

**Information and Communications Technology (ICT)** includes device such as computers, network, hardware, software, electronic technology and satellite systems as well as the various services and applications related to this. The term ICT is also referred as the combination of audio-visual and telephone networks with computer networks through a cabling or link system. ICT removes problems of space and shares the knowledge in an easier and user-friendly way. Research in Chemistry includes systematic analysis of compounds, designing of novel compounds, structure determination of newly synthesized compound etc.

This manuscript shows, apart from learning content, learner should have knowledge of ICT to change in the way of traditional teaching and learning. This can be accomplished through the use of online database like Scopus, Scifinder, Reaxys etc to update knowledge of chemistry in the field of academics and research. The scope and demand for ICT is increasing day by day and it is most important to create intellects by providing world class education for promotion of global standards in the Chemical Sciences. One of the most important facets in the teaching and learning is evaluation. Therefore, ICT should become a vehicle for ensuring the quality in the area of Chemical Sciences.

**Keywords:-** ICT, Research, Group works activities, Virtual Laboratory, Chemical Sciences.

### Introduction:

ICT stands for **Information and Communications Technology**. ICT is an umbrella that includes the technological tools and resources used to communicate, to create, to store and manage the information." ICT plays a vital, valuable and critical role in the education of every country. With the help of ICT, we can learn the concepts of Chemistry easily. Presently, Chemistry Encyclopaedias are available in mobile phone and students should be encouraged to make use of them. ICT which can be utilized for transmission of audio, print and video through broadcasting. ICT opens the door for communication in a user-friendly manner. ICT removes problems relevant to space and time and the learners can communicate anywhere and anytime.

Communication tools like Synchronous and Asynchronous are useful for e-learning. Examples of synchronous communication tools are skype, google talk, yahoo messenger, video conferencing. The opposite of synchronous is asynchronous, which includes tools like email, blogs, wikis, newsgroups, podcasts, YouTube, audio graphics, online forums, social networking sites. These tools provide good connection and create a free flow of knowledge and experiences as well as ease of testing new innovations.

A student's chemistry knowledge can be enriched on a gradual basis with the help of judicious use of ICT. ICT connects various educational and R & D institutions. Therefore, ICT is one of the very significant tools for good quality research. In this research paper, we have tried to analyse the emerging role of ICT in Chemical Sciences.

### **Scope of the Study:**

In this study we have made an attempt to analyse the role of ICT in Chemical Sciences. ICT can be used for developing online course material; delivering study content and sharing content with remotely located students.

### **Objectives of the Study:**

- Role of ICT in the five main disciplines of Chemistry
- Tracing the role of ICT in Research
- Significant challenges for successful application of ICT in Chemical Sciences
- Suggestions for fully utilization of ICT

### **Why ICT?**

- Today the learner's attitude is changing radically therefore use of ICT is important.
- ICT is the one who facilitates communication in effective and user-friendly manner.
- ICT removes problems related to space and saves the time. Therefore, it gives entry to sharing of knowledge.
- Through ICT the learners can gather and exchange information anywhere, anytime more effectively and can produce a global pool of knowledge.
- The students can prepare notes and power point presentations and can be used it for exams.
- The concept of 'e' includes e-mail, e-marketing, e-shopping, e-health, e-banking, e-commerce, e-books, e-governance, e-exam, e-interview, e-learning etc. which provides fast response to users which ultimately increases interactivity.

### **Role of ICT in the disciplines of Chemistry**

The five main branches of chemistry are physical chemistry, organic chemistry, inorganic chemistry, analytical chemistry and biochemistry. Various computing tools like word processors, spreadsheets, presentation software, database maintenance can be used in chemistry. The knowledge base sources like online encyclopaedia, libraries, journals, magazines added valuable role in the disciplines of Chemistry.

### **Tracing the role of ICT in Research**

"Research" is creative, critical and careful study which aims to contribute to the advancement of knowledge. Research in Chemical Science includes systematic and scientific analysis of a problems. Solving the chemistry related problem is a critical process and it can be worked out with proper research methodology and statistical analysis. Therefore, ICT has a major role to play in it. Most of the journals are having data on their website so learner can go through web page of concerned journal and acquire essential knowledge.

Online databases like Scifinder, Reaxys and Scopus are useful for literature survey, for preparing manuscripts, research proposals and scientific paper writing. Any topic related to organic chemistry can be searched on Scifinder, Reaxys or on Scopus to get an idea regarding novelty of that topic. Scifinder and Reaxys is an excellent database and web-based tool for the retrieval of chemistry information and data from published work. It indexes "journals, patents, dissertations, conference proceedings, books, technical

reports and many more.” The information includes several chemical reactions, substance data, its chemical properties, synthetic plan as well as experimental procedures from selected journals and patents. In addition, it often shows who funded a particular piece of research. Scifinder can serve as a way to find out who is working on the topic you may be interested in; it can lead to collaboration and cooperation among scholars. So, researchers can go through this type of databases to collect information about any topic of chemistry research. They can find out laboratory procedures for synthesis and can plan the laboratory work accordingly. As both the databases are providing chemical and physical properties of substances, researchers can go through this and can be benefited by following safety practices in chemical laboratory. The information obtained from these databases will be helpful for researcher to verify analysis reports like physical constant, IR, NMR, X-ray data for most of the chemical compounds with authentic database.

#### **Following free services can be used to manage & share research in Chemistry**

1. **Mendeley** ([www.mendeley.com](http://www.mendeley.com)) : It is a free reference manager and designed for researchers, students and academics.
2. **Dropbox** ([www.dropbox.com](http://www.dropbox.com)) : It is a modern workspace used to share files, collaborate on projects, and to bring best ideas to life.
3. **Google Drive** is developed by Google and used to file storage and synchronization. Google Docs, Google sheets, and Google Slides are used for collaborative editing of documents, spreadsheets, presentations, drawings, forms etc. from any device or location.

#### **Virtual Laboratory with telecommunication facilities**

The chemistry laboratory experimental procedures can be taught by means of a virtual laboratory on a personal computer. Instructional laboratory duplication can be included in the virtual laboratory stratagems where students are free to make the decisions they would confront in an actual laboratory setting. The student may take additional support online after he has attended the same in the chemistry laboratory. Concepts and skills learnt by him through hands-on activity in the classroom-laboratory would be intensified through this sort of combined learning approach. So the chemistry teachers should be aware of the potential of these virtual laboratory resources.

#### **Existing Virtual Labs**

The topics of chemistry practical which are already present on the net for virtual lab are: Organic Qualitative Analysis, Inorganic Qualitative Analysis, Organic Synthesis, Fundamental Experiments in Quantum Chemistry, Properties of gases, Titration Experiments and Instrumental Experiments.

#### **ICT tools useful for Chemistry**

1. **LinkedIn** ([www.linkedin.com](http://www.linkedin.com)) : It is social network designed for career and business professionals to connect, which is a great platform to search for job openings and to connect with HRs of preferred companies.
2. **Academia.edu** ([www.academia.edu](http://www.academia.edu)) : It is a commercial social networking website for academics and students which is used to share research papers, monitor their impact, and the research in a particular field.
3. **ResearchGate** ([www.researchgate.in](http://www.researchgate.in)) : It is social networking website for scientists and researcher which is used to share research papers, and answer questions, and find collaborators.

4. **Google Scholar** ([www.scholar.google.com](http://www.scholar.google.com)) : It is a freely accessible web search engine which helps to discover scholarly sources that exist on your topic.
5. **You tube**([www.youtube.com](http://www.youtube.com)) : Learners can go through this to find out solutions for various chemistry related problems. For e.g. Mechanistic pathway for organic reactions, how metal complex is formed. It is also used to find out SOP for various simple chemistry instruments like P<sup>H</sup> meter, potentiometer, colorimeter etc. and sophisticated instruments like UV-Visible spectrophotometer, IR, NMR, Mass Spectrometer, GC, LCMS, HPLC, etc.
6. **Wikis**([www.wiki.com](http://www.wiki.com)) : If learner have doubt on any topic of chemistry they can go through this to get knowledge regarding that topic.
7. **Google Earth** ([www.google.com](http://www.google.com)) : It will be useful for Chemical industrialist or researchers to find out the exact locations for planning in industry set-up.
8. **Presentation Tools like Slide share**([www.slideshare.net](http://www.slideshare.net)) : This will be helpful for researchers to exchange their knowledge and views of chemistry in the form PPT or PDF.
9. **Blogs**([www.blogger.com](http://www.blogger.com)) : It can be useful for communication and publication of information on the World Wide Web.
10. **Google maps**([www.maps.google.com](http://www.maps.google.com)) : It can be used to trace out the locations of various chemical industries, academic institute and research institutes.

#### **Significant challenges for successful application of ICT in Chemical Sciences**

1. Non-availability of infrastructure for using ICT devices particularly in colleges.
2. The employees are hesitant to learn and use ICT facilities.
3. Academics are not using technologies for teaching and learning or organizing research.
4. Limited ICT infrastructure remains a major barrier.
5. Still, there is threatening problem of confidentiality while using ICT.
6. To create an environment for actual implementation of the strategy.
7. ICT has a very valuable role to play in research as long as it is used appropriately, supports genuine research, does not detract or distract from the proposed research work.

#### **Suggestions for fully utilization of ICT**

1. We can observe that research is rigorous activity and the efforts can be minimized while bringing precision in the research activity and for this ICT is an important tool.
2. ICT can bring an idea of collaborative research by creating a National Knowledge Network.
3. Digital libraries can vary in size and can be maintained by individuals or organizations.

4. Corrections of mistakes of chemistry laboratory should be made in the possible shortest period.
5. All eligible university and college teaching staff should be used for assessment work by developing data base.
6. Word-play, crossword and puzzles through exchange by way of WhatsApp: The teacher can send some words, sentences or pictures to students with the help WhatsApp and then he can ask them to describe/narrate or to write short paragraph related to chemistry.
7. The learners can have their own community by way of Blog, Chat Rooms, Twitter, Face book, and other such application to share their subject knowledge.
8. Change the way you publish, move to open access and check publisher copyright agreement properly.
9. Placing an article or version thereof on your own website is one of the important steps.
10. Today's learners are different, therefore create or maintain your online presence.

#### **Conclusion:**

ICT is a useful tool to have transparency, reliability and efficiency in Chemical Science. There should be fullest use of ICT for bringing changes in the existing system. Thus, ICT is best tool in the hands of researcher in chemical sciences.

A student's knowledge can be enriched on a gradual basis with the help of judicious use of ICT and one should always show keen interest and enthusiasm in finding, learning and understanding the concepts of chemistry.

ICT saves time, creates interest, makes learning efficient, economize learning cost, overcomes space problem therefore encourages for the development of an independent research culture in the field of Chemical Sciences.

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