

Usage of Technology-Mediated Biology Instruction

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Abstract

Visual presentation in multimedia is used by teacher instructional technologies in their classrooms to promote effectiveness in learning and skill development. Biology teachers use a wide range of ICT tools in schools and colleges, although it is very difficult to provide student-centered instruction and assessment. The researcher wants to understand the usage and rationale for using ICT in biology classrooms in urban colleges, so that she can identify the issues, merits and perceptions of biology teachers about using educational multimedia. The theoretical basis is also important so as to devise an effective and pragmatic implementation policy for computer-aided biology instruction. Interviews of 20 biology teachers in five colleges of south Mumbai, revealed that they used the internet to enhance lectures, for research work, to enhance laboratory practicals and for students to review their learning, in project work and in the laboratory work. Teachers felt encouraged to use ICT infrastructure to promote students' knowledge, due to available technical support. A few biology teachers in Sophia College felt inhibited to use PPTs due to a lack of technology resources, a lack of a 'departmental technology' plan, less access to computers/tablets, software problems, equipment malfunction; and they preferred students' active participation.

Keywords: Instructional technologies, Student-centered, Biology instruction, Educational multimedia, ICT infrastructure

Introduction

Teachers manage an electronic generation of students, whose everyday life is primarily based on visual and auditory communication. It is important to facilitate the effective instruction of visual learners through image-rich instructional tools, as is important to promote the learning of auditory learners through discussions and lectures. While multimedia effectively provides effective learning experiences, it also enables teachers to enhance class participation in the right teacher's, improve their teaching techniques and achieve learning outcomes. Teachers and students connect through social media, email and video conferencing. Some science teachers are reluctant to use new ICTs because they do not see it improving their students' learning. Others depend totally on ICT for science instruction, because of its vast scope for individualized learning, its updated



knowledge bank and extensive availability of contemporary data resources, museums and online libraries, as well as science classrooms and virtual field trips, across the world.

The five urban colleges, affiliated to the University of Mumbai, were re-accredited for the third time, with high CGPA grades. They were grant-in-aided by the state government for some courses. They conducted Higher Secondary courses in Arts, Science, Commerce and Vocational streams, Undergraduate courses in BA, BSc. (Biochemistry, Biophysics, Chemistry, Life Sciences, Maths & Stats, Microbiology, Physics and Zoology), BMM, BBA and BSc-IT; PG Diplomas in Medical Laboratory Technology, Laboratory Management and Quality Assurance in the Foods/Pharmaceuticals Industry; MSc courses in Life Sciences, Applied Biology, Biochemistry, Biophysics and Chemistry; and new PhD programmes.

All Science departments have requisite computers. The faculty have dedicated departmental laptops. The college general staff rooms have computers and an internet broadband connection. The libraries have photocopying counters, open access facilities, online journals, an AV section (with numerous audio, video, CD-ROMs, films, maps and scan-resources), computers, scanners, printers and an internet broadband connection. The classrooms have fixed overhead LCD projectors and dedicated laptops. The college timetable Committee allotted at least one technology enriched classroom to each lecturer/professor, to promote the use of AV instructional material in classrooms.

The computer laboratories were established with UGC funding, and also conducted short term courses in Computer Basics, Programming Languages C, C++ & Java, Tally, Photoshop, Corel Draw and Web Design; are conducted for a nominal fee. The computer centres were Authorized Learning Centres (ALC) for the MS-CIT, MS-ACIT and KLiC (Data Management course: Advanced Excel) online courses certified by the Maharashtra Knowledge Commission Limited (MKCL), a state government subsidiary.

Significance of the Study

Science students need skills that are “not only needed by scientists, but by every citizen in order to become a scientifically literate person able to function in a society where science has a major role and impact on daily life” (Huppert et al., 2002, 807). Many college and university administrators expect their faculty to use ICTs to extend quality, access, and equity in higher education. The science departments get grants which impact their educational and research programmes. The root question is: with all its digital educational facilities, have these colleges adequately integrated ICT-enabled learning and teaching in its science programmes? Hence, it is very important to assess if the science (especially biology) teachers of these five urban colleges



provide optimum ICT enabled instruction for students in the junior and senior college programmes.

Definition of Terms

Each discipline develops a working vocabulary, and so the discipline of educational technology has increased the use of technology terms & phrases in education.

- a. Browser: Software to see internet sites as graphic images, and not just as text.
- b. Compact-Disc Read-Only Memory (CD-ROM): A multimedia platform that can include presentations, animations, tutorials, quizzes, glossaries of key terms.
- c. Email (Electronic Mail): Messages sent via computers or mobile phones.
- d. ICT: Information and Communication Technology.
- e. Multimedia: Integrating several media (text, graphics, animation, audio, video).
- f. Network: A set of connected people or computers.
- g. Online: Being connected to the internet during an activity.
- h. PowerPoint: A complete presentation graphics package.
- i. WebCT: A web-based set of course tools designed to deliver online learning.
- j. Web Page: A single screen of information that may contain text, images, animation and perhaps sound and video.
- k. WhatsApp: Messenger service to send instant text, images, PDF, Word, PPT, Excel, etc.,
- l. World Wide Web (WWW): An internet system, which displays sites as graphic images and connects information among, and between sites, through hypertext links.

Related Literature

- a. Bitok E. B (2012) investigated Kenyan secondary biology teachers' perception and support in using ICT. The biology teachers showed a positive perception in the integration of ICT in Biology and also recommended on-going administrative support to use computers in instructional activities.
- b. Dubey Arun K. (2009) found that secondary students trained on a multimedia package performed better than conventional teaching for biology. He concluded that there is no difference among genders in their science achievement, while using multimedia packages.
- c. Jahan Israt et al. (2014) used a triangulation approach (teaching aids, ensuring student participation, "student-centered" activities) to ensure students quality learning, in grade IX instruction in Biology in Bangladesh.
- d. Ludwig T. E. (2004) suggested that teachers need to display instruction through a digital projector; or a TV/VCR, videotapes, and to obtain good legal multimedia content.



- e. Millen James A. (2003) Teachers in Florida's Community Colleges were less likely to use ICT in their classrooms and laboratories, without training and digital infrastructure.
- f. Nachimuthu K. (2012) concluded that the use of multimedia programmes impacts positively on the B.Ed student teachers, improves perceptions on Colour concept of the diagrammatic skills of student teacher knowledge; and found significant differences between male and female secondary student teachers in perception and attitude towards multimedia on biology.
- g. O'Day D. H.(2007) showed that long-term memory retention improved, 21 days after viewing a biology animation without narration as compared with equivalent graphics.
- h. Schut C. (2007) found that students preferred the interactive white board instruction through enhanced visuals and notes.

Research Questions

The information gathered from the biology teachers (from the departments of Biology, Life Sciences, Zoology, Biochemistry, Biophysics and Microbiology), will direct me to respond to these questions:

1. To what extent are Biology teachers using the Internet?
2. Which factors encourage Biology teachers to use the Internet?
3. Which factors inhibit Biology teachers from using the Internet?
4. To what extent are Biology teachers using the Multimedia?
5. Which factors encourage Biology teachers to use Multimedia?
6. Which factors inhibit Biology teachers to use Multimedia?
7. How do Biology teachers communicate with their students outside the classroom?

Objectives of the Study

1. To comprehend how ICT is used in biology classrooms and laboratories.
2. To understand the issues, merits, and perceptions of biology teachers for usage of ICT
3. To understand the foundation reasons for using ICT in biology education
4. To make a pragmatic policy for ICT usage in biology instruction.

Sample of the Study

A total of 20 teachers formed the sample of this study:

1. Four teachers of the higher secondary educational (junior college level)
2. Sixteen teachers of the higher educational level (senior college level).



Tools of the Study for Data collection

The primary research question that generated this survey was, “What factors encourage and inhibit the use of educational technology in the teaching of biology? The format of the two-part survey was a linear and tabular checklist for some items and a rating scale for other items.

Figure 1: The extent of use of internet resources by biology teachers in the classroom and in the laboratory

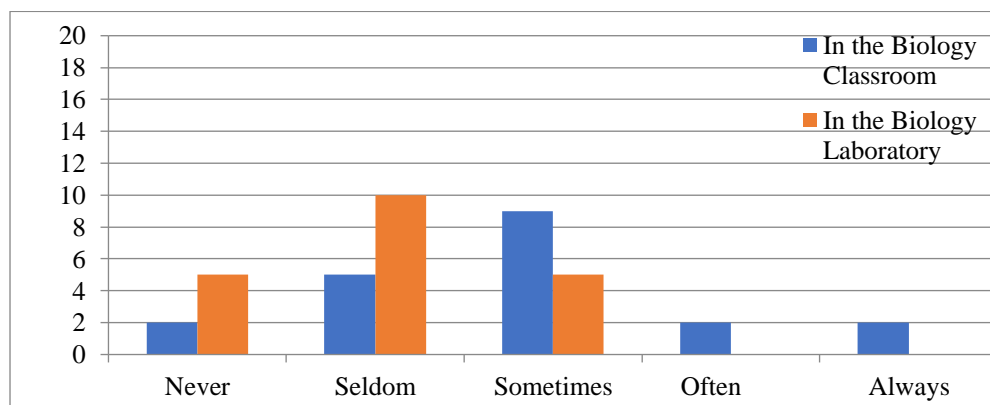
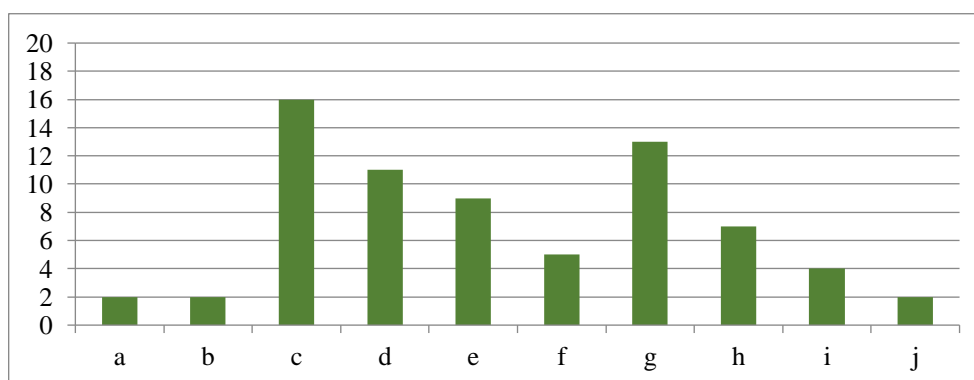


Figure 1 shows only one-tenth of the teachers had never used the internet in the classroom, during lectures; although nearly half reported that they had sometimes used the internet in the classroom. In the laboratory, the number that had never used the internet rose to one-fourth, although a small group of one-fourth teachers sometimes used the internet in the laboratory.

Figure 2 Teacher’s use of internet resources for biology instruction

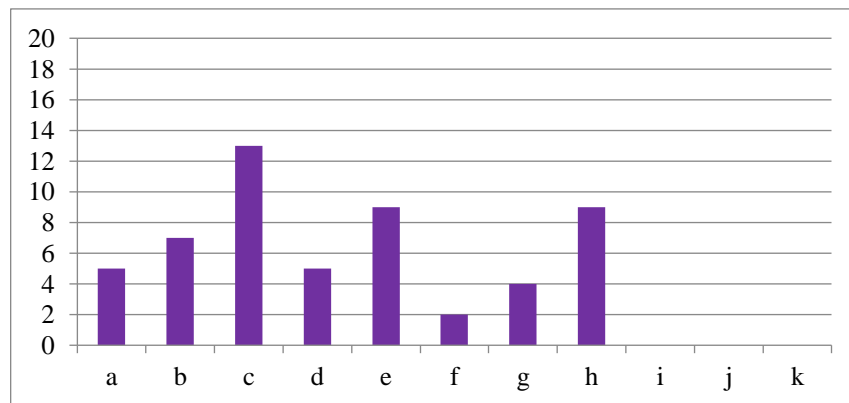


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| a. In place of the lecture | b. In place of laboratory practical |
| c. To enhance the lecture | d. To enhance laboratory practical |
| e. As a review for students | f. For student assignments |
| g. For research work | h. For students project work and reports |
| i. For students online quizzes | j. For additional online laboratories |



Figure 2 shows that nearly four-fifths of the biology teachers use the internet to enhance their lectures; three-fifths use the internet for research work; while half use the internet to enhance laboratory practical and for students to review their learning. Nearly one-third teachers used the internet for students' project work.

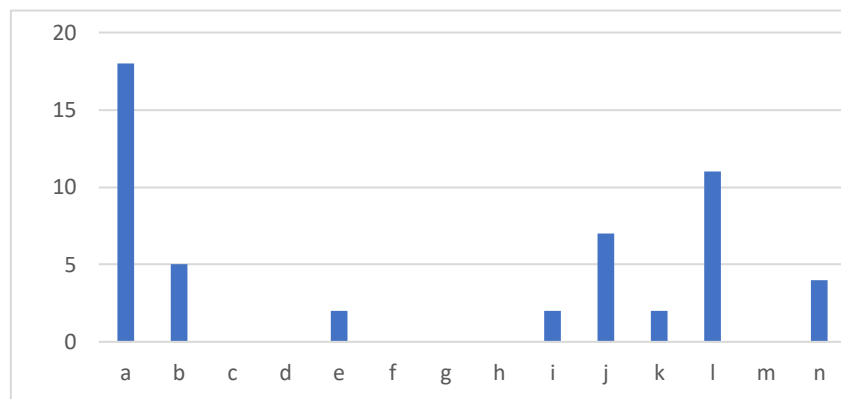
Figure 3: Factors that encourage the biology teacher's use of internet in classrooms and laboratories.



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|---------------------------|--|
| a. Easy access | g. Available technology planned session. |
| b. Tech support available | h. Teacher's interest |
| c. Current information | i. Pressure from students |
| d. Syllabus needs it | j. Pressure from administrators |
| e. Students need to know. | k. Pressure for department & colleagues |
| f. Training provided. | |

Figure 3 shows that nearly three-fifths of the biology teachers were encouraged to use the internet to source current information; nearly half were encouraged out of interest and to promote students' knowledge; while nearly one-third teachers were encouraged to use the internet because technological support was available.

Figure 4: Factors that inhibit the biology teacher's use of internet in classrooms and laboratories.



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|---|---|
| <ul style="list-style-type: none"> a. A lack of connectivity for teachers b. A lack of means of projection. c. A lack of training to use technology. d. A lack of teacher's interest e. A lack of preparation time f. No administrator encouragement g. No colleague encouragement | <ul style="list-style-type: none"> h. A lack of college/department plan i. A lack of technology resources j. A lack of access to computers & tablets k. Prefer traditional instructional methods. l. Prefer more student active participation. m. Time lost from traditional methods. n. Equipment malfunction |
|---|---|

Figure 4 shows that most of the biology teachers are inhibited from using the internet in classrooms and laboratories, because of a lack of internet connectivity, i.e., no wiring nor Wi-Fi connection is provided in the classrooms and laboratories. More than half the biology teachers reported that they faced a lack of technology resources for teachers, while nearly one-third teachers were inhibited from using the internet because of a lack of access to computers and tablets. At least one-fifth reported a lack of adequate projection and equipment malfunction.

Figure 5 A: The biology teacher's use of multimedia in the classrooms

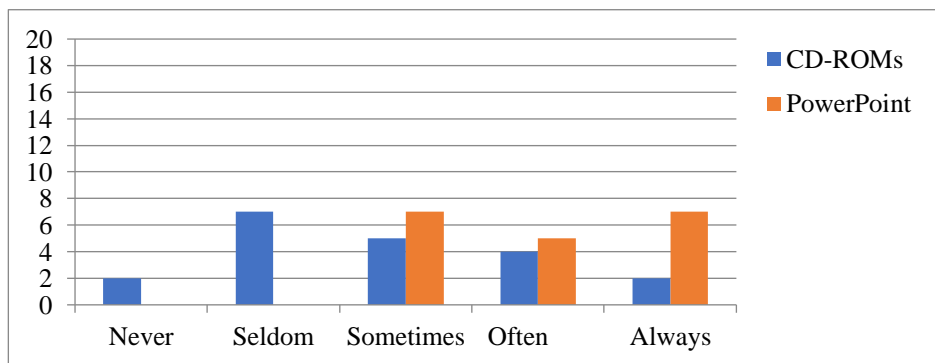


Figure 5 (A) shows only one-tenth of biology teachers never used CD-ROMs in the classroom; although nearly half reported that they do use CD-ROMs in the classroom. Half the teachers use PowerPoint presentations quite often. One-tenth teachers always use CD-ROMs in the classroom, while one-third teachers always use PPTs in the classroom.

5 B: The biology teacher's use of multimedia in the laboratories

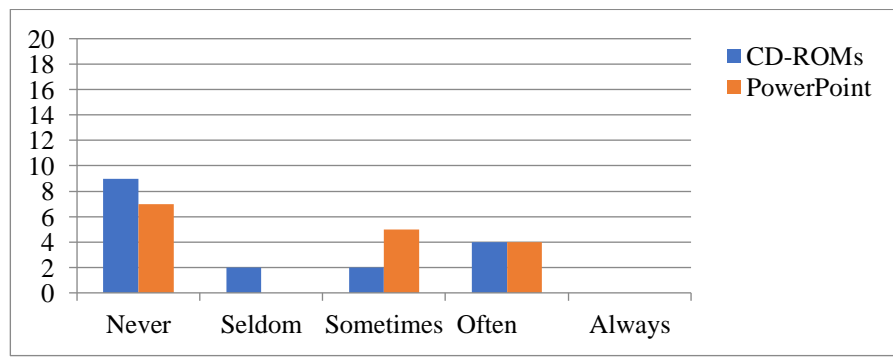


Figure 5 (B) shows nearly half the biology teachers never used CD-ROMs in the laboratories, while nearly one-third teachers never used PPTs in the laboratories. A small number of biology teachers reported that they do use CD-ROMs and PPTs in the laboratories, to some extent.

Figure 6: The biology teacher's use of multimedia for instruction

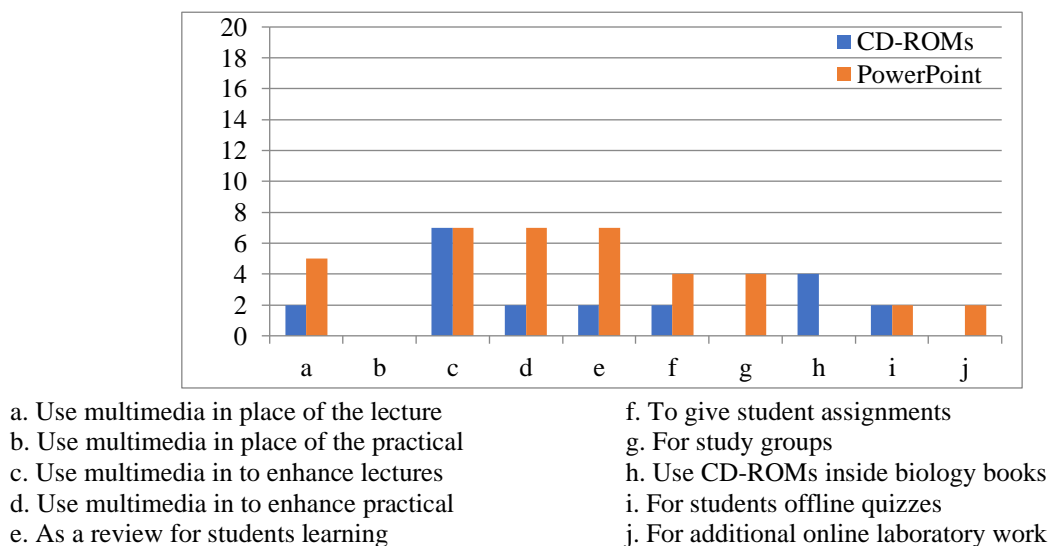
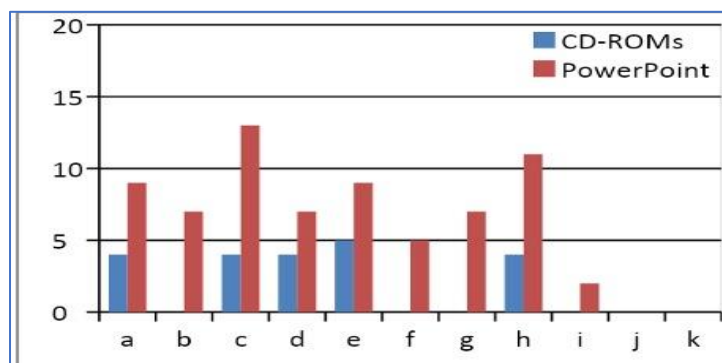


Figure 6 shows only one-third of biology teachers use multimedia like CD-ROMs to enhance lectures, while a few biology teachers use CD-ROMs inside reference books for instructional purposes. Smaller groups use CD-ROMs to replace lectures, to enhance practical, for students to review their learning, and to give student-assignments and offline quizzes.

Teachers preferred to use PPT presentations, in comparison to CD-ROMs.

Three teacher groups of one-third each, use PPT presentations to enhance lectures and practical, and as a review for students' learning. Smaller groups use PPTs to replace lectures, give student-assignments and for study groups.

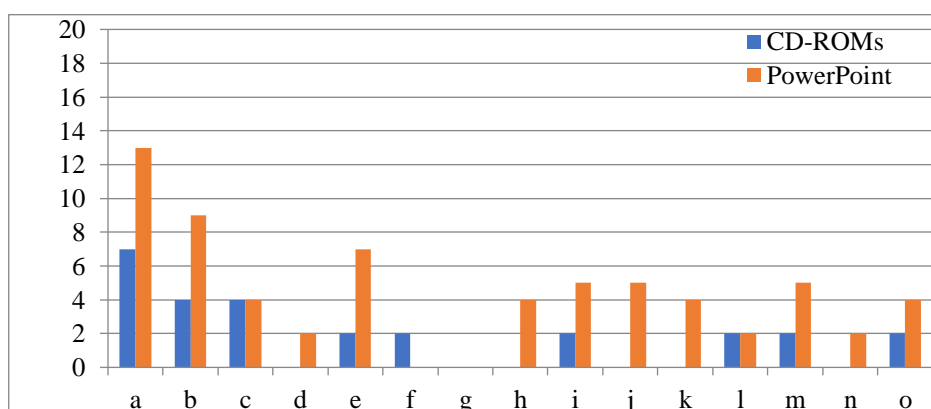
Figure 7: Factors that encourage the biology teacher's use of multimedia in classrooms and laboratories.



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| <ul style="list-style-type: none"> a. Easy access to multimedia b. Can post lectures on website / email. c. Good for visual learners d. CD with text/images available with book e. Students need to know. f. Training in multimedia is provided. g. Available technology plan or vision | <ul style="list-style-type: none"> h. Teacher's interest in using multimedia. i. Pressure from students to use multimedia. j. Pressure from administrators k. Pressure for department and colleagues |
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Figure 7 shows only one-fourth of biology teachers were encouraged to use multimedia as they wanted to upgrade students' knowledge, while four groups had easy access to them. Teachers were more encouraged to use PPT presentations rather than CD-ROMs. More than three-fifth of biology teachers felt encouraged to use PPTs as they were good for visual learning. Three groups of one-third each, were encouraged to post PPTs online. A few biology teachers use PPTs as they were provided training individually or through the MS-CIT course.

Figure 8: Factors that inhibit the Biology Teacher's Use of Multimedia in the Classrooms and Laboratories



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|---|--|
| <ul style="list-style-type: none"> a. A lack of connectivity for teachers b. A lack of means of projection c. A lack of training to use technology d. A lack of teacher's interest e. A lack of preparation time f. No administrator encouragement g. No colleague encouragement h. A lack of college/department plan | <ul style="list-style-type: none"> i. A lack of technology resources j. A lack of access to computers & tablets k. Software problems encountered l. Prefer traditional instructional methods m. Prefer more student active participation n. Time lost from traditional methods o. Equipment malfunction |
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Figure 8 shows nearly one-third of biology teachers feel inhibited to use CD-ROMs as there was a lack of connectivity i.e. no wiring nor a Wi-Fi connection is provided in the classrooms and laboratories. Two groups of one-fifth each reported a lack of adequate projection, a lack of training to use CD-ROMs and a lack of technology resources. A few teachers indicated equipment malfunction, a preference for using traditional instructional methods. More than three-fifths of the biology teachers reported that they felt inhibited to use PPTs as there was a lack of connectivity/projection in the classrooms and laboratories.



Figure 9: Biology teacher-pupils communication outside the classroom

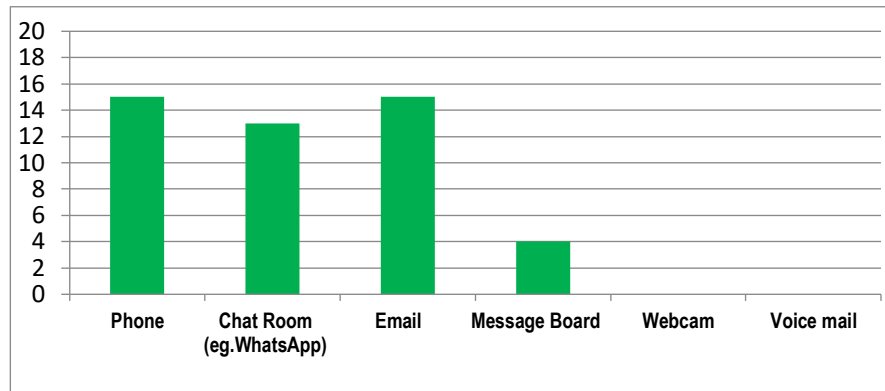


Figure 9 shows three-fourths of the biology teachers communicate with their students outside the classroom via phones and emails. More than three-fifths of the biology teachers communicate with their students outside the classroom via chat-services like WhatsApp, while one-fifth of the biology teachers communicate via message-boards.

Conclusions

The main purpose of this study was to list the factors that stop and promote the use of ICT by biology teachers. The literature suggests that technology planning, adequate resources and time, training, access to computers and teacher interest are important elements in the effective implementation of technology policies in colleges. The results of this survey are:

1. The Biology teachers used the internet to enhance lectures, for research work, to enhance laboratory practicals and for students to review their learning and project work.
2. They felt encouraged to use the internet to source information, out of personal interest, to promote students' knowledge, due to available technical support.
3. Most biology teachers used PPTs in preference to CD-ROMs in the classroom. They felt encouraged to use PPTs for visual learning, by their MS-CIT course training, to post PPTs online, embed it with text/images content; and they had a basic technology policy.
4. Many biology teachers communicate with their students outside the classroom by phone, email and via chat-services like WhatsApp
5. They were inhibited from regularly using the internet in classrooms and laboratories, because of a lack of internet connectivity, a lack of technology resources for teachers; a lack of access to computers/tablets and a lack of adequate projection and equipment malfunction.
6. A few biology teachers in Sophia College felt inhibited to use PPTs due to a lack of technology resources, a lack of a 'departmental technology' plan, less access to computers/tablets, software problems, equipment malfunction; and they preferred students' active participation.



ICT is an expensive resource to provide to all teachers and students. Access to computers and projection technology is important for science education. In the previous academic year 2022-to-2023, the colleges have increased the number of laptops, desktop computers and LCD and portable projectors for its laboratories and classrooms. Smart Boards and TV consoles were installed in classrooms and corridors respectively. Effective ICT maintenance schedules must be followed for optimum ICT use by teachers.

It is evident that biology teachers are interested in using ICT resources efficiently and effectively for their students' benefit. It is impossible to provide each science teacher with a computer or laptop or tablet as resources are scarce. Although the science departments have computers, it is evident that some biology teachers still want more resources and training in using ICT. There are many salient factors that encouraged the biology teachers to use the internet and multimedia in their instructional activities. Hence, colleges need a Technology Committee which must present a technology plan for each academic year. It must also facilitate the training of biology teachers to use new ICT effectively. The technology committee must comprise heads of departments, ICT skilled faculty, technology experts and the principal. Teacher training in ICT skills is extremely important. These five colleges offer both the MSCIT and the ACIT courses to faculty and students. Yet, more comprehensive training and andragogical sound instructional strategies, including mentoring and modeling are critical to successful ICT use in colleges. Despite teacher interest, college policies and upgraded curricula, if the biology teachers do not feel confident and enthused about new ICT implementation, they will proceed with didactic teaching-learning methods. Too often change facilitators get involved in the new technology and fail to address the needs of the people involved. Hence, administrators must understand the technology needs of their faculty for effective instructional practices.

It is not surprising that most of the biology teachers communicate with their students through smart phones, emails and WhatsApp messenger. This promotes access to teacher facilitation that is very important to GenNext. In addition, access to daily instruction can be brought about by using LMS like Moodle, which keeps the teacher-pupil connection strong.

Suggestions for future studies and technology implementation

Science teachers must accept that learning styles of active learners and reflective learners are important. Active learners might possess high interpersonal intelligence, whereas reflective learners might excel in the domain of intrapersonal intelligence (Howard Gardner's theory of Multiple Intelligences). Using offline or online multimedia promotes multi-sensorial learning, advocates different learning styles and thus is an effective resource-based learning and teaching



method that is effective, innovative and inclusive. Hence, teachers must use audiovisual resources and thereby facilitate learning styles and multiple intelligences.

Teachers and administrators may probably use the results of this study to improve instructional systems in urban biology classrooms in India. In addition, there is a need to study the way that students and teachers view the use of ICT, so as to improve the resources and strategies in educational technology, in practice and in theory. Only then will we move from crossing the 'digital divide' to getting a 'digital dividend'!

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