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Impact of Use of Audio-Visual Aids on Knowledge and Comprehension of Low Achiever Science Students

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Abstract
Teaching of chemistry by use of educational technology has enhanced student's interest in chemistry. Cognitive learning plays vital role in conceptual development of students. In the present work audio-visual aids were used to find their effectiveness on knowledge and comprehension of low achiever students in chemistry. A sample 51 students was selected from 2 two different institutes. On the basis of previous year results of students, they were distributed into control and experimental groups. During this experiment 15 different topics of chemistry were taught to students for 73 days. The control group was taught with lecture method whereas experimental method was taught with the help of AV AIDS such as models, charts, animated videos, and power point presentations. Knowledge based and comprehension based pre and post tests were conducted to evaluate the effectiveness of audio-visual aids. The results showed that the experimental group performed better as compared to the control group marking significance of audio-visual aids on knowledge and comprehension of students in chemistry.it is recommended to use AV Aids to teach chemistry to the low achievers as it helps to conceptualize the abstract concepts.

Keywords: *Audio-visual resources, comprehension, knowledge, secondary school students; teaching learning process*

Introduction

Chemistry is a subject of concepts which is difficult to understand when presented only by theoretical ways. Mostly students of high schools consider chemistry as a nightmare. They either try to avoid chemistry periods or try to cram what have been taught and then throw it off as soon as possible. This is because of lack of effective or better communication between teacher and students while learning chemistry (Sanger, 2000). It has resulted in increased number of failure students at secondary school level and this number is approaching at the alarming level.

Visual aids are important in education system. It had been reported by the scientists and scholars that teaching chemistry through visual aids is effective and helpful rather than any other teaching method adopted for chemistry teaching (Ardac, 2004). These are the devices which invigorate teaching learning process by making it unchallenging and entrancing. These are the best impedimenta for effective teaching and promulgation of knowledge (Rasul, 2011). Learning with visualization in general is termed as a constructivist cognizance of learning. The uppermost bulletin is that students after getting directions through visual aids will be able to construct new ideas. Visual aid learning has been one of the paramount forces for the development of empirical research attitude in students.

Use of visual aids provides learners a visual stimulation and an opportunity to interact with the content from a vintage point. In this way each learner can grasp more swiftly. These aids not only arouse the inquisitiveness of learners but also help the teachers to make conceptions easier for the learners (Eilks, 2009). So, the focus of present study will be the analysis or measure of effect of visual aids on learning abilities of students at secondary school level.

Statement of the problem

Effective learning of chemistry is purely dependent upon methods adopted for teaching purposes. Theoretical methods of teaching so far have little effect on students learning in chemistry. Usage of visual aids in teaching chemistry can be valuable for improving learning of students in chemistry. There are hundreds of secondary schools in Azad Jammu and Kashmir. Their performance in 2017 and 2018 board examination is not satisfactory especially in chemistry. There might be different factors responsible for poor results. Existing literature has visualized that learning aids have potential impact on the academic performance of students. Rasul (2011) reported that visual aids have played significant role in teaching and learning process. These materials not only improve the effectiveness of teaching and learning process but also provide core ideas of the subject with depth explanation. Mathew and Alidmat (2013)have inferred that these aids act as a source of inspiration and motivation for students and their effective usage substitutes tedious learning environments. Awasthi (2014) also concluded that visual aids make learning very effective by increasing interest of students in education. So, in general it is acknowledged that visual aids make learning process effective in such a way that student can easily get command in their subjects (Mohsen, 2016). There are many other problems faced by students in secondary schools making their performance weak in chemistry but lack of use of visual aids is the key problem in this regard. The objective of the present work was to examine the efficacy of visual aids in learning of chemistry at the secondary school level.

Objectives of the study

The leading purpose of the study was to observe the impact of visual aids on performance of chemistry students at secondary school level. Other objectives of the study include to explore the effect of audio-visual aids for learning chemistry among low achievers.

Hypotheses

H_{01} There is no effect of visual aids on students learning.

$H_{02.}$ There is no significant difference between mean scores of control group and experimental group regarding knowledge when taught with visual aids.

$H_{03.}$There is no significant difference between mean score of control group and experimental group regarding comprehension when taught with visual aids.

Literature Review

Education is indispensable for all and sundry. Its importance cannot be denied because a good life can never be enjoyed without it. Imperative constituents of education are teaching and learning. The teachers practise diverse approaches and aid materials to make learning more effective. Resourceful teachers are always beloved by students because they encourage their involvement in different technology based learning activities thus creating a beautiful learning environment (Mohammed, 2017). This environment in turn is dependent upon planning of teachers for technology based lessons (Kausar, 2013). Such lessons trigger fear free attendance of students in the classroom (Halwani, 2017). Teaching aids not only trigger the interest of pupils but also clarify the concepts smoothly. Audio and visual materials are used to innovate and enhance teaching and learning process (Daniel, 2013). These are also used to make this process easier, effective and interesting (Awasthi, 2014). Audio visual tools, in learning process, concretize learning and help in improving mastery and understanding of students for different subjects (Almurashi, 2016). These tools also enhance and maintain student interest for science subjects (Ibe, 2019). They make a smooth, strong and faultless between the learning material and the learner (Richard, 2020). Positive influence of these tools was also reported by Al-Khayyat (2016). Improved understanding of school students for various subjects was also found by Tang (2018).

The material like film strip, models, maps, charts, projectors, television and radio etc. are called audio visual aids. Visual aids are operative tools that" invest the past with an air of reality." These aids have advantage of providing the learners the atmosphere of realistic experience by capturing their attention. They motivate the mind by involving the visual and the auditory senses. It is clear that all of us gain knowledge by using our senses. This makes clear that these aids are helpful in making teaching and learning process more easy and effective because these aids stimulate thinking and understanding approach (Jane, 2020). There has been manifold values use of these aids in teaching and learning process. A consistent and professional presentation can be made by the presenter by using these items.

The teaching profession is dressed with incalculable opportunities to improve the academic performance of students. Although some objectives and concepts being stress-freewill be easier to hold yet others will have need of creative thinking to achieve learning objectives. Teaching by visual aids is one way of boosting lesson plans and offering additional ways to have command in subject (Ehsan, 2019).They epitomize knowledge and help in improving learning process. They furnish the work of the teacher with new ideas. It had been well stated by Comenius that the basis of all learning types involves clear representation to the senses along with sensible objects for their appraisal (Tang, 2017).

The process of teaching and learning has pivot role in educational development. If this is well organized and directed, it is a key to progress and success of an individual. Thus, finest methods must be used to enrich effectiveness of teaching and learning. Visual resources in addition to increasing the enthusiasm of the teachers and the learners also add clarity making the learning very exciting (Adamu, 2018). The goal of education is permanent learning so that the learners are able to retain with clear concept what is taught. This is achieved by using visual aids because these aids involve many senses. It is found that learners can retain maximum of knowledge by involving hearing, seeing, and feeling instead of involving only sense of hearing (Tang, 2017). This concept endures weight to the old Chinese wise saying according to which ‘what I hear I forget what I see I remember and what I do, I know.

A visual coaching vitalizes the use of visual resources so that non-figurative ideas are more real to the students (Iqbal, 2020). Thus, the teacher’s responsibility is to make learning living experience of education instead of making it just something to memorize. This objective may be achieved effectively by hiring the use of visual resources in teaching process while imparting knowledge (Gilakjani, 2012). Educators have found that the effectiveness of teaching and learning can only be achieved if a student has direct experience with his subject. It is observed that a learner can have best learning by doing and this activity is well offered only by use of visual resources because enrich motivation, concentration, attention and preservation of facts. However, there has been no harmony on usage of visual materials in teaching as referred by authors, researchers and intellectuals.

Usage of diagrammatic representations in popular magazines, newspapers professional, scientific journals and science textbooks is now a common practice. They have turned into an essential constituent in handing over scientific information from scientists to the general public and school students (Qaiser, 2011). Keeping in view their prominent place in scientific communication and science learning it is shocking that they have not been addressed more amply and systematically in scholarly discussions. Pakistan is endlessly wrestling for an above board position in the circle of the scientific nations. So a muscular base of science and technology is needed by Pakistan to solve its problems of energy, health, food, education, poverty, shelter, security, overuse of natural assets. Hence, it is much needed to pay full attention towards scientific achievements to ensure the development of Pakistan.

Procedure of study

Research Design

This study marked the differences between lecture method and method based on use of visual aids while teaching chemistry. It was purely experimental in nature. Graphs, models, slides, animation videos were used. Pre-test and post-test were conducted.

Population

All chemistry students of class of 10th class of the government institutes namely institute 1 and institute 2 of district Bhimber Azad Jammu and Kashmir constituted the population. Number of 10th class chemistry students was 30 in institute 1 and 21 in institute 2.

Sample

There was random selection of students of chemistry of 10th class and they were classified as “Control Group” and “Experimental Group” on the basis of their previous annual exam scores in chemistry. 15 students were in the experimental group and 15 students were in the control group of Institute 1. Similarly, 11 students were in the experimental group and 10 students were in the control group of Institute 2. Students for both the groups were selected according to bright, medium and dull levels of academic achievements.

Tool Development

Pre-test and post-test were conducted to evaluate the learning of students. These tests comprised of twenty knowledge based questions (K.B.Qs) and fifteen comprehension based questions (C.B.Qs).

Tool Administration

It was necessary to inspect whether the adeptness of both groups in chemistry was at the same or different level. There were ten K.B.Qs about the main idea and ten K.B.Qs about related terminologies in the pre-test. Similarly eight C.B.Qs were about pictorial representation of ideas and seven C.B.Qs were about definitions and short explanation of different ideas.

Intervention

Both groups of students were given same lecture about specific topics with the exception of the experimental group which was delivered lecture with the help of visual aids like animation videos, models, and slides. Since in experiment the visual aids were used thus less time was consumed for explanation in case of experimental group as compared to the time consumed in case of control group. Thus no extra time was given to any group. Post-test was also conducted on same pattern for evaluation purposes. This process was completed in 73 days. Total 15 different topics were taught. These concepts were taught using models, power point presentations, animated videos, and charts. Following topics were taught by models and animated videos;

a) Structure of an atom
b) Comparison of atom, element, compound, mixture and free radical.
c) Periodic functions of elements including atomic and ionic radius, ionization energy, electronegativity, electron affinity, and isotopes.
d) Environmental topics like greenhouse effect, acid rain, primary and secondary pollutants.
e) Analytical chemistry and organic chemistry topics including acid base titration, role of indicators, properties of acids, bases and salts, solutions, classification of organic compounds, geometries of different organic compounds, carbohydrates, nucleic acids, and vitamins.

Topics a, b and c were taught in 24 days while topics d and e were taught in 32 days.

Following topics were taught by using charts and power point presentations within 16 days;

f) Topics of industrial chemistry like Solvay's process, Haber's process, metal extraction and refining.
g) Laws about behaviour of gases like Boyle's law and Charles law.
h) Chemical kinetics

Results

Performance of Participants of Institute 1

The number of control group participants was equal to the participants of test group in this college i.e 15 participants per group. According to the data of initial assessment none of the participants of both the groups was able to score rights answers of M.C.Qs between 16-20 and S.Qs between 13 -15.

Section-I

Assessment of control group

Table 1

Overall results of knowledge based and comprehension base tests of control group

No. of students	Performance	Mean score K.B.Qs	Mean score C.B.Qs	T_{cal} for K.B.Qs	T_{cal} for C.B.Qs
15	Before lecture	6.6	4	2.83	1.23
	After lecture	9.7	7.33		

K.B.Qs = Knowledge based questions

C.B.Qs = Comprehension based questions

df = 14

T_{tab} at 0.05 level of significance = 1.761

Table 1 shows that there was a greater difference between mean scores of control group before and after lecture for the test of K.B.Qs and C.B.Qs. The T_{cal} value for K.B.Qs test was greater than T_{tab} while it was less than T_{tab} in case of C.B.Qs.

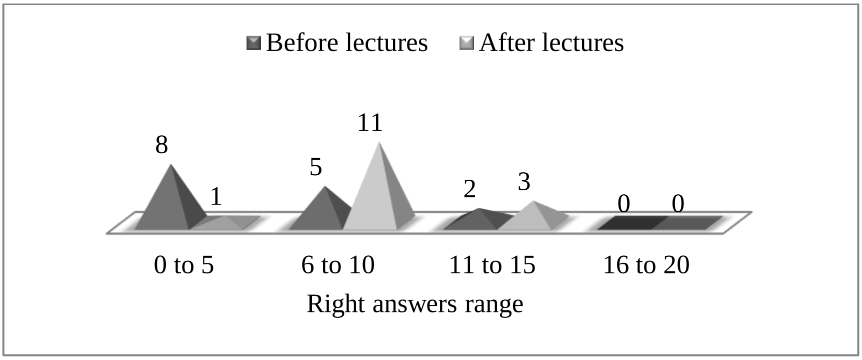

Figure 1: Comparative representation of K.B.Qs results of control group

The number of participants of the control group initially for giving right answers of K.B.Qs in range 0-5 was 8 which decreased to 1 after the lecture, for the range 6-10 initially the frequency was 5 which increased to 11 after the lecture, for the range 11-15 it was initially 2 which increased to 3 after the successful completion of the study.

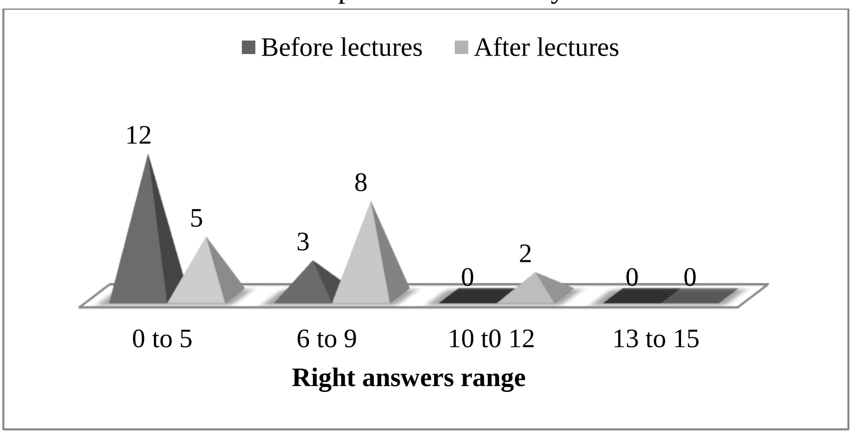

Figure 2: Comparative representation of C.B.Qs results of control group

The performance of these participants in answering C.B.Qs varied in such way that the frequency in the range group 0-5 initially was 12 which decreased to 5 after the lecture, for the range 6-9 it was 3 before lecture and after lecture it increased to 8, for the range 10-12 it was initially 0 but increased to 2 after the lecture.

Section – II

Assessment of experimental group

Table 2

Overall results of Knowledge based and comprehension based tests of experimental group

No.of students	**Performance**	Mean score K.B.Qs	Mean score C.B.Qs	T_{cal} for K.B.Qs	T_{cal} for C.B.Qs
15	Before lecture	6.73	5.4	1.85	1.86
	After lecture	17	11.53		

K.B.Qs = Knowledge based questions C.B.Qs= Comprehension based questions df = 14 T_{tab} at 0.05 level of significance = 1.761

Results of table 2 show that mean scores of this group before lecture for Comprehension based and knowledge based tests were 5.4 and 6.73 respectively. These were improved to 11.53 and 17 respectively after the lecture. T_{cal} values for C.B.Qs and K.B.Qs were 1.86 and 1.85 respectively which were greater than T_{tab}.

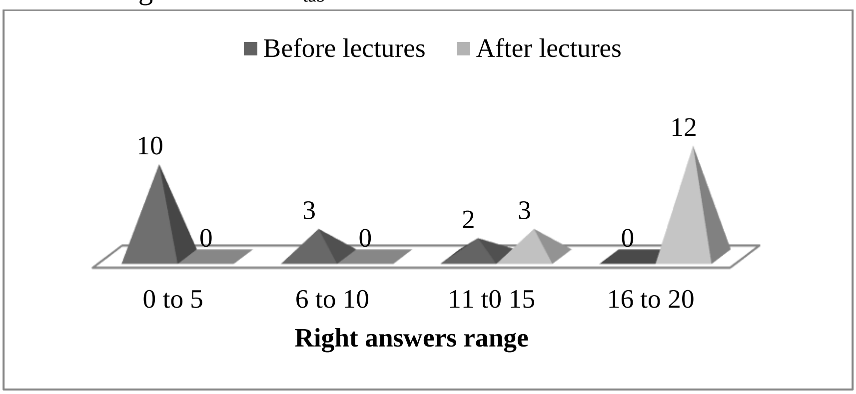

Figure 3: Comparative representation of K.B.Qs results of experimental group

The number of participants of the test group initially for giving right answers of K.B.Qs in range 0-5 was 10 which decreased to 0 after the lecture, for the range 6-10 initially the frequency was 3 which decreased to zero after the lecture, for the range 11-15 it was initially 2 which increased to 3 after the successful completion of the study. The initial assessment showed that none of the participant was in range of 16-20 but it increased to 12 after the lectures.

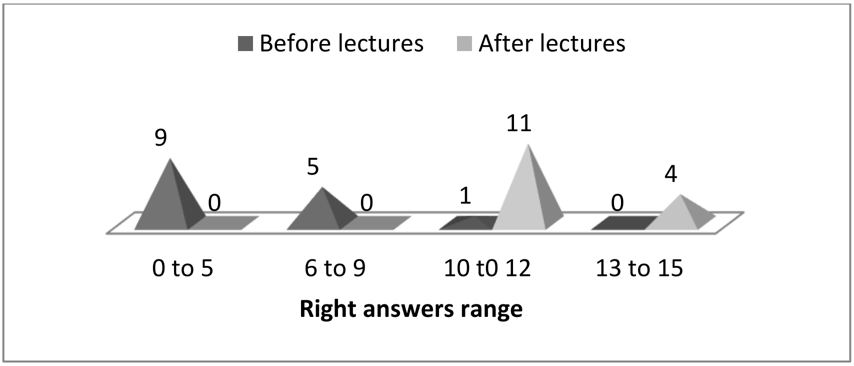

Figure 4: Comparative representation of C.B.Qs results of experimental group

The performance of these participants in answering C.B.Qs varied in such way that the frequency in the range group 0-5 initially was 9 which decreased to 0 after the lecture, for the range 6-9 it was 5 before lecture and after lecture it decreased to 0, for the range 10-12 it was initially 1 but increased to 11 after the lecture. Before the start of lectures the frequency of the range 13-15 was zero which increased to 4 after the lectures.

Performance of Participants of Institute 2

The control group comprised of only 10 participants while the experimental group was made by 11 participants of this institute. According to the data of initial assessment none of the participants of both the groups was able to score right answers of K.B.Qs between 16-20 and C.B.Qs between 13 -15.

Section-I

Performance of control group

Table 3

Overall results of knowledge based and comprehension based tests of control group

No.of students	**Performance**	Mean score K.B.Qs	Mean score C.B.Qs	T_{cal} for K.B.Qs	T_{cal} for C.B.Qs

10	Before lecture	7.6	5	3.54	2.86
	After lecture	12.4	7		

K.B.Qs= Knowledge based questions, C.B. Qs= Comprehension based questions df = 9 T_{tab} at 0.05 level of significance = 1.83

Table 3 shows that there was a greater difference between mean scores of control group before and after lecture for the test of K.B. Qs and C.B.Qs. The T_{cal} values for K.B. Qs and C.B.Qs tests were greater than T_{tab}.

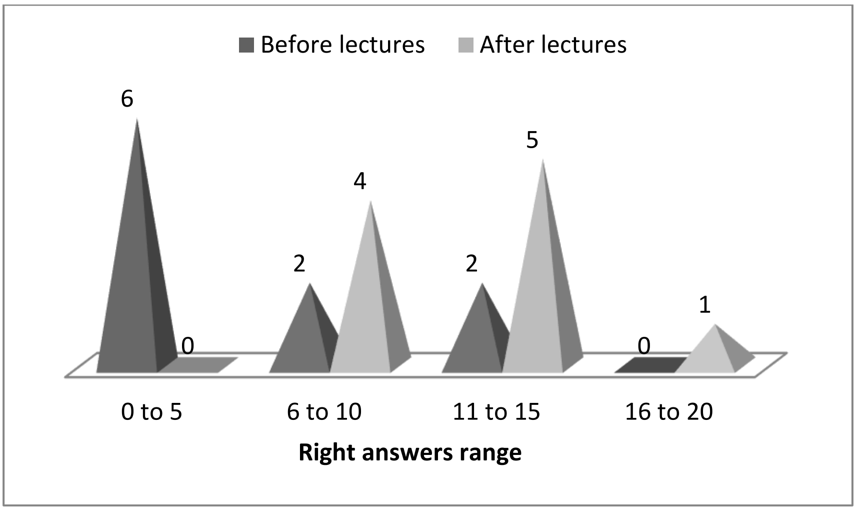

Figure 5: Comparative representation of K.B.Qs results of control group

The number of participants of the test group initially for giving right answers of K.B.Qs in range 0-5 was 6 which decreased to 0 after the lecture, for the range 6-10 initially the frequency was 2 which increased to 4 after the lecture, for the range 11-15 it was initially 2 which increased to 5 after the successful completion of the study.

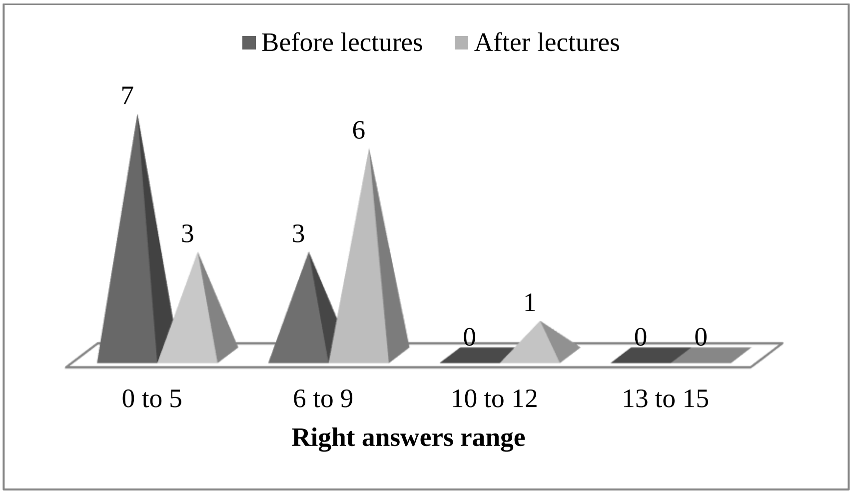

Figure 6: Comparative representation of C.B.Qs results of control group

The performance of these participants in answering C.B.Qs varied in such way that the frequency in the range group 0-5 initially was 7 which decreased to 3 after the lecture, for the range 6-9 it was 3 before lecture and after lecture it increased to 6, for the range 10-12 it was initially 0 but increased to 1 after the lecture.

Section-II

Performance of experimental group

Table 4

Overall results of knowledge based and comprehension based tests of experimental group

No.of students	**Performance**	Mean score K.B.Qs	Mean score C.B.Qs	T_{cal} for K.B.Qs	T_{cal} for C.B.Qs
11	Before lecture	8.4	5.9	1.63	1.25
	After lecture	17.7	12		

K.B.Qs = Knowledge based questions C.B.Qs= Comprehension based questions df = 10 T_{tab} at 0.05 level of significance = 1.812

Results of table 4 show that mean scores of this group before lecture for C.B.Qs and K.B.Qs were 5.9 and 8.4 respectively. These were improved to 12 and 17.7 respectively after the lecture. T_{cal} values for C.B.Qs and K.B.Qs were 1.25 and 1.63 respectively which were lower than T_{tab}.

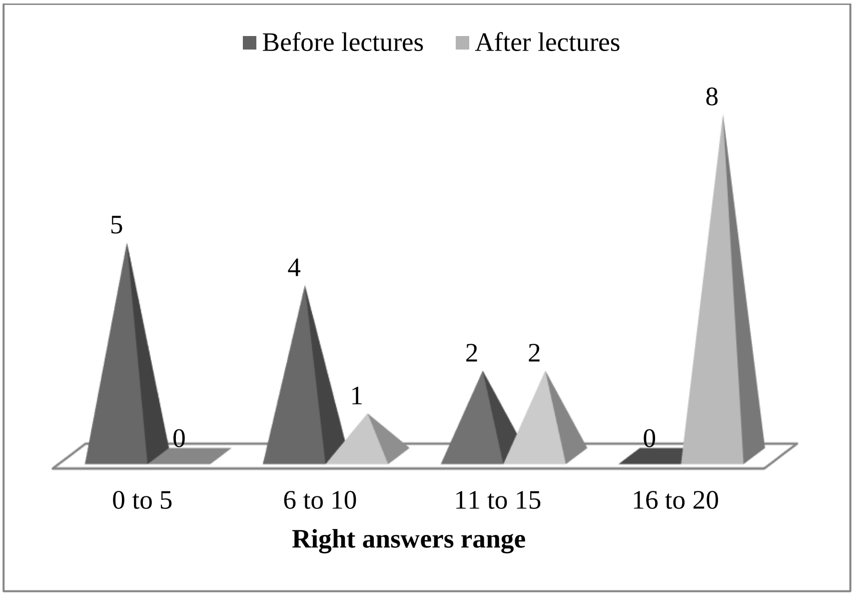

Figure 7: Comparative representation of K.B.Qs results of experimental group

The number of participants of the test group initially for giving right answers of K.B.Qs in range 0-5 was 5 which decreased to 0 after the lecture, for the range 6-10 initially the frequency was 4 which decreased to 1 after the lecture, for the range 11-15 it was initially 2 which remained unchanged after the successful completion of the study. The initial assessment showed that none of the participant was in range of 16-20 but it increased to 8 after the lectures.

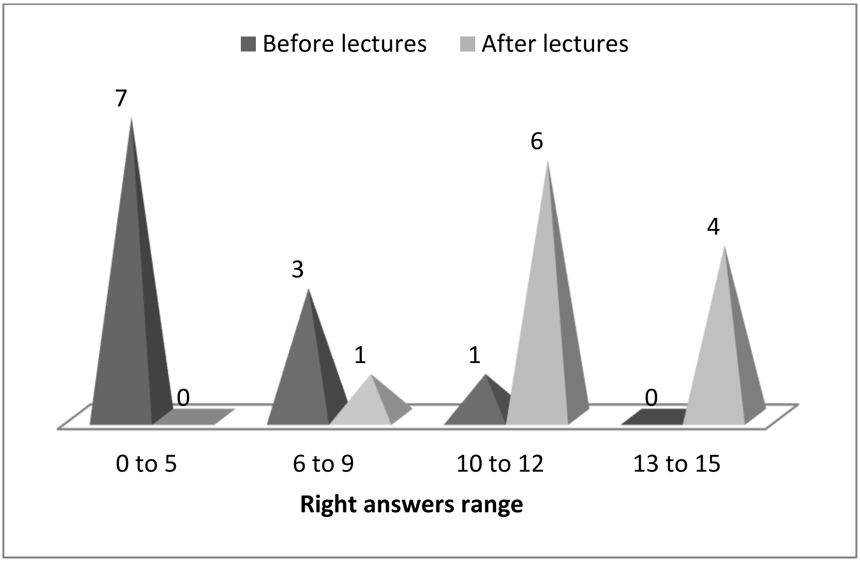

Figure 8 Comparative representation of C.B.Qs results of experimental group

The performance of these participants in answering C.B.Qs varied in such way that the frequency in the range group 0-5 initially was 7 which decreased to 0 after the lecture, for the range 6-9 it was 3 before lecture and after lecture it decreased to 1, for the range 10-12 it was initially 1 but increased to 6 after the lecture. Before the start of lectures the frequency of the range 13-15 was zero which increased to 4 after the lectures.

Table 5

Effect of visual aids on knowledge level of participants

Mean scores of knowledge based tests of experimental groups		
	Institute 2	Institute 1
Before Lectures	8.4	6.73
After Lectures	17.7	17

The mean scores of participants of Institute 2 and Institute 1 were 8.4 and 6.73 respectively before lectures which improved to 17.7 and 17 respectively. Improvement in mean scores of participants of both institutes confirmed that visual aids have improved knowledge level of the participants as shown in the table 5.

Table 6

Effect of visual aids on comprehension level of participants

Mean scores of comprehension based tests of experimental groups		
	Institute 2	Institute 1
Before Lectures	5.9	5.4
After Lectures	12	11.53

Mean score of participants of Institute 2 was 5.9 before lectures and improved to 12 after lectures. Similarly mean score of participants of Institute 1 was 5.4 before lectures and improved to 11.53 after lectures. These results confirmed that comprehension level of students can be improved to significant level by using visual aids as indicated in the table 6.

Discussion

The core scheme of this work was to find out the impact of visual aids on learning of chemistry. The data analysis shows the favourable attitude of students toward the use of visual aids to learn chemistry in diverse ways. Visual aids are not only beneficial for students but also for teachers because by the use of visual materials. In the classroom, they can teach making the class thought-provoking. Different visuals can bring different variations in chemistry teaching which may draw the devotion of the learners toward the lessons. For example, if a chemistry teacher uses different pictures the classes becomes stimulus for learners to understand the theme of the topic. Therefore, it will always be better having something visuals for the students for their better performance. Gardner's (1993)suggested that there is a problem of multiple intelligence levels which means that all the students cannot learn in the same way because some are able to learn by watching while others can learn better by listening. The role of pictures in making lessons appealing was also acknowledged by Harmer (2001). He cited the recent textbooks along with the design of different newspapers which were intentionally designed to grab readers' interest. In the present research students were given lecture about acid rain. Before this lecture they were having no idea of acid rain and its effects. Those students who were given lecture with the help of pictures were able to understand the concept of the topic much better than who were given lecture without pictures.

Moreover, videos provide the students more opportunities to get engaged with the lessons. They become more capable of predicting the topic of the lesson. In addition to this, teachers may ask various questions to elicit concepts from the students about the text. In this way better class discussion opportunities are created which are very important for chemistry learning. For example, the idea of generation of ions and free radicals is difficult for students to understand with its true meanings. The present study focused to use videos of generation of ions and free radicals for test group. Their interest touched the heights of keenness as compared to those students who were taught without videos.

During the study PowerPoint presentations were also used to make idea of an atom and its fundamental particles more explicit. A class can be mad live by using PowerPoint slides because the lecture can be visualised easily. In case any part of lecture is missed then students can take notes taking help from the slides. The advantages of use of PowerPoint presentations were also emphasized by (Mutar, 2009). He mentioned that the teachers can make their class more dynamic and interesting if PowerPoint slides are used.

The contextualization of the lessons by using visual aids was mentioned as a great advantage by the students during the present work. With the help of visual aids teachers can create contexts and make the lessons effective. Furthermore, correlation between visual aids and concepts of lessons can easily be made by the learners. Moreover, visual aids leave a long-lasting impact on minds of the learners. Mathew and Alidmat (2013) also found that visual materials can make lessons easy to comprehend. Images which students view on the screen can be easily understood and remembered as compared to descriptive reading materials.

Findings

- Performance of students in chemistry at secondary level was improved by using visual aids.
- Visual aids improved knowledge level of students to a significant level.
- Comprehension level was also improved by using visual aids.

Conclusions

Literature visited during the research work, without criticism, has supported the effectiveness of visual aids in the chemistry learning as compared to only verbal communication. Apart from these outcomes, the study has also showed that only few participants were cognizant of visual aid effects on chemistry learning. It was found that learning of students in chemistry was improved only because of use of these visual aids but the institutes were with mere availability of these important aids.

Recommendations

Keeping in view the importance of visual aids in achievements of students in chemistry along with overall development of the students, following are the recommendations of imperative need.

- Infusion of usage of visual aids as a central teaching strategy in chemistry taught at secondary school level.
- The ministry of education must give unambiguous strategy for making the use of visual aids compulsory in chemistry teaching.
- Training exercises for chemistry teachers at secondary school level to get familiar with the effective usage of visual aids must be organized by the concerned authorities.
- School management should contact the organizations which provide these visual aids free for poor and needy students.
- Chemistry teachers must visit the research journals for better understanding of chemistry concepts and new developments and innovations.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institution and/ or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

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