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## Learning Elementary Science through Technology: Conceptualization of Usage of Videos By Students

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**Abstract:** Video Based Learning (VBL) is one of the most unique ways of making learning as a fun. Effective and attractive. Video-based learning is considered an effective way and strategy for teaching science as this subject is being taught traditionally through the chalk and talk and lecture method. A number of studies have been done to investigate the use of videos in science teaching learning to show the positive effect of videos on the teaching and learning process, especially in the science at the elementary level. The main focus of the study were to find out the effectiveness of the practice of Video-based learning in the elementary science classrooms. This study was carried out at one of the elementary schools of the Sukkur Sindh. The design was qualitative in nature. The population of the study was all students of grade 8 who are 27. Unstructured interviews were used as a research tool. By adopting convenience sampling ten elementary-level students were selected. Thematic analysis was used as data analysis technique. The findings of the study revealed that Video-based learning in science makes learning easy, effective, retentive. It creates an active classroom environment, which is needed in this modern era. This study concluded that teachers do not use videos in their classroom practices, resulting in students and teachers taking this subject a little bit more difficult. It was concluded that video-based learning is an effective way of learning. It was suggested that VBL could be practiced by the teachers if they had a fully trained teacher who used VBT as a learning tool instead of a way to play movies.

**Key Words:** Science Teaching, Science Learning, Technology, Videos, Students

### Introduction

According to Grünwald, Meinel, Totschnig, and Willems (2013), Videos have been considered an excellent way of engaging students in learning and have gotten importance in education as it provides an important content-delivery tool in many flipped, blended, and online classes. The Effective use of video in education has become a tool for learning enhancement. For that, teachers should consider three elements: 'how to manage the cognitive load of the video, how to maximize student engagement with the video, and how to promote active learning from the video. Educators can integrate videos for supplemental and instructional content by making appropriate choices in video selection(Brame, 2016).

Videos are used in classrooms to show students science experiments that they cannot perform in the school due to the lack of resources, lack of science laboratory and other reasons. Videos make science classroom learning fruitful and meaningful, and students take it as fun. Videos help students to explore the world near or far. Moreover, students can search out the videos from all over the websites on any of the topics they want to learn. In this way, they can cover a wide range of scientific topics. In science, there

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are many abstract concepts that students cannot understand only by listening to the lecture. For example, Global warming, Water cycle and so on. In order to understand such topics, teachers can visualize these concepts by allowing them to watch videos on these topics (Allgaier, 2013). It cannot be denied that online digital videos are being watched globally, and these sites, for example, YouTube, Metacafe, and Vimeo, are used by millions of people.

The videos are being utilized by the students as a learning tool, which is changing everything. Thanks to the availability of educational videos, abstract concepts have now become understandable and meaningful, which seemed difficult previously. 92% of the population watches and uses digital videos for educational purposes, which is remarkable. It has been identified that the usage of educational videos makes students more efficient in processing and understanding any concept (Saxena et al., 2008) as videos visualize the concept due to the visual and auditory nature of videos. Therefore, it helps students and appeals to them to learn in a natural way. The use of videos is not only helpful or beneficial for the students, but it is also helpful for the teachers.

A study conducted in 2015 found that 93% of teachers believe that the use of educational videos enhances the teaching and learning process as it can break down the barriers to learning. For example, lack of resources, access to the laboratory and so on. This results in educational institutions being unable to meet their objectives, but these barriers can be broken down with the usage of videos. Institutions or schools can also create their own videos using different websites and software wares, or they can contract with a company that can provide them with videos according to the student's needs (Sinha et al., 2014).

### Statement of the Problem

In Pakistan's current situation, it has been observed that students are facing many difficulties in their science learning. Students considered this subject difficult to teach and learn. This problem has been identified in many studies. However, there are many researchers who suggest implementing effective strategies for teaching and learning science to make it clear and understandable. One of those strategies is the use of videos in science subjects to make it visual and clear for the students in order to promote better learning. Considering this problem faced by the students and teachers, this study aims to find out the effectiveness of videos in science teaching.

### Objectives

The following are the objectives of the research.

1. To identify the practice of Video-based learning in the elementary science classrooms of the Public School of Sukkur.
2. To recognize the effects and usefulness of video-based learning in science classrooms.
3. To find out the effectiveness of Video Based Learning in elementary schools on the subject of science

### Research Questions

What are Educational videos?

### Following were the Research Questions of the Study

1. What is the impact of videos in science elementary classrooms?
2. How do videos help in science teaching?
3. How are videos helpful in science learning?
4. What are the possible implications of video-based learning?

### Review of Literature

In this era of modernization, technology is playing an important role in every field, especially in the field of education. Teaching and learning have become successful and effective due to the usage of technology (Brame, 2016). Science is considered the core as well as the difficult subject in the curriculum due to its abstract concepts. Students opt for science subjects because they are related to their lives, but when they take classes, their motivation decreases as they don't get the concepts clearly when they are taught through

traditional methods of teaching, i.e., lecture methods. This problem has been resolved in many developed countries by integrating ICT in education in general and in science subjects in particular (Bartolomé et al., 2017).

### **Use of Videos in Education**

Educational institutions can benefit their students and can fulfil their learning needs by integrating videos into the teaching and learning process. Educational videos help students as well as teachers to make effective learning environments. Furthermore, Teachers can make effective use of it for the course content delivery. These videos can be accessed and watched by students several times for a better understanding of the concept (Dong & Goh, 2015).

### **Use of Videos in Science Teaching**

Teaching science subjects is considered a complex process, and it is difficult for them to be updated in their dynamic profession. Therefore, it is important to grow in their field and put in continuous effort.

Videos are considered to be effective sources of teaching science. Videos can make abstract concepts understandable (concrete) as students can visualize the concept easily. Not only do they understand concepts easily, but they also take an interest in their learning (Allgaier, 2013). Though videos can never replace the personal dynamics between students and teachers, they can be used to increase learners' motivation and curiosity for learning. If the teacher has access to technology, then they can ask students to watch videos on any science concept and ask for their reactions to videos. Moreover, videos are also beneficial in a situation where the teacher discusses any science concept and students start discussing with each other by ignoring what the teacher is teaching in the classroom. So, it is good to show them video a short video clip and ask for a discussion on the video (Tucker, 2012).

### **Benefits of Using Videos in the Classroom**

There are numerous benefits of using videos in Education. The benefits of the usage of educational videos have been highlighted below (James et al., 1999).

#### **Benefits to Students**

1. Videos create a fruitful and meaningful learning environment in the classroom. It enhances students' sensory skills when they watch videos rather than just listening to the teachers and reading from books.
2. Students can visualize abstract concepts and process them in their minds. Students learn and understand better when they see the pictorial form of any concept.
3. Educational videos can be watched for any subject. There are many videos available on the internet for every subject. So, every information related to their subject or query is at their fingertips.
4. They can watch videos several times and pause and resume that video when they don't get the idea. However, they feel hesitant to ask the teacher any questions.
5. All subjects can be learned through videos, but videos help students in the most complex subjects, for example, science, mathematics, etc.
6. It also improves students' computer skills, which are required for the 21<sup>st</sup> century.
7. Videos help students to boost their achievement and process the information step by step.

#### **Benefits to Teachers**

1. It helps teachers in terms of flexibility in that they can pause the video at any time, discuss it with students, and ask questions as well.
2. Teachers can create flipped classrooms using videos in the classrooms.
3. It also helps teachers who believe in the traditional teaching approach.
4. It also helps teachers to create a flipped or blended classroom environment.
5. Teaching through videos provides remote learning opportunities where students can be reached by teachers from all over the world.

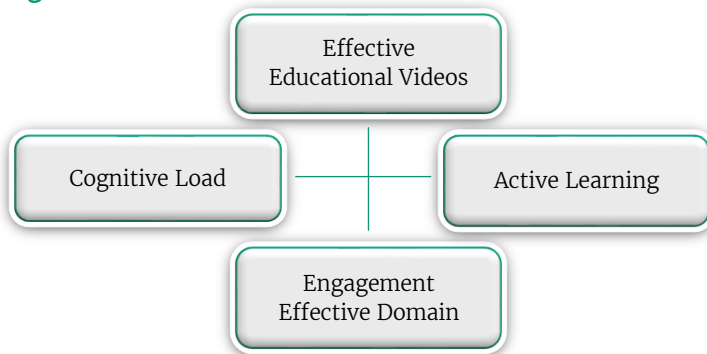


6. Videos help in changing teachers from lecturers to facilitators who only facilitate students by providing guidance. It is important to understand that videos cannot replace course material. Rather, these just help to understand coursework in a better way.
7. Videos help teachers increase their intrinsic motivation as they increase their interest in teaching science.

### Using Educational Videos in the Classroom: Theory, Research and Practice

Brame (2015) identified that the area of cognitive science focuses on the information processing of the human mind. It has been found that when students are taught through videos, they learn visually, auditory, and verbally, which enables them to make associations that help them recall their memory. This fact is undeniable: our culture is being influenced by digital videos. This widespread platform of influence leads to education as videos are now being used in educational settings.

Figure 1



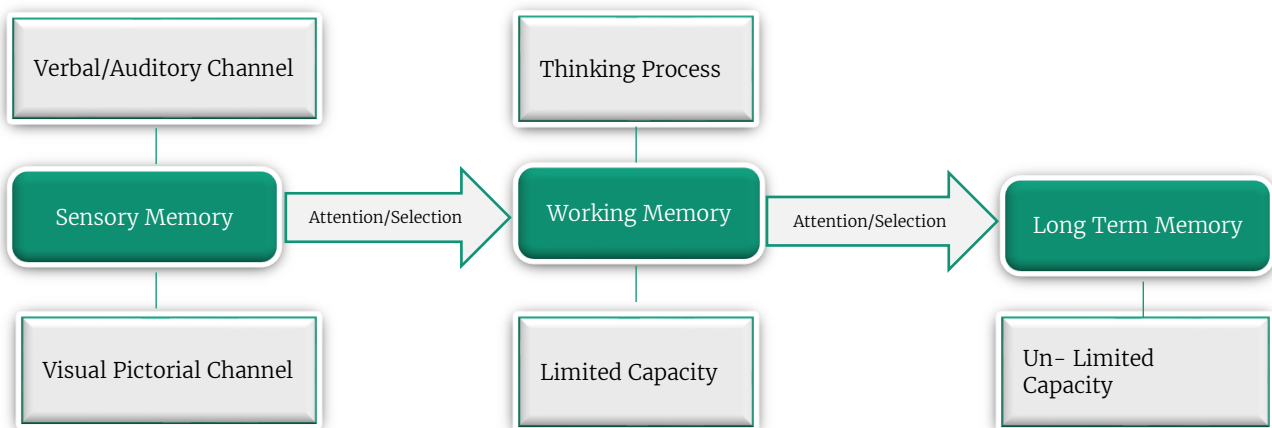
Instructors should consider three components of videos in order to enhance the productivity of learning through videos. Firstly, Cognitive load; secondly Non, non-cognitive elements that affect engagement; thirdly, the features that enhance active learning. These three components are considered as a basis for the use of videos and their development in educational settings.

### Cognitive Load

Cognitive load theory has been given by Paas and Van Merriënboer (1994) as they suggest that memory has some important components, which can be seen in the figure given below.

Figure 2

Cognitive load theory



Cognitive load theory suggests that there are three components of any experience of learning, as mentioned in the above picture (Paas & Van Merriënboer, 1994).

## Cognitive Theory of Multimedia Learning

This theory about multimedia learning is based on the theory of cognitive load, which states that the memory that works has two stations for acquiring and processing information: the visual / picture channel and the auditory/verbal processing channel. Although the capacity of each channel is limited, the use of these channels helps in the integration of new information into existing intellectual structures. By using two channels simultaneously, working memory capacity would be the maximum use, but any one channel may be drowned by high cognitive load. Therefore, the design strategy for managing the cognition load of these two channels in multimedia learning materials helps in enhancing learning (Ibrahim et al., 2012). In addition to the two key hypotheses of dual-channel processing and limited working memory, multimedia learning cognitive theory describes any goal of learning as "meaningful learning", which requires cognitive processing, including attention to the displayed material. Psychologically, the presented material is organized into a coherent structure, and the presented material is combined with existing knowledge (Brame, 2015). These theories give rise to some suggestions about educational videos. There are four effective practices based on the premise that an effective learning experience can minimize the external cognitive load, optimize the cognitive load of the Germans and manage the inner cognitive guidance(Ibrahim et al., 2012).

**Signalling:** Signalling, also known as a prompt, is to highlight important information using text or symbols on the screen, for example, by the emergence of two or three keywords (such as colour or contrast changes to provide a signal or draw attention to the sign of the screen area(Ibrahim et al., 2012). Highlighting key information helps to direct the learner's attention to a specific element of the video as a target for processing in the working memory. This can reduce unnecessary burdens by helping novice learners identify which elements in complex tools are important tasks and can also increase related burdens by emphasizing the organization and connection of information. (Yung & Paas, 2015)showed that this method improves the ability of students to retain and transfer new knowledge of animation, showing that these effects extend to video.

**Segmenting:** This is a block of information that allows learners to handle small fragments of new information so that they can control the flow of new information(Brame, 2016). In this way, it can manage the inherent load and can also increase the German load by emphasizing the structure of the information. You can complete the segmentation by making a shorter video and including a "click forward "pause in the video, such as using YouTube Annotate or Hap Yak to ask students questions and prompt them to click forward when they are finished. It turns out that both types of segmentation are important for students to participate in video learning and learn from video (Brame, 2015)

**Weeding:** is the elimination of interesting but insignificant information from the video, that is, information that does not help the learning goal. For example, extra features in music, complex backgrounds, or animations require the learner to determine if they should be looked at, which adds an extra burden and reduces learning. Importantly, as learners shift from novice to expert status, the information that adds to the unrelated load changes. That said, information that may be irrelevant to a novice learner may actually be helpful to a learner like an expert, while information that is essential to a novice may be distracting to an expert for a long time(Brame, 2016). Therefore, it is important that teachers, in addition to educational videos, consider their learners, including information necessary for its processing, but they do not need to eliminate the learning objectives and may make work memory overload information. (Brame, 2016)has shown that this approach can improve the retention and transmission of new information in video.

**Matching Patterns:** This is considered the process of using both audio/language channels and visual/picture channels to convey new information, making a specific sort of information suitable for the most appropriate channel. For example, two channels are used to illustrate the process while telling the story while displaying the animation on the screen, providing a dual and complementary flow of information for learners to highlight the features that should be handled in working memory. Instead, both animated and printed text are displayed using only visual channels, overloading the channel and hampering learning (Mayer & Moreno, 2003). In another example, using the "chatter" video explains the



complex process can only be an effective use of verbal channels (because watching the speaker does not convey other information), and the Khan-style tutorial provides a sketch of the symbols to illustrate the use of verbal interpretation of the two channels provide additional information. It has been shown that the use of both channels to convey appropriate and complementary information can improve retention and messaging skills among students (Mayer & Moreno, 2003) and increase student engagement with video (Thomson et al., 2014; Guo et al., 2014).

### Student Participation/Engagement

The most important aspect of making an educational video is the inclusion of elements that help promote student engagement. If students don't watch the video, they won't be able to learn from them. Early research into multimedia teaching and the latest research into the use of video within MOOCs have produced experiences that facilitated student motivation, engagement and retention.

### Length of the Video

Guo and colleagues examined the length of time students watched streaming video in four edX MOOCs, and analyzed the results of 6.9 million video viewing sessions (Saxena et al., 2008). They observed that less than six minutes of video had an average engagement time of nearly 100%—that is, students tended to watch the entire video. However, with the extension of video time, student engagement has decreased, so the average participation time for 9–12 minutes of video is about 50%, while the average participation time for 12–40 minutes of video is about 20%. The maximum median interaction time for a video of any length is six minutes. Therefore, a video production time of more than 6–9–9 minutes may waste a lot of energy.

- Use the dialogue style. The principle of personalization is Richard Meyer. The informal language used in multi-media teaching has had a big impact on students' learning, perhaps because the conversational style encourages students to build social partnerships with narrators, leading to greater engagement and effort (Saxena et al., 2008).
- Speak relatively quickly and enthusiastically; in a study of student engagement with MOOC videos, Brame (2015) observed that student engagement was dependent on the narrator's rate of speech and that student engagement increased as the rate of speech increased. It may be tempting for the video narrator to say slow words to help ensure that the student grasps important ideas, but including in-video questions, "chapters", and speed control allows the student to control this feature, and increasing the speed of the narrator seems to facilitate the student's learning Benefits.
- Make sure the materials are suitable for these students in the class; for teachers, one of the benefits of creating an educational video is the ability to reuse it for other classes and other semesters. When reusing a video, be sure to package it with text outside the video to associate it according to the specific category in which the video is used. In addition, it's important to make them for the sort of environment in which they have been used. Guo and colleagues examined student engagement with MOOC videos created by shredding video lectures recorded in face-to-face lectures (Sinha et al., 2014). Students are much less engaged than when considering creating a lecture in a MOOC environment.
- Game mode: While this consideration is vital for managing cognitive load, it's also associated with promoting student engagement. When storytelling, showing the face of the storyteller or showing the story animation is very effective. The Khan Academy-style video is especially useful when solving problems and can teach students step-by-step how to solve problems. In teaching invisible phenomena, it may be helpful to provide illustrations. In each case, providing visual elements added to the course not only promotes the student's understanding but also participates in the course (Sinha et al., 2014).

### Active Learning

To help students get the most out of their educational videos, it is important to provide tools to help them process information and monitor their own understanding. There are several ways to do this effectively.

Grünewald et al. (2013). Studied the impact of instructional questions on students' learning through an introductory psychology course video on social psychology. Lawson, Bodle, Houlette, and Haubner (2006) let students in some parts of the course watch videos without special instructions, while students in other parts of the course receive eight guiding questions for viewing. Students who answered instructive questions while watching the video scored much higher on the video test later.

Use interactive features that students can control. Brame (2016) compared the impact of interactive and non-interactive video on student learning in computer science courses. Students who are able to control motion through video, select important parts to review and move backwards when needed demonstrate better learning outcomes and greater satisfaction. One simple way to achieve this interactivity is to introduce a tagged "chapter" into a video using YouTube Annotate, H5P, or another tool. This not only has the benefit of giving students control but also can demonstrate organization and increase the critical juncture of the course (Lawson et al., 2006). It was found that the videos were valuable to the student compared to the one-semester that did not use these videos together with the assignment and that the videos improved the student's understanding of difficult concepts. Mary worked with Kathy Friedman to develop video and follow-up questions as pre-lesson preparation for the genetics course. While there is no significant change in learning outcomes in the classroom, students see the video and post-video questions as learning tools and believe that they can be effective in promoting student understanding (Lawson et al., 2007). Integrate the problem into the video. Tools such as the H5P allow teachers to integrate problems directly into the video and give feedback based on the student's reaction.

Lawson et al. (2007) suggest the important thing to remember is that watching a video, like reading, can be a passive experience. In order to make the most of our educational videos, we need to help students process and self-evaluate the learning that leads us to want to see. The specific mode of operation should be guided by the course objectives and discipline specifications.

## Methodology

### Research Design

Qualitative research has been used to conduct this study in the field because qualitative research is a research design used to collect and work with non-numerical data, give insight, and provide in-depth information and understanding of any life experience or phenomenon.

### Population of the Study

A total of 132 Science students studying in secondary grades (6-8) have been selected for the data collection for this study because this research aims to conceptualize the use of videos in elementary science classrooms. Therefore, data was gathered from the science students in elementary grades.

### Sample of the study

A total of 10 students from the 7<sup>th</sup> and 8<sup>th</sup> grades have been selected from the whole population using a purposive sample in order to gather data from these participants.

### Sampling Technique

A purposive sampling technique has been used for this study as the purpose of this study is to conduct a study on science students. Therefore, in grades 7<sup>th</sup> and 8<sup>th</sup>, only science students have been selected from the Public School Sukkur.

### Data Collection Technique

Data has been collected through semi-structured interviews from the participants because semi-structured interviews are the types of interviews in which the interviewer does not follow the structured questions but allows the interviewee to participate in the discussion rather than asking stay-forward questions. So, Open-ended questions have been asked from the participants in order to get an in-depth understanding of the participants.



## Data Analysis

Data has been analyzed through thematic Analysis as it focuses on the identification, Analysis and interpretation of the patterns and gives meaning to the qualitative data. Therefore, themes and codes have been generated from the transcribed interviews and provided with interpretations supported by the literature review.

## Data Analysis

For the Analysis of data, thematic Analysis was used. Following are the themes and their Analysis

### Videos as a main Source of Learning of Science Subject

While responding to question no 1 of the interview, one of the participants responded *"Yes, videos play a vital role in science learning because we can visualize the concepts which cannot be understood through the lecture as there are some difficult concepts and topics in science. However, we are not taught through this method. We are just taught through lecture; the science teacher comes in the class and just uses blackboard for teaching but does not use pictures and videos"*. Nonetheless, the literature suggests that videos are a meaningful source in the teaching and learning process as they help students understand abstract concepts easily. Moreover, it has been suggested that videos increase students' engagement and help in the achievement of good results. Videos also boost students' achievement. Moreover, they remember and understand the concept lifelong because when students see and visualize pictures and objects, they understand and comprehend them better.

### Use of Videos as Audio Visuals to Develop Students' Interest towards Science

One of the participants also responded in the same way: *"When we watch any video in the classroom or outside of the classroom, it develops our interest because pictures and videos, colour and cartoons attract us, and we don't get bored while watching videos. The second respondent also highlights that "whenever I watch videos, it helps me visualize the concepts. It gives a clear picture of the concepts that are difficult to understand through lecture."* One of the studies also highlights that video-based learning helps students visualize how something works. Videos also give information in pictorial form in order to explain science concepts. Moreover, it has been suggested by one of the studies that videos in science classrooms attract students' attention. Abstract Concepts become concrete when students are taught through audio-visual aids.

### Videos as a Source of Communication and Collaboration

One of the respondents says that *"videos are helpful in engaging students and create a learning environment where we can communicate, collaborate with other students as we watched videos today on the Water cycle and food chain. After watching videos, you allowed us to discuss with each other, so this helped us to develop our communication skills as well as we got cleared these concepts."* Another respondent highlights that *"we are not taught through videos in our science class, but when you showed videos on science concepts these concepts were understood by me in a better way. We have already been taught the water cycle just through the lecture method, so it was not as clear before. After watching the video on the water cycle that you showed us, the concept is clearer, and I can also explain it to others in a better way. -----* suggests that videos can be used in an active as well as passive way. When teachers just show students videos and don't take pauses, do not ask questions, do not allow them to talk and discuss, and do not allow students to question, then the use of videos becomes passive and meaningful less. So, this strategy may be used in a way that causes classrooms to become places where students are active, not passive. Teachers can make it active by allowing students to discuss, question, and share ideas.

### Videos as Supporting Factor to Different Learning Styles

There are different students with different learning styles in educational settings. It can be identified from the responses of respondents as one respondent said, *"I learn more when I see the things rather than just listening from the teacher because I get a clear picture of the things illustrated in the video"*. Similarly, another participant said, *"I learn more when things are in pictorial or in audio form because we can see the whole process of anything, especially science concepts, step by step, and we can visualize each and everything by listening to the*



audio of it. Grünewald et al. (2013) Suggest that visual learners can learn best by reading a book or watching a demonstration or a video. They often need to see concepts and facts through pictures, videos, charts and diagrams. One of the researchers reported that 65% of the whole population is visual learners.

### Videos as a Source of Discussion

Videos provide a forum for discussion where they can share their ideas on a video they have watched. As one participant discussed, *"In our whole experience of schooling, we have watched video only twice, and that experience of watching videos was very good as the teacher allowed us for the discussion at the end, which helped me to share my ideas with others about that topic and I also got different ideas from the other class fellows which improved. The discussion also improves communication and collaboration as well as confidence levels.* Majekodunmi and Murnaghan (2012) discuss that videos improve communication among students and give time to students to reflect, share, and discuss with their class fellows. This helps them to learn what they have comprehended from the video, but they can also get the others' ideas to have been comprehended.

### Videos as Flexible to Pause and Resume

Videos are considered effective when it comes to facilitating. As one of the students said, *"Videos are helpful because I can pause it wherever I want, whereas when the teacher teaches us, we hesitate to interrupt and ask questions during the lecture. Therefore, it is good to learn from the video rather than other methods as we can pause and result in the videos"*. It has also been mentioned in the studies that videos are flexible as they can pause and resume the video until they understand the concept of science. This flexibility helps students learn the concept step by step; not only can this, but students also connect to the activist world (O'Hagan, 1995).

### Findings and Discussion

From the Analysis of the data, it was found that

1. videos are helpful in teaching and learning science, as the literature says that videos play a vital role in conceptualizing the topic better for students. When they watch videos, they learn more because they can visualize the abstract concepts that are not clear to them through lectures or another strategy.
2. Similarly, the responses of students also suggest that science learning occurs better when they are taught through the strategy of using videos. It can also be analyzed from the data that students get motivated to learn rather than when they listen to the teachers because they hesitate to ask questions from the teacher during lectures. However, they can pause and resume the video when they feel needed.
3. Moreover, videos are a source of motivation for the students as the colourful pictures, moving objects, and cartoons attract students, and they don't get bored or sleepy while watching videos on science subjects. Therefore, videos should be used in the classrooms for teaching and learning.
4. However, it can be accessed from the students' answers that the teachers in their school who teach science don't use videos for teaching. This practice has been implemented only once or twice. When the videos were shown by the researcher before data collection on science topics, then the results were very good as they were unable to answer the questions from the topic they watched videos on. For example, they were shown a video on the water cycle and another video on the food cycle in order to check the difference between understanding the topic through the lecture method and after watching videos. So, the results were in favor of videos, as can be seen from the data analysis portion. So, this approach of using videos in science classrooms should be used by science teachers as they can improve the teaching and learning process, but unfortunately, this practice is not being implemented in the school where this research has been done.



## Conclusion

According to the findings, it was concluded that

1. video-based learning has not been promoted in schools for science teaching. However, when students were shown some videos on science concepts, they were more able to understand concepts than when they were taught through other traditional teaching methods. Teachers do not integrate video-based learning in the teaching and learning process where this study has been conducted.
2. On the other hand, the literature suggests that videos have long been an excellent way to engage students. When it comes to science, today's online videos take us places far beyond field trips. They show us science experiments that you just can't do in the real classroom. They help answer the eternal "Why does it do that?" question. In short, they make science learning fun and meaningful.

## Recommendations

It was recommended that Video-based learning be used for better results in science as this is the major subject and the subject related to their life. The purpose of teaching science courses remains meaningless when students are unable to clear the concepts that they are being taught. Not only this, videos help students take responsibility for their own learning. The quality of education may be improved when such types of effective strategies are being applied.

The implication of This research is that it gives a clear idea to other researchers for future research. It will also be helpful for the teachers as they can identify the gaps and implementations of videos in science classrooms.

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