EFFECTIVENESS OF USING KNOWLEDGE CLIP ON STUDENTS' ENGAGEMENT AT HIGHER SECONDARY SCHOOL LEVEL

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NATIONAL UNIVERSITY OF MODERN LANGUAGES
ISLAMABAD

OCTOBER, 2021

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B.Ed (Hons)., Fatima Jinnah Women University, Rawalpindi, 2017

A THESIS SUBMITTED IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Philosophy In **Education**

To

DEPARTMENT OF EDUCATION,
FACULTY OF SOCIAL SCIENCES

NATIONAL UNIVERSITY OF MODERN LANGUAGES, ISLAMABAD

NATIONAL UNIVERSITY OF MODERN LANGUAGES FACULTY OF SOCIAL SCIENCES

THESIS AND DEFENSE APPROVAL FORM

The undersigned certify that they have read the following thesis, examined the defense, are satisfied with the overall exam performance and recommend the thesis to Faculty of Social Sciences for acceptance:

Thesis Titled: Effectiveness of Using Knowledge Clip On Students' Engagement at Higher Secondary School Level

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Master of Philosophy
Degree Name in Full

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Candidate of **Master of Philosophy** at National University of Modern Languages do hereby declare that the thesis **"Effectiveness of Using Knowledge-Clip on Students' Engagement at Higher Secondary School Level**" submitted by me in partial fulfillment of M. Phil Degree, is my original work, and has not been submitted or published earlier. I also solemnly declare that it should not, in future, be submitted by me for obtaining any other degree from this or any other university or institution.

I also understand that if evidence of plagiarism is found in my thesis/ dissertation at any stage, even after the award of a degree, the work may be cancelled and the degree revoked.

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ABSTRACT

Title: Effectiveness of using knowledge clip on students' Engagement at higher secondary school level

This study aimed to investigate the effectiveness of Knowledge Clips (Kcs) on students' engagement at the Higher Secondary School level. This study was focused on investigating the effectiveness of KCs on students' in-class engagement, including Cognitive, Emotional, and Behavioral Engagement. Comparison of in-class engagement of control and experimental group, assessment of the difference in pre-test and post-test scores of the control group and comparison of engagement scores of the experimental group before and after an intervention was investigated in this study. A quasi-experimental research design by following a non-equivalent group pre-test post-test design was used. A mix-method approach was adopted for data collection. The sample includes 43 first-year Biology students from one college of Rawalpindi for each control and experimental group which were selected through a purposive and convenient sampling technique. Independent t-test, dependent t-test, and percentages were calculated for quantitative data analysis. Whereas, thematic analysis was done for qualitative data. The results of the study indicated the effectiveness of Knowledge-Clip on students' in-class engagement including Cognitive, Emotional and Behavioral engagement in Biology course at the Higher Secondary School level. Moreover, it is recommended to utilize Knowledge Clips instead of third-party videos for engaging students within the class. Teachers may include thought-provoking questions, appealing colors, text, pictures, and animations within KCs for improving the in-class engagement of students. Trainings may be provided to teachers regarding creating KCs by using easy software's like PowerPoint.

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LIST OF ABBREVIATIONS

KC	Knowledge Clip
HSSC	Higher Secondary School Certificate
ICT	Information Communication Technology
IT	Information Technology
UNESCO	United Nations Educational, Scientific and Cultural Organization
CE	Cognitive Engagement
EE	Emotional Engagement
BE	Behavioral Engagement
CCTM	Campus Class Technology Model
CD	Compact Disk

ACKNOWLEDGEMENT

I owe my deepest gratitude to my research supervisor Dr. Wajeeha Aurangzeb for her expertise, her infinite hours of reflecting, analyzing, encouraging, and her patience during the whole process of research. I would like to say a special thanks to my closest one who always supported me and motivated me whenever I stuck and thought that I am unable to complete this work. I would like to thank the participants for taking part and their institute for permitting and arranging access. Finally, I would like to acknowledge my parents, teachers, and friends specially Annam, Bushra, Kazim, Laraib, Sarah and Sohail who always supported me, assisted me and assured me that I am capable of doing this challenging task.

DEDICATION

I sincerely dedicated this research work to my forever adoring parents and one of the most supportive person in my life for immeasurable love, support, and continuous encouragement, which made it feasible for me to complete my research work and strengthened me throughout every phase of my life. They have always stimulated me and contributed to making my learning an achievement

CHAPTER 1

INTRODUCTION

Educational Technology is growing day by day, three of its distinctive generations have passed and now recently the fourth one is emerging. This generation is focused on enhancing the students' interaction with their learning environment and learning materials by utilizing technology-based pedagogies (Murillo, Sánchez, & Godoy, 2019). Information and Communication Technology (ICT) is serving an important role in bringing novelties to the educational sector.

Information Communication Technology (ICT) consists of two parts; one is information technology and the other is communication technology. The merged form of these two technologies is known as ICT. There is no fixed definition of ICT but Ratheeswari (2018) explained that ICT is a mixture of computer-based networks, software, telephones, and all audio and visual elements and systems with having an aim that technology will be helpful for every institution in achieving their goals. Furthermore, it is also highlighted that ICT is a powerful means for information storing, transmitting, and manipulating. By using various ICT means we can quickly transmit information to a larger population within few seconds.

There are various forms of ICT tools that are being served as effective platforms for spreading and manipulating information. Computers, televisions, and smartphones are considered as most known tools of ICT. Developed countries like Japan, United Kingdom, and the United States are using these effective tools to bring revolutions in teaching processes and learning techniques. Using ICT for teaching and learning is a step that allows learners to do learning by doing through interacting with the learning materials personally (Uskov et al., 2018).

In the modern era of technology, every country is aiming to develop its future generation in a way that they become able to survive in the ever-changing needs of society and attain success in the development of the country (Ochilova, 2020). For surviving in a society whose needs are not fixed students' must be capable of solving the problems of their societies. That is why there is a need to inculcate problem-solving and critical thinking skills among students to make them able to think critically regarding challenges they are facing and developing a plan to deal with those challenges by using their problem-solving skills. ICT integration in education can serve an important role in improving students' critical thinking and problem-solving skills. Sarker et al., (2019) also explained that by using technology-based innovative teaching methods teachers can develop the minds of the students in a way that they can think critically and solve problems simultaneously.

The combination of ICT and education can also improve students' academic achievement, performance, and competencies. Comi et al., (2017) indicated in their study that if the teacher utilizes ICT tools properly in class, students will get engaged, learn better, their academic performance and achievement will be enhanced and it will also help in making students competent. Moreover, it is also indicated that ICT can enhance students' creativity and their level of understanding.

ICT-based education is not only beneficial for students but for teachers as well. It saves time and energy on part of the teacher. Moreover, enough time and energy allow teachers to make learning engaging and fun for students. Mostly, the teacher serves the role of a facilitator in ICT-based learning environments and pays more attention to the students and their learning needs. Furthermore, it can also enhance teachers' creativity and make them able to plan more interactive, engaging, and attention-gaining lessons for students (Khokhar & Javaid, 2016). Moreover, ICT is not

a magical tool that wipes out all of our problems regarding education and education systems but it helps the communities in molding their education systems effectively.

Now a day's using ICT-related tools in education is trending all over the world. Altbach, Reisberg and Rumbley (2019) indicated that European countries are focusing on digital means of education for making improvements in the learning experience of their students and making them more competent and favorable for the country. By utilizing digital means of teaching and learning developed countries like Spain, Malaysia and Japan indicated a great improvement in the academic performance and engagement of their students. With this dramatic change in society, the use of computers has been increased and computers have become the part and parcel of every home, workplace, and school (Zhang, Yang, Chang & Chang, 2016).

In addition to this, developing countries are also making efforts in improving their teaching and learning processes by using means of ICT but due to weak digital infrastructure, these countries are facing challenges in complete adoption of ICT and digital tools for education which cause a digital divide among developed and developing countries. The digital divide is a term that indicates a difference in the usage of ICT among developed and developing countries (Hennessy et al., 2016). Furthermore, ICT-based education is not possible without ICT-based tools like computers, multimedia, projectors, internet connection, etc. and developing countries do not have enough financial resources to provide these necessary tools for all of their educational sector. Gulati (2008) indicated in his study that Second Information Technology in Education Study (SITES) conducted a project and highlighted that developed countries are having more computers in educational institutes and easy access to the internet. In contrary to this, limited internet access and less number of

computers in educational institutes have been observed in underdeveloped or developing countries.

Pakistan as a developing country needs to bring a change in its educational sector for improving the teaching-learning quality for students. ICT is being served as a tool for making improvements in the educational sector, *National Education Policy Framework 2018* (2018) indicated that Pakistan is concerned about using ICT in education because it wants to improve the education system and to achieve better results. It is also indicated that the use of ICT tools like computers and the internet are the best solutions for attaining improved learning outcomes in less time. Furthermore, in this policy benefits associated with the use of ICT in Education are also discussed. Details of these benefits are as follow:

1. For enhancing teachers training, improving their content-relevant knowledge, and making them able to play an active role in the classroom, usage of ICT is the best option.
2. By using ICT in classrooms we can make our new generation capable of surviving in a workplace that is completely based on ICT.
3. For transferring new and unique knowledge to the teachers and students of remote areas ICT is considered a most powerful tool.

National Education Policy (2018) indicates that ICT-based teaching and learning promotes student-centered learning which follows constructionists' education methods and allows students to work freely, explore more, do experiments with the learning materials, and bring innovation in their work. If we want to implement this approach of learning in Pakistan we need to keep in mind the five points given by UNESCO for using ICT in education:

1. For improving teachers' teaching skills and students' learning ability ICT provides various learning resources.
2. For educating people anytime and anywhere ICT provides imminence to education.
3. ICT promotes independent learning beyond the boundaries of days and nights or
4. geographical locations.
5. By giving the facility of online libraries and distance education ICT facilitates collaborative learning
6. For giving access to education and information to students with having learning disabilities ICT is one of the best options.

Although National education policies are in favor of ICT usage in education still are facing challenges in implementing those policies because of which traditional methods of teaching are still common in Pakistan.

Teaching styles of teachers have a greater impact on students' performance and a teacher is a person who can use various strategies to make a boring lecture attractive for students. For producing highly skilled and quality learners' teachers teaching methods serves a vital role (Umer & Siddiqui, 2013). Moreover, Davis (2019) explained in his book that teachers adopt a teaching method as per their teaching style and teachers' teaching style involves personal behavior of teacher and tools utilized for transferring knowledge and getting information about the needs of the learners. Various teaching methods are present but most of the teachers can choose a teaching method as per their own choice. By getting the results of the students' performance a teacher can indicate that either the teaching method was appropriate for students or not.

The most common and old method of teaching is the traditional lecture method. It is simple and easy to deliver a lecture on various issues to a large group of students. In Pakistan, most of the teachers are still adopting this method however it has various drawbacks included students' inactiveness in the classroom, only communication on the part of the teacher, or one-way communication because the teacher only delivers lectures and students only take notes and because of students' least participation in this method they forget the concepts in less time (Raja, 2018). Furthermore, most of the students do not get engaged within the class and do not pay attention to what their teacher told them. Lack of engagement leads towards less concept clarity and understanding of students and it compels students to rote memorize the concept. When a student rote memorizes a concept he/she will not be able to apply that concept in a new situation. That is why it is necessary to engage the students in the classroom by utilizing various teaching methods that involve students' active participation. Traditional teaching methods are less engaging for students in contrary to this, modern teaching methods support the active participation of students within class and learning activities.

Modern methods of teaching are following the constructivists' approach which is in support of student-centered learning and aims to compel students for taking responsibility for their learning and constructing new knowledge based on the previous knowledge they have. Furthermore, Scrivener and Teaching (2005) explained in their book that in modern methods of teaching the teachers' most important role is to involve students in learning, monitor their progress, and instead of giving long explanations motivate students to take part in learning activities, ask questions and interact with other students, learning materials and with the teacher as well. As technology is intervening in every field of life and with the advancement in digitalization, technology-based

teaching methods also became a part of modern pedagogies. Digital learning or online learning is also a part of modern teaching methods which involve online means. Recently, flipped classroom approaches and blended learning approaches are the most common forms of modern online pedagogies (Gruba, Hinkelman & Cárdenas-Claros, 2016). The flipped classroom is a shift of in-class and homework paradigm because students watch concept-based videos from home and in-class time is utilized by the teacher for conducting activities only. In contrast to this in the blended learning approach, both in-class and online interactions are involved but no shift of classroom homework paradigm is involved (Gruba, Hinkelman & Cárdenas-Claros, 2016).

Knowledge consumption has become easy through smartphones, computers, the internet, and online media. Because of e-learning means especially internet now students can get access to knowledge not only within the class but also from their home or anywhere within no time (Kafyulilo, Fisser, Pieters & Voogt 2015). Blended learning is a form of modern learning which combines both face-to-face interactions of teacher-student and online components of learning (Picciano, 2014). Furthermore, blended learning is also referred to as a blend of traditional and technology-based pedagogies which help learners in achieving their goals (Picciano, Dziuban, & Graham, 2013). There are various formats of blended learning and teacher can adopt any of them as per his/her choice by keeping in mind the pedagogical context. One of its forms involves the use of some extra learning resources with in-class instructions. Moreover, using the internet for information with in-class instructions is also one of the formats of blended learning. In addition to this, dividing learning into specific percentages of online instructions and in-class instructions for enhancing students in dependent learning is also an effective format of blended learning. Blended learning modules are flexible and provide a choice to every college and university that they can modify their modules by

setting the percentage of in-class and online instructions as per their own choice (Graham, 2013).

One of the forms of distributed interaction is the video in education, which is getting popular in recent years. In blended learning, teachers can use effective videos for content delivery and use the rest of the in-class times for various attention-gaining learning activities. Video is a combination of sound, motion, and content in recorded form. In today's era of technology, it is easy for everyone to get access to videos and use multiple devices for watching those videos. In the past experts were needed to make videos but now everyone can make videos without requiring any special expertise. Today, the most common tools for recording videos are mobile phones, smartphones, iPads, digital cameras, etc. (Woolfitt, 2015). People can easily watch videos at any time, which is convenient for them. In addition to this, video is also playing an important role in facilitating various online courses (Duzenli, 2018). Recent modern and technology-based pedagogies considered video is of much importance and as per previous researches; the most important learning tool of the 21st century is video or video-based lectures (Inman & Myers, 2018). Videos can also be used to capture a lecture, demonstrate a skill, or make animated films (Woolfitt, 2015).

Video lecture includes video of a teacher in which he or she explains the key concept or gives numerous examples for better understanding of students (Scagnoli, McKinney & MooreReynen, 2015). Recently teachers are using and preferring not only online video lectures but also using videos in their classes. While recording a video teachers deliver the lecture in the same way as they deliver in the class usually the content and delivering strategy remains as same as the live lectures (Thomson, Bridgstock & Willems, 2014).

Video-based teaching and learning have many benefits, which include students' interaction with the content, learners can themselves interact with the content and try to understand it. Students involvement is another benefit of video-based teaching and learning because students can remember and grasp the concepts easily by watching videos (Seifert, 2019). In addition to this, teachers can achieve students learning outcomes effectively and enhance their satisfaction by utilizing educational videos (Yousef, Chatti, & Schroeder, 2014). Another benefit of educational videos is that students can get engaged in lectures by getting control of their learning and it has a significantly positive effect on students overall learning (Hung, 2015). Overall, video teaching is less time-consuming, cost-effective, and enjoyable for students (Woolfitt, 2015).

Various kinds of videos are available such as YouTube videos, Lecture capture, Screen casting, Khan Academy, and Knowledge Clip. 'Knowledge Clip' is also an effective form of the instructional video, which can be made by the instructor itself. It can be made either by a technician or by the lecturer itself. It is a 5-10 minutes' video clip, through which a teacher tries to achieve didactic goals (Guo, Kim, & Rubin, 2014). Knowledge clips have different types, Moes and Young (2013) suggested three types of Knowledge clips, which are introductory clips, skill demonstration clips, and modeling problem solution clips.

According to Schwartz (2013) Knowledge Clip is effective because a large concept or unit can be covered in less time. It is easy for students to grasp the concept by watching videos with animations and sounds. It is also effective for teachers because teachers will get more time for questions/answers and classroom activities. In addition to this, knowledge clip is efficient in providing answers to students' questions they can use these videos any time and get help in problem-solving. Furthermore, by utilizing a

Knowledge clip effectively we can promote independent learning among students which makes students more responsible (Moos & Bonde, 2016). Teachers can use the Knowledge clip for delivering a concept within few minutes instead of delivering a long boring lecture of 30-40 minutes. In addition to this, a Knowledge clip can also be used for demonstrating a skill like giving experiments demonstrations to students regarding Biology, Physics, and Chemistry subjects. Moreover, it can also be used as a problem-solving clip in which the teacher can guide students that how they can solve their problems.

Among various fields of educational psychology, one of the most important study fields is students' engagement in the classroom or at the campus level. Student engagement has no single universally accepted definition; it can be in the form of access and attendance, emotional engagement, or overall course engagement. Some people thought that engagement is just being active in a task but it is more than that. Instead of only being active in a task student's feelings related to the task and their willingness to do a task are also a part of student's engagement (Pachler, Kuonath & Frey, 2019).

Student engagement indicates the level of students' participation in learning tasks and how well their participation can improve their learning. Different researches indicated that students' learning can enhance when they get engaged in class (Goss & Sonnemenn, 2017). Disengaged students usually face boredom because they do not complete their home works, pay less attention to lectures, and are less participative in extra-curricular activities. In the end disengaged students preferred to leave the schools because they feel classroom activities boring (Fredricks et al., 2019).

Student engagement is considered as a multi-dimensional term, classroom engagement of students and campus engagement of students' are considered as major two dimensions of students' engagement (Gunuc & Kuzu, 2015). The term campus

engagement indicates that to what extent students are obeying campus rules, participating in various activities held at the campus, and how much they are emotionally attached to their educational institute (Lau, Garza & Garcia, 2019). Furthermore, CE, EE, and BE are important components of classroom engagement (Gunuc & Kuzu, 2015). The most important component of class engagement is cognitive engagement which includes how well a student is investing in his learning and to what extent he is giving value to the learning needs, learning goals, and how he plans to achieve those goals (Ben-Eliyahu et al., 2018). Whereas, emotional engagement includes feelings, attitude, and interest of students towards learning and their responses towards teachers, peers, and overall course content. In addition to this, behavioral engagement refers to students' participation in in-class activities. Furthermore, it also includes how much a student is putting his efforts into learning and to what extent he is attending the classes (Yu et al., 2019).

The role of video is considered as effective in enhancing students' engagement in the aspect of participation, emotional engagement, and overall course engagement. The video promotes student-centered learning which in turn enhances students' engagement (Lee & Hannafin, 2016). A survey conducted by the United States and Canada relevant to student engagement highlighted a positive significant relationship between student engagement and technology-based pedagogies that utilize videos (White, McGowan & McDonald, 2019). That is why this study was focused on investigating the effectiveness of Knowledge Clips on students' engagement at the Higher Secondary School level.

1.1 Current Purpose of Study

It has been concluded from the above discussion that for enabling our students to survive in this technology-laden era traditional means of teaching are needed to be replaced with modern pedagogies such as blended learning. The blended learning approach involves both in-class and online interaction of students with the teacher. It aids them in solving their learning-related problems by asking questions within the class. Furthermore, the online phases of blended learning allow students to do independent learning. It not only compels students to get in touch with the learning materials but also helps them in solving their problems by constructing new knowledge. Videos are the most important component of the blended learning modules and teachers can use Knowledge Clips which is a 5-6 minutes' short video clip as a concept delivery tool that not only saves in-class time for learning activities but also engage students and make them responsible for their learning. Teachers at the college level in Pakistan deliver long lectures and students show less engagement in classes that is why the current research purpose was to investigate the effectiveness of using a Knowledge-clip on students' engagement at higher secondary school level. In this study researcher only examined classroom engagement as a component of students' engagement, within classroom engagement researcher specifically investigated students' cengagement (CE) behavioral engagement (BE), and emotional engagement (EE).

1.2 Rationale of the Study

Technology has transformed the pedagogies of the teaching-learning process. As per the demand of the current era for making our students competitive with the students of other countries it is necessary to opt for more technology-based pedagogies which not only improve the students' engagement but also aids in conceptual and

effective learning. Furthermore, until the students will not be engaged there will be more chances of low understanding, which in turn may affect students' performance. In addition to this, Mattis (2015) also concluded that in traditional pedagogies teacher is less concerned with knowledge construction and engagement of students and more concerned with imparting knowledge.

Students are not empty vessels who are only concerned with absorbing the knowledge, delivered to them. In actual students' engagement and involvement in the teaching-learning process is very important because until we may not involve or engage students they will not learn effectively. Pillai, Kasat, Pednekar and Shaikh (2018) indicated that e-resources like videos are effective teaching tools for better conception and engagement of students. Long lectures create boredom and less engagement on the behalf of the students. Instead of delivering a long lecture of 30-40 minutes with no engagement, it might be better if we allow students to see a short video of 5-6 minutes related to the topic in which their teacher can him/herself introduce a concept in easy language by using a combination of visuals and text. It may engage students effectively and enhance the conceptual clarity of students in less time. That is why there is a need to explore the effectiveness of the Knowledge clip at the Higher Secondary School level in terms of improving students' in-class engagement. The reason is, at this level, most of the teachers prefer to use the traditional lecture method. It causes less engagement of students within the class and in turn increase boredom and less concepts clarity.

The researcher has personally observed being a student and a teacher that in Pakistani context at Higher Secondary School level traditional approach of teaching is common. Teachers are more focused on lecture delivery and least bothered about students' engagement. Teachers usually impart knowledge without engaging the students. In return, students usually do not pay attention to what their teacher said. They

are less engaged with learning material, teachers as well as peers, and less participative in classroom activities. Less engagement leads towards less concept clarity, which compels students to do rote memorization. One of the reasons behind rote memorization is; there are many abstract Biology concepts at the Higher Secondary School level and it is difficult for the students to get better conception without getting cognitively, emotionally, and behaviorally engaged with the course content. Making Knowledge clips as a part of the study in the Pakistani education system might be a good solution for the above-mentioned problems. Moreover, it might be a fruitful step for improving students' in-class engagement, concepts clarity, and producing more active learners instead of passive learners.

1.3 Statement of the Problem

In Higher Secondary Schools of Pakistan traditional approach to teaching is more common. Students are passive learners in this approach that is why their classroom engagement in terms of cognitive, behavioral, and emotional engagement may be less. For enhancing students' engagement, teachers can use more technology-based pedagogies in their teaching. Some teachers use third-party videos for delivering a concept. Third-party videos are those which are available on the internet or created by someone else instead of the instructor. There are some drawbacks of using third-party videos including lack of teachers' personal teaching style, these videos are not as per the need of the students and use difficult to understand language. In contrary to this, Knowledge clips are first-party videos because the instructor personally creates those videos by his/her self by considering the needs of her/his students which might enhance students' engagement in the classroom. A knowledge clip is a video lecture, which can be pre-recorded by a lecturer instead of made by an external person. It can be more effective if we use it by combining it with other learning activities (Van Puffelen, Van

Berkum & Diederen, 2018). Moreover, Knowledge Clip is different from third-party videos because it is more specific and focused on a single subject/topic and has many didactic goals (van Puffelen & van Berkum, 2018). Furthermore, the utilization of Knowledge clips is interesting, engaging and aid students in learning and understanding the concepts (Alpert, 2016). In addition to this, Knowledge clips serve an important role in making students independent learners (Suhonen & Tiili, 2016). That is why the researcher wanted to investigate the effectiveness of knowledge-clip on students' engagement at the Higher Secondary School level.

1.4 Significance of the Research Study

As the importance of Technology in teaching and learning cannot be ignored in this modern and competitive era where the world is moving quickly towards the online approaches of teaching and learning. This study is utilizing a new technique including a technology-based tool (knowledge clip) for improving the students' in-class engagement which might provide a way forward for the instructors to add a combination of technology and face-to-face activities in their lesson plans for improving the engagement of their students within the class.

This study might be helpful for curriculum developers because this study indicated the effectiveness of knowledge clips for enhancing students' classroom engagement. Curriculum developers can make technology-based amendments in the curriculum by making Knowledge Clips a part of the curriculum. Teachers might be directed to add at least one Knowledge Clip for the introduction of the topic in their Biology lesson plans. Especially for the topics which need more conceptual clarity on the part of the students.

This study might be significant for educational institutions as by using knowledge clips students will show more engagement within the class which in turn might improve their campus engagement. Students might show good results which aid in improving the overall reputation of the educational institute. The administration of the educational institutes might allow teachers to take Biology classes within the computer lab where teachers can make topic/day-wise folders of Knowledge Clips and related activities. Moreover, Educational institutions can allow teachers to use multimedia and speaker for showing Knowledge clips to students. On the other hand, educational institutes can arrange training for teachers regarding using ICT in the classroom and creating Knowledge Clips for improving the quality of Education.

This study might be significant for teachers because if a teacher will use the Knowledge clip his/her role will be shifted to a role of a facilitator and he/she will get more time for planning innovative activities. Furthermore, it might be helpful for teachers in enhancing students' engagement and their active participation within the class.

This study highlighted the effectiveness of Knowledge Clip for students' cognitive, emotional and behavioral engagement. Thus, it might be significant in terms of improving students' cognitive, emotional and behavioral engagement within the classroom. For improving the cognitive engagement of students' teachers may include thought-provoking questions in Knowledge Clips. For improving the emotional engagement of students appealing color schemes, pictures, texts, and animations in Knowledge Clips can be used. For improving the behavioral engagement of students instead of long lectures teachers can use Knowledge Clips of 5-6 minutes as an introductory clip by considering the attention span of students.

This study might be helpful for students because by using Knowledge Clip students might cover a lesson content in less time and they will get an opportunity to interact with the learning materials which in turn might enhance their engagement, concept clarity, in-class performance, and overall learning.

Moreover, the study will contribute to the existing literature as no study according to HEC data has investigated the effectiveness of knowledge-clip on students' engagement at higher secondary School level in Pakistan.

1.5 Objectives of the Study

The objectives of the current research were to:

1. Investigate the effectiveness of Knowledge-Clip on students' engagement at the Higher Secondary School level.

   1a: Investigate the effectiveness of Knowledge-Clip on students' Cognitive engagement at the Higher Secondary School level.

   1b: Examine the effectiveness of Knowledge-Clip on students' emotional engagement at Higher Secondary School level.

   1c: Explore the effectiveness of Knowledge-Clip on students' Behavioral engagement at Higher Secondary School level.

2. To compare in-class engagement of control and experimental group.
3. To assess the difference in pre-test and post-test scores of the control group.
4. To compare engagement scores of the experimental group before and after the intervention.

1.6 Research Question

For this research study following research question was under investigation:

Q1: What is the effectiveness of Knowledge-Clip on students' engagement at Higher Secondary School level?

1.7 Hypotheses

The hypotheses for the current study were:

H_0^1: There is statistically no effectiveness of Knowledge-clip on students' engagement at the Higher Secondary School level.

H_{01a}: There is statistically no effectiveness of Knowledge-clip on students' cognitive engagement at the Higher Secondary School level.

H_{01b}: There is statistically no effectiveness of Knowledge-clip on students' emotional engagement at the Higher Secondary School level.

H_{01c}: There is statistically no effectiveness of Knowledge-clip on students' behavioral engagement at the Higher Secondary School level.

H^{02}: There is statistically no significant difference in students' in-class engagement for the control and experimental group.

H^{03}: There is statistically no significant difference in pre-test and post-test scores of the control group.

H^{04}: There is statistically no significant difference in engagement of the experimental group before and after the intervention.

1.8 Conceptual Framework

The current study was based on Engagement theory which is the most appropriate framework for testing students' engagement by using technology-related pedagogies. For technology-based teaching and learning, engagement theory is an appropriate framework. It argues that technological instruments and systems facilitate the cooperation, involvement, and engagement of the students. Furthermore, it also indicates that various technological tools can enhance students' engagement in different ways and we are unable to achieve that without utilizing technology (Kearsley & Schneiderman, 1998).

For the current research study, the researcher followed the model of Gunuc (2013) known as the Campus-Class-Technology (CCT) model. This model has explained the strong association between technology and students' engagement. Furthermore, it is explained that valuing education is an important factor for enhancing students' sense of belonging and motivate them to spend more time at the campus that in turn may enhance students' classroom engagement. In addition to this, another factor responsible for enhancing student's engagement is the use of technology in the classroom. For enhancing students, classroom engagement effective integration of technology is necessary. It will lead towards positive outcomes and helps in increasing students' academic achievement. This model was tested on students of higher education. After getting consent from the developer of this model researcher used this model for the Higher Secondary School level (See Annexure N). For the current research study, the researcher only followed or used the classroom engagement dimensions of the CCT model. The researcher investigated the effectiveness of technology integration in terms of Knowledge-Clip on students' classroom

engagement. Moreover, this study investigated the three dimensions of classroom engagement that are cognitive, emotional, and behavioral engagement.

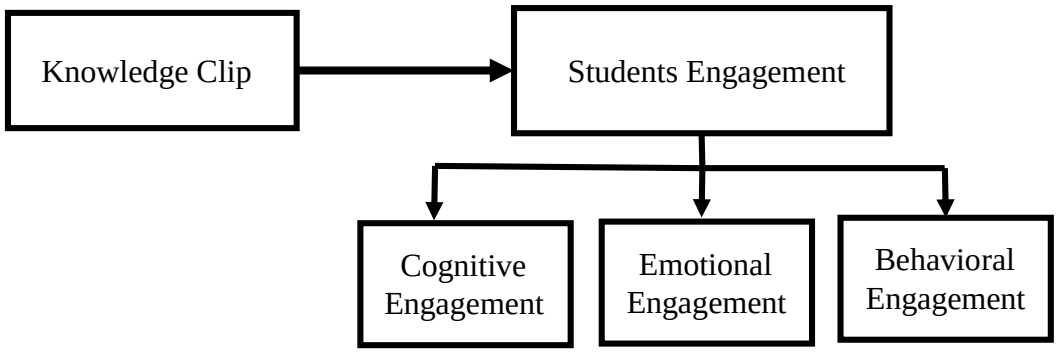

Figure 1 Conceptual Framework

1.9 Framework for Biology Modules

For the current study, the researcher used a framework for designing blended learning modules (Alammary, Sheard & Carbone, 2014). This framework has consisted of three different approaches for developing blended learning modules.

1.9.1 Low-impact approach. In this approach, a blended learning module can be designed by enhancing the proficiency of existing courses by adding an online activity.

1.9.2 Medium-impact approach. In this approach, there is the flexibility of replacing one in-class activity with online activity.

1.9.3 High-impact approach. This approach allows an instructor to develop a module in a way that is flexible for making any change at any time in face-to-face and web-enhanced modules.

For the current study Medium-impact approach was used for designing the modules for Biology. This approach is more preferable because activities may deliver in an effective way to engage and motivate students. Furthermore, the researcher wants

to replace a lecture with a Knowledge Clip that is why this approach is more suitable. In addition to this, teachers are allowed to make any changes in the module by utilizing different pedagogical tools. It also provides an opportunity to redesign the module and allow teachers to explore new pedagogical approaches (Alammary, Sheard & Carbone, 2014).

1.10 Biology Modules as Per Blooms' Taxonomy

The researcher developed a blended learning module by following the lower level thinking order of revised taxonomy given by Bloom's which are remembering, understanding and applying. The reason behind selecting these domains of Revised Bloom's Taxonomy is that the idea of Knowledge Clip is new and it was difficult for the researcher to check its effectiveness for both lower and higher-order thinking levels. Within each lesson of module following sequence was followed:

1.10.1 Remembering. The first stage in the Revised Bloom's Taxonomy is remembering. In this stage, the instructor tried to make the unfamiliar concepts familiar to the students. In all of the lessons for giving the basic concept of the topic to the students instead of lecture, the researcher used the Knowledge clip. It was a video developed by the researcher herself and its duration was 5-6 minutes approximately.

The duration of the video was kept less and it was being set by keeping in mind the attention span of students. Each of the videos was started with a basic question that compelled students to recall the knowledge they already have. The language used within the Knowledge clip was English because it is the academic language and at the college level, students can understand it. Furthermore, students have to reproduce whatever they learned in the English language during exams it is another important reason for making Knowledge clip in the English language.

1.10.2 Understanding. Understanding is the next stage in Revised Bloom's taxonomy it is difficult to measure. Within the current module, students tried to understand the basic concepts by watching knowledge clips and discussing their queries with the teacher. The researcher also paused Knowledge Clips and asked questions from students to check their understanding. Furthermore, the the researcher attached an online quiz made on Google forms at the end of every video. After watching a video students solved that quiz and researcher got an idea about students' understanding by utilizing their quiz scores. The reason for making a quiz on Google forms is that it is easy to make, automatic scoring can be possible and it provides the complete stats of results within seconds that will provide a clear picture of students understanding to the researcher.

1.10.3 Applying. Applying is the stage in which students have to utilize the concepts they gained from the first two phases and apply them to new situations. In this module, the researcher created a small group of students and involved them in conversations or discussions relevant to each topic introduced by using the Knowledge clip. Furthermore, after discussion, every group made a small presentation on the given topic as per their understanding. Each group presented their topic and the researcher gave them on-the-spot feedback.

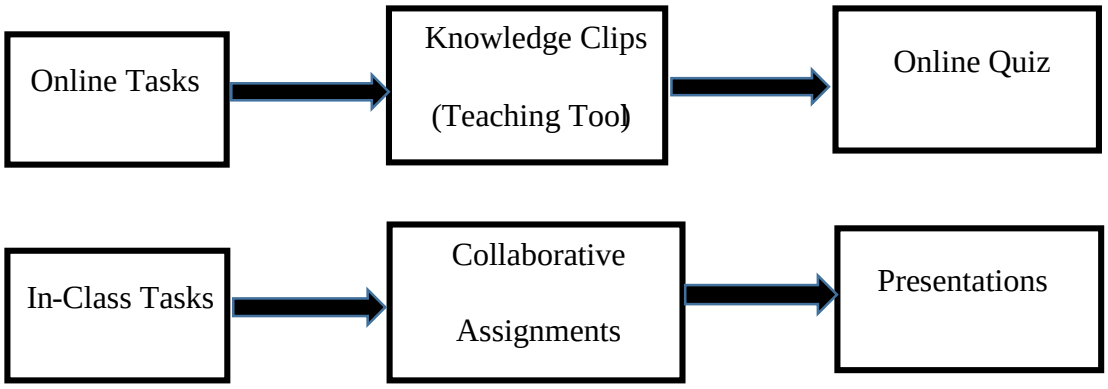

Figure 2 Conceptual Framework for Biology Modules

The Biology Modules for the current study had both online and in-class activities. Within online tasks instead of taking in-class topic-introductory lectures, students watched Knowledge Clips by utilizing the computer labs of the school. After watching Knowledge Clip they solved an online quiz. Whereas Collaborative assignments were given to the students within class and at the end, students presented their work and got on spot feedback from the instructor. Moreover, both online and in-class tasks of the modules were designed to promote students' classroom engagement.

1.11 Operational Definitions

1.11.1 Knowledge clip. a 5-6 minutes' video was produced by the teacher (researcher) to introduce the topic of the study. It aids students in remembering, understanding, and applying the concepts. Furthermore, it grabs the attention and concentration of students by providing a visual stimulus.

1.11.2 First Party Videos. The educational videos which instructors personally create for their students by keeping in mind their attention span and needs.

1.11.3 Third-Party Videos. Third-party videos are those which are either available on the internet or created by someone else other than the instructor.

1.11.4 Students engagement. It is the extent to which, students enjoyed and took part in learning activities and incorporates these levels i.e; CE, EE, and BE.

1.11.5 Cognitive engagement. It is the degree to which students take an interest, paid attention, concentrate and remembered, understood, applied the concepts, or put extra effort into learning tasks.

1.11.6 Emotional engagement. It is the extent to which students have positive feelings (excitement, enjoyment, and happiness) and likeness about Knowledge Clip and learning activities.

1.11.7 Behavioral engagement. It is defined as the level to which students participated in learning activities, follow instructions, responding to questions, watched complete Knowledge Clip, regularity in their class attendance, and no distractions.

1.12 Delimitations

For the current research study following were the delimitations:

1. The researcher specifically selected one college of Rawalpindi as per convenience.
2. The study was delimited to 11th-grade students.
3. The study was delimited to those students who were studying Biology as a subject.
4. The researcher used a Quasi-experimental research design by following Non-equivalent comparison group design and Non-equivalent groups pre-test, post-test design.
5. The participants in both the control and experimental group were 43 each.
6. The researcher only investigated students' classroom engagement, not students' campus engagement.
7. The researcher has developed a blended learning module by only following the lower-level thinking order of revised Bloom's Taxonomy instead of using both high and lower-level thinking orders.

CHAPTER 2

LITERATURE REVIEW

2.1 Technological Innovations

In the modern era, the educational field is not lacking behind in getting the benefits of new technological innovations. Modern pedagogies are focusing on the integration of technology in education to improve students' learning. Same as Akçayır and Akçayır (2017) also highlighted that education and fields related to education are also getting benefits of new technological inventions which are positively contributing to improving students' knowledge and skills. In general, it shows that Technology is intervening in all fields of life and its major aim for the field of education is to transform the education for students and providing a completely new and effective learning experience for them in which they can learn in a better way.

Many of the educational institutes are now having technology-based pedagogies which are beneficial not only for students but for teachers. Same as Zinger, Tate and Warschauer (2018) also indicated that for supporting modern pedagogies educational field is getting equipped with technological tools that improve students learning and practices of teachers at educational institutes. Furthermore, Muijs and Reynolds (2017) also stated that technology has altered the active role of teachers in the classroom which also reduced the load of work on part of the teacher. In contrary to this, some teachers are also having a point of view that because of technology they become more burdened as they require more time for understanding technology-based tools and also need more time for planning effective lessons (Li, 2007). It concludes that modern pedagogies are replacing the role of teachers in classrooms and compelling them to learn more about

new technology and plan lessons, which involves more active participation on part of students.

Content, pedagogy, and technology are the most important component of effective teaching. If it will miss any of these ingredients the overall teaching will lose its effectiveness and impact on students. Same as Kafyulilo et al., (2015) indicated that content of the course, pedagogical tools, and technology-based tools like (videos, multimedia, games, etc.) serve an important role in making teaching effective. Moreover, a teacher is responsible for selecting the right pedagogy and technological tool for the right content because if pedagogy and the technological tools are not appropriate for teaching content then it might negatively affect students learning (Benekos, 2016). On the whole, teachers are required to plan lessons in such an innovative way which includes a mix of best teaching methods and technology-based equipment for making learning an exciting experience for students.

2.2 ICT in Education

Information Communication Technology (ICT) involves two types of technologies, one is Information Technology (IT) and the other is Communication Technology (CT). The most common tool of (IT) is the computer because it consists of hardware, various applications, and software that aids in information storage, retrieving, and information handling (Patchan & Puranik, 2016). Whereas, Communication Technology (CT) involves tools that are utilized for transferring information either message, picture, or voice from one place/person to another. The most modern communication technologies include telephones, fax, television, radios, and various internet-related applications (Rodney, 2017). On the whole, it is concluded that IT and CT were two separate terms but in previous years, experts have combined

the two terms IT and CT because of their overlapping features and coined a new term as ICT which can be used for both information technologies and communication technologies.

Advancements in IT have enhanced the demands of computers and computer-related technologies in all fields including the education sector because of their quick speed and effectiveness. In addition to this, the ICT sector has transformed in very little time and it is kept on changing every day that is why the importance of ICT in education has been also increased. Now it is the major focus of the educational sector to modify their teaching curriculums as per the needs of the modern era because there is a need to keep the ICT and education together (Kaware & Sain, 2015). It is concluded that educational institutes are not lacking behind in the race of technology and they are trying their best to do all the necessary modifications which are required for the improvement of the education sector in this technology-driven era.

ICT is the major tool for modern education, which is common worldwide and promotes effective teaching and learning. Same as Vahtivuori and Kynäslahti (2016) indicated that the most significant tool for working and learning in the modern era is ICT. It includes many of the software and internet-related applications that can be utilized effectively for teaching and learning purposes. Furthermore, Jarvis (2014) highlighted in his book that ICT has the potential to improve the teaching/learning process because it can grasp the attention of students and involve them in the teaching and learning process. Moreover, it also can improve students' skills by motivating and engaging them in the learning process. In old times, only computers were used to teach computer programming to the students' but with the passage of time due to its effectiveness in grasping students' attention schools has introduced many technology-dependent pedagogies by using computers. It is concluded that educational institutes

are aware of the importance of ICT tools in education and they are utilizing these tools for improving the quality of teaching and learning.

Nowadays most of the peoples prefer to use ICT in various fields because of its convenience and fame. Same as Sinha and Sarma (2017) indicated in their study that everyone can use ICT-based tools anywhere and anytime as per their own choice. Same as, in the educational field usage of ICT relevant tools have also increased among those tools computers, laptops, iPads, smartphones, multimedia, projectors, and smart screens are very common in the field of education. All of these devices have completely transformed the dimensions of instructions and made educational institutes a place for innovative learning and true learning experiences.

2.3 ICT in Education in Pakistani Context

Pakistan is a developing country and the government of Pakistan is also taking initiatives for the inculcation of ICT in education because they are aware of the negative consequences if they do not accept this merge of ICT and education. The most important negative consequence will be that our students will be left behind from the rest of the countries and they will not be able to compete with the foreign students. The government of Pakistan has also incorporated ICT-related benefits in the National Education Policy summary of which claims that for improving the quality of education in Pakistan, the government of Pakistan is making efforts for improving the usage of ICT tools in education. Furthermore, if we want to achieve better outcomes in less time than the number of computers in the educational sector needs to be enhanced. Moreover, if we want to make our generation competent and able to compete with generations of other developed countries then ICT relevant tools must be part of the educational sector. (*National Education Policy Framework 2018*, 2018).

Governmental authorities of Pakistan took many initiatives in previous years to promote ICT in education and equipping the youth with ICT facilities for improving their learning as well as their skills. Among those youth schemes, one of the biggest was the “Prime Minister Laptop Scheme” started in year the 2013 and the government was having an aim to distribute 10,0000 laptops per scheme and also continue this scheme for up to five years. The major objectives behind launching this scheme were making education technology accessible for students and also improving the quality of education and research in the country. Through this scheme, many of the college and public sector university students have not only received laptops but also internet facilities in the form of Evo ("PM's National Laptop Scheme", 2019). On the whole, this scheme was a very great initiative for college and university students because now they can access information anytime and anywhere by using laptops and the internet. Moreover, after equipping students with this facility now it might be easy for us to make our students independent learners.

The government of Pakistan has also started a program to promote ICT in education and to facilitate students’ learning and teachers’ teaching. This program is known as e-learn Punjab it is a website containing learning resources for students and teaching resources for teachers. This website contains e-books having pictures and animations from primary school till college level, especially for science subject college-level students. Moreover, teachers’ guides containing lesson plans are also present on this site through which teachers can plan innovative lessons for their students. The major objective behind launching this program is not only to promote individual needs but also to make learning content accessible for students. Another objective behind taking this initiative is to reduce the need for tuition centers for students’ where students can pay extra fees and enhance the financial burden of their

family ("elearn Punjab Media Highlights", 2017). On the whole, this initiative also indicates that the government of Pakistan is making efforts to improve their teaching-learning quality by incorporating ICT and ICT-relevant programs in education. Moreover, they are concerned with the financial load of students' family and they want to reduce it by launching ICT-relevant programs in education which are accessible for students' from their homes as well as anywhere at any time.

2.4 Benefits of Using ICT in Education

There are many benefits of using ICT in education. Suryani (2010) indicated that numerous benefits are associated with ICT among those; cost-effectiveness, developing ICT skills, recruiting and retaining students, enhancing students' achievement, and making learning materials accessible for students worldwide are the major benefits of integrating ICT in education.

One of the reasons for students' dropout from educational institutes is the lack of students' engagement in class or at the campus level. In Pakistani educational institutes, ICT tools are assisting in enhancing the performance and in-class or campus level engagement of the students. Same as Rashid and Asghar (2016) highlighted that technology has a positive effect on students' engagement which compels students not only to pay attention to the learning materials but also to take part in all the learning activities taking place in the classroom. In addition to this, Rissanen (2018) also highlighted that when a student gets engaged in class he or she understands the concepts properly and shows better results which in turn enhances their affiliation with their class and campus. It is not wrong to say that ICT tools can enhance students' engagement in class which in turn might improve students' campus engagement and reduce students' dropout rate from colleges.

Another important advantage of using ICT in education is that it allows students to get in touch with the learning materials, explore materials and use their minds to solve learning relevant problems which in turn improves the academic skills of students. Same as Mahmood et al., (2018) Concluded in their study that in developing countries like Pakistan incorporation of ICT is of much significance because it aids in developing the academic skills of students as well as prepare them for future life. On the whole, it is concluded that if we want to improve the skills of students and make them efficient learners then the use of ICT in education is the best choice.

Teachers are required to teach students' but a single teacher can only teach a specific number of students within a single class and it is impossible for a teacher to teach thousands of students at once in a traditional classroom. Information Communication Technologies has resolved this problem and it has made it easy for the teacher to access thousands of students and for students to access various teachers related to their fields by sitting at their homes. Hendriks (2016) stated in his study that ICT has introduced platforms of education where various students can access course content and materials at any place and at any time beyond the boundaries of traditional classrooms. Such platforms are known as digital means of teaching and learning which are different from traditional means of teaching.

2.5 Traditional Method of Teaching

Traditional means of teaching are common for a long time and our teachers are experts in teaching students by just delivering long lectures. In this method, there is a very active role of the teacher and he or she is considered as the only source of knowledge without whom students are unable to learn a single word. Same as Naithani

and Rathi (2018) indicated in their study that in traditional teaching teacher prepares long lectures and delivers them to the students. Teachers consider the student as an empty vessel and they try to fill this vessel by imparting a bunch of knowledge. They prefer to deliver long lectures and are least concerned about students' engagement. Students lose their interest in long lectures and get bore during class, which may affect their performance. Overall, it is highlighted that due to the long duration of lectures and no engaging activities students cannot pay proper attention to lectures delivered by the teachers.

Traditional pedagogies are quickly replacing with modern pedagogies because traditional ways of teaching are more teacher-centered instead of student-centered. Same as Mattis (2015) indicated in their study that the major reason behind the shift of traditional to modern pedagogies is the passive role of students in the traditional teaching and learning process. Moreover, one of the research studies also indicated that in traditional lecture-based pedagogies, students have to sit and listen to the teacher during the whole lecture. They absorb that knowledge and get less chance of learning by doing and being engaged with the learning material because of which major focus of students is on rote memorization instead of concept clarity, which may affect negatively their academic performance (Meguid, & Collins, 2017). It is analyzed from the above review that traditional teaching might become a serious concern for our students learning in this modern technology equipped era because this approach of teaching is least bothered with students' participation in the classroom due to which students used to do rote memorization instead of understanding the things. The biggest dilemma of rote memorization is that students forget whatever they learn after some time and if we develop a base of our future generation on rote memorization then it might be alarming for the progress of our country. Whereas, if we develop our future

generation with the demands of the era by using modern ways of teaching then they will contribute to the progress of the country.

2.6 Modern Teaching

Modern education is supportive of student-centered learning because students can learn more when they experience something and get in contact with the learning materials personally. Same as Zhu (2012) also concluded that modern pedagogies are more concerned with knowledge construction on the part of the students. Students can get better conception and perform well when they construct their knowledge based on previous knowledge instead of absorbing teacher-delivered knowledge. In addition to this, modern technology-based teaching methods compels teachers to engage students and involve them in various activities that make students responsible for their learning. That is why in modern teaching approaches, the teacher role is passive and the student role is active. Student active role makes students' responsible for their learning and is positively associated with better performance of students (Naithani, and Rathi, 2018). In addition to this, in modern teaching approaches, teachers plan a lesson in such a way that promotes students' active participation in their class, their interaction with learning materials, interaction with their teacher and classmates, knowledge construction, and problem-solving capabilities of students (Sultana, 2016). On the whole, it is indicated that modern teaching is more concerned with students' energetic participation in the classroom as compared to traditional teaching approaches. Moreover, these approaches compel students to think critically, construct new knowledge and solve their problems on their own instead of rote memorizing concepts. These approaches might help instructors to overcome the rote memorizing habits of students by improving their level of understanding by using ICT-relevant tools. In almost all of the modern teaching, approaches the use of ICT tools is a major element and various modern teaching

approaches like flipped classroom approach, virtual classrooms, e-learning, and blended learning approaches are most common now a day in almost all over the world.

2.7 Blended Learning

For making students responsible for their learning there needs a phase in teaching in which students can get an opportunity to learn on their own without the instructions of anyone. There are various modern pedagogies such as hybrid learning, flipped classrooms and blended learning, etc. The blend of learning is a modern pedagogy that includes a mix of online interaction and in-class interaction of teacher and student (Milad, 2019). Furthermore, Thorne (2003) in his book highlighted that the name of blended learning indicates that this approach is a blend of online teaching and learning with the existing traditional means of teaching and learning. As we mix the coffee ingredients as per the preferences of the guest, same as an instructor can blend online means of learning with traditional ones as per the needs of the students. The major focus of this approach is on the active role of the learner and knowledge construction. In the online phase, students can get an opportunity to learn on their own.

Blended learning systems provide an answer to the most important question which is how we can blend online and traditional means of learning? Bonk and Graham (2012) in their book mentioned three categories of the blended learning system, which are; 'Enabling blends' that involve access and convenience issues and the ways to address those issues. 'Enhancing blends' involves an incremental change in methodology but the whole way of teaching and learning may not be disturbed and 'Transforming blends' includes a whole transformation of pedagogy.

Blended learning can occur in three ways: by combining different instructional methods, different delivery media, or both computers based and face-to-

face interaction (Graham, 2013). Teachers' can use any of the blended approaches as per need that supports knowledge construction and allow students for learning by doing. In all kinds of blended approaches, the major focus is on engaging students, which improves the concept clarity and learning of students. Same as Baragash and Samarraie (2018) concluded in their study that in blended learning approaches students get involved in engaging activities and do independent learning that may improve their overall learning. In addition to this, blended learning involves visual, auditory, and written components for a better understanding of students (Van Puffelen & Berkum, 2018). A research study conducted by Wong and Wong (2018) has indicated video as an important component of blended learning and the effectiveness of video in blended learning is dependent on the type of video used and how it can be used. From the above review of literature, it has been analyzed that blended learning is an amazing approach to enhance students' in-class participation and engagement where the teacher is having various options to blend a class as per convenience and as per the needs of the students. The most important benefit associated with blended learning is that a teacher can add on or remove any of the components at any time in this learning approach. In addition to this, teachers can allow students to do independent learning by watching visuals that grasp students' attention and might improve their concept clarity,

2.8 Video

A video is an effective tool in educational technology that can be used for a better conception of students. According to Woolfitt (2015) Students can learn better when they see something with their own eyes. Videos that consist of various pictures, animations, audios, and content can help students in their conceptual clarity. A video is a tool for delivering content engagingly and effectively, videos can be used for online courses where instructor-based lecture methods may not be used. Same as Brame

(2016) also indicated in his study that in blended, flipped and online classes instructors are using video as a vital content-delivery tool. In blended, flipped, and online courses, there are phases of individual learning in which students can learn alone without any help from the instructor. In these phases, various forms of videos can be used as an effective content delivery tool. On the whole, it is not wrong to say that video is one of the most demanding components of modern teaching approaches including blended learning by using which teachers can promote independent learning among students.

2.9 Different Kind of Educational Videos

Videos do not have a single pattern different videos may have different features. Forms, patterns, and features of videos are evolving with the passage of time and numerous video formats are available for teachers to use within their classrooms. Woolfitt (2015) has indicated different types of educational videos, which are described below:

2.9.1 YouTube clip. YouTube videos are online videos, which can be made by anyone else other than a lecturer, student, or technician. They do not have any approximate length but have many didactic goals. In addition to this, most of the YouTube educational videos have been recorded by foreign peoples in the English language (Rttberg, Dissanayake & Katz, 2016).

2.9.2 Khan academy. These kinds of videos cover a specific subject. They are not teachers, students, or technicians made, they can be made by any external person. The approximate duration of these videos is 5-10 minutes. It also has numerous didactic goals (Woolfitt, 2015).

2.9.3 Live lecture capture. These videos cover live lecture sessions delivered by the lecturers in front of students. It can be automatic or technician-assisted

lecture recording. External persons may not make these kinds of videos whereas; these videos can be made either by the technician or by the lecturer. The approximate duration of live lecture capture is 45-90 minutes. These videos can be used as recorded lectures within a course or these videos can also help teachers to reflect upon their teaching style and strategies they have used while teaching and make plans to improve it further (Sadik, 2016).

2.9.4 Web lectures. These lectures can be pre-recorded by technicians or teachers. The approximate length of these video lectures is 10-45 minutes. These lectures may help in achieving many didactic goals. This kind of video help students to review videos, again and again, to refresh the concept and do preparation for their exams (Montrieux et al., 2015).

2.9.5 Knowledge clip. Knowledge clip is also a video lecture, which can be pre-recorded by a lecturer instead of made by an external person. It is different from web lectures because it covers only one subject instead of multiple subjects. The approximate duration of the knowledge clip is 5-10 minutes and it has many didactic goals (van Puffelen, E., & van Berkum, 2018).

2.9.6 Micro clip. The micro clip is also a short-duration pre-recorded video that only covers a single subject. It is different from the knowledge clip in terms of its approximate duration, which is 15 minutes. It also has various didactic goals (Woolfitt, 2015).

2.9.7 Screencast. Screencasts can be used to demonstrate any skill. It includes audio and visuals of a mouse click through which a lecturer demonstrates that how a specific action can take place. The approximate duration of these kinds of videos is 1-10 minutes. It also helps in achieving various outcomes (Sadik, 2016).

2.9.8 Webinar. The webinar can be made by an external person, technician, or lecturer. It covers a live-streamed discussion session on various topics. It is an amazing platform for having discussions and sharing views regarding some topics. The approximate duration of the webinar is 60 minutes (An & Bedford, 2017).

2.9.9 Virtual classroom. The virtual classroom is a type of distance education in which a lecturer can have a live interaction with their students, and give an impact of the live classroom to students. Its duration may vary as per the requirement of the lesson (Woolfitt, 2015).

2.10 Benefits of Teaching Through Videos

Different studies have indicated different benefits of teaching through videos. Some of them are described as under:

2.10.1 Improve learning outcomes and satisfaction. Teaching through video can help instructors to plan the instructions in a way that can aid in achieving learning outcomes. Video-based teaching can improve learning outcomes and the satisfaction of students. Same as it is also concluded that video-based teaching can improve students learning and their satisfaction (Garrison, 2016; Ramnanan & Pound, 2017). In contrast to this, O'Flaherty and Phillips (2015) indicated in their study that there is no direct evidence that highlights the association between video-based teaching and students' satisfaction. By reviewing these contrasting arguments it is required to do more researches to find out the association between teaching through videos and improving students' learning outcomes and satisfaction.

2.10.2 More chances to pass an exam. Video teaching has the benefit that students can watch recorded videos multiple times and at any time. This can help students in the exam as well, instead of seeking the help of an instructor; they can watch

videos and get the answers to their queries on their own. Same as Garrison et al., (2012) also concluded that recorded lectures can provide an opportunity to the students to review the video lectures repeatedly which may enhance the chances of passing the exam.

2.10.3 Positive impact on learning. Video lectures are an effective content delivery tool that can enhance students learning. Students can get engage with the mixture of audio and visual content in the form of video that can enhance their understanding and in turn, may improve their learning. Multiple research studies also indicated the positive impact of videos on students learning (Woolfitt, 2015; Hung, 2015).

2.10.4 Accessibility. The traditional lecture-based approach is dependent on the teacher and the teacher is the whole source of knowledge in that approach but in video-based teaching accessibility of video content is a major benefit. The teacher can provide video sources to the students and students can get access to those sources any time and from anywhere. It can also help teachers to target a large population at once instead of giving instructions to every individual. Same as Ramlogan, Raman and Sweet (2014) also highlighted accessibility as a chief benefit of video lectures. He further highlights that students can get a chance to recap lectures at their own convenient time. In contrary to this, in one research study students also indicated that they do not like to watch the video alone because for some queries they want their teacher to be available to respond to their questions (Van Puffelen, Berkum & Diederen, 2018).

2.10.5 Cost-effectiveness and time-efficient. The most important benefit of teaching by using video is that it saves time, it is enjoyable for students and it is cost-effective. Teachers can make various videos one time and then can easily use them for

many years. In addition to this, it is less time-consuming to deliver content through 5-6 minutes' videos easily. Students can also enjoy the video-based lectures and pay more attention to them. Same as Schwartz (2013) also highlighted cost-effectiveness, time-saving as chief significances of video-based teaching. In contrary to this Caicco (2016) conduct a research study and the results of the study indicated that teachers were not happy in making videos because it takes too much time on the part of the teacher and it is easy for them to deliver a lecture instead of putting many efforts in making videos but some of the teachers also commented that it is a onetime effort to make videos and then they can use these for a long time.

2.11 Knowledge Clip

Knowledge Clip is a type of instructional video, which can be created by an instructor. Instead of preparing a long lecture teacher can jot down the major concept of the topic in a 5-6 minutes' video. It can be a concept delivering video, skill demonstrating video, or exercise solving video that helps students in their learning (Guo, Kim & Rubin, 2014). Students can either watch those videos online or the teacher may show videos to them in class. In addition to this, the video is only 5-6 minutes which allows a teacher to use the rest of the time effectively for queries and other activities. There are different kinds of Knowledge clips Moes and Young (2013) suggested three types of Knowledge clips which are described as under:

2.11.1 Introductory clip. Teachers can use knowledge clips to introduce any concept of a single subject. Instead of giving a live lecture in class, the teacher can make a small video and introduce the major concepts of any topic. In this clip, the teacher can use PowerPoint slides having text and pictures, as well as teachers, own sound in the background of the video.

2.11.2 Skills demonstration clips. Whenever a teacher needs to demonstrate any practical skill, she can make a simple knowledge clip of few minutes to demonstrate that skill. For example, A Biology teacher can demonstrate how to set a microscope for lab experiments through a knowledge clip.

2.11.3 Modelling problem solutions. Sometimes when all students may face difficulty in solving any problem, instead of helping every student one by one teacher can make a knowledge clip in which she demonstrates the solution of a problem and shares it with the whole class at once and save class time for other activities.

2.12 Why Knowledge Clip?

Knowledge Clip is the best option for teachers who wants to facilitate students learning within the school and after school as well by allowing their students to learn from their home anytime which is convenient for them. In addition to this, it is also the best solution for teachers who are facing a shortage of time in conducting learning activities for students in class because Knowledge Clip only consume 5-6 minutes of daily class and teacher can utilize rest of the time effectively for various learning activities. Moreover, a benefit of independent gaps identification is also associated with Knowledge Clip because by watching these clips students' get time-alone to identify the knowledge gaps they are facing and making plans to overcome those gaps. Furthermore, if a teacher does not want to explain a single concept again and again to every individual student separately then Knowledge Clip is the best solution because it allows students to review teachers' concept explanations for unlimited time. Moreover, Knowledge Clip allows a teacher to make her students independent learners because students' can watch Knowledge Clips alone and they are responsible for whatever they have extracted out from that clip ("Knowledge clips",

2019). On the whole, it is not wrong to say that if we want to reduce the workload of teachers, increasing the participation and engagement of students in class, enhancing learning accessibility for students, and making students autonomous learners then Knowledge Clip is the best choice.

2.13 Effectiveness of Knowledge Clip as a Teaching Tool

Knowledge clip is a short 5-6 minutes' video that teachers can use to deliver content in less time. It is an effective content delivery tool because it saves time for both teachers and students' which is impossible for teachers who use the traditional lecture approach for teaching. Furthermore, Pre-class video watching can prepare the students for in-class activities and allow teachers to utilize classroom time effectively for collaborative activities, which may improve students' understanding and learning. Same as Long, Logan and Waugh (2016) also concluded that students can be prepared for the classroom activities when they watch the videos along with other activities before coming into the class it enhances their understanding and readiness for classroom activities. Furthermore, Suhonen and Tiili (2016) also indicated that Knowledge clips can make students independent learners. In addition to this, knowledge clips can be more effective if we use them in combination with face-to-face interaction. Same as a research study conducted by van Puffelen, van Berkum and Diederen (2018) concluded that for effective use of knowledge clip it needs to be combined with other teaching-learning activities instead of using it alone. Moreover, Knowledge clip can engage students, which may positively affect their learning. Stockwell et al., (2015) also indicated that videos have the potential to engage students that improves their conceptual clarity. By reviewing the existing studies, it has been analyzed that researchers used Knowledge Clips and they found it useful for learning and improving understanding of students' because students get time to learn

independently and understand the concept alone. Independent learning allows students to think critically and solve problems on their own which improves their learning. In contrary to this, some researchers suggested to not use Knowledge clips alone but in combination with face-to-face interaction because sometimes students get stuck and do not understand things without getting help from their teacher. Moreover, Knowledge Clip has been used by few researchers as a teaching tool that is why there is a need to conduct more studies for exploring more benefits of using Knowledge Clip as a teaching tool or to investigate the effectiveness of Knowledge Clip as a teaching tool.

2.14 Students' Engagement

Student engagement is not having a specific definition. Some people considered students' engagement as their participation in classroom activities but in actual it is more than that. Students' engagement is usually considered as student thinking, feeling, and doing during learning (Zepke, 2018). Wankel and Blessinger (2013) highlighted in their book "Increasing Student Engagement And Retention In E-Learning Environments: Web 2.0 and Blended Learning Technologies" that students' engagement is how much time and effort students put in learning tasks? by observing students activities in class teachers may get an idea about the extent to which their students are engaging with the learning activities and what strategies he or she can use to improve students' thinking, feelings and doing relevant to learning.

The level to which students show an engagement in their class is affecting their learning and academic performance. Students that are more engaging in class may show better academic performance as compared to those students, which are less engaged in class. Same as

Parsons et al., (2018) also highlighted a substantial association between students' engagement and their academic achievement. In addition to this, Wang, Bergin and Bergin (2014) indicated in a research study that students' less engagement in class may lead to poor academic performance and have a negative effect on students learning. Wang, Bergin and Bergin (2014) highlighted three different dimensions of students' classroom engagement, which are described as under:

2.14.1 Cognitive engagement. Cognitive engagement is referred to as students' ability to process information and understanding it. In addition to this, it also indicates the strategies used by the student to do meaningful processing of information and how much concentration or attention he paid towards the content to extract meaning out of it. According to Pohl (2020) cognitive engagement is considered as a subtype of student overall engagement and it is impossible to measure it directly but its indicators can be observed in students through, utilizing surveys/questionnaires, discussing with students, and by observing students directly or in real-life situations. Cognitive engagement involves students' interest in learning, motivation towards learning, setting learning goals, and using self-regulated learning techniques.

There are different types of cognitive engagement. Clarke (2001) indicated four types of Cognitive engagement: Self-regulated learning, Task focus, Resource Management, and Resilience. Self-regulated learning is a kind of cognitive engagement in which both lower-order and higher-order thinking skills are involved. It involves students planning regarding the task, monitoring their performance during the task, and reflect on the achievement regarding outcomes. Whereas task focus is a type of cognitive engagement in which students put all of their efforts and focus on specific task planning, they also monitor their performance related to the task which requires more information rather than task achievement. Resource management is also one of

the types of cognitive engagement in which students can get help from external resources like internet, additional books, etc for completion of their task. In addition to this, Recipience is a type of cognitive engagement in which little mental investment is involved and students respond passively towards the instructions which try to stop their self-regulated cognitive processes.

Cognitive engagement is directly associated with the academic as well as behavioral engagement of students. Same as Pohl (2020) in his study indicated that cognitive engagement, academic and behavioral engagements are directly associated. Cognitively engaged students within the classroom showed good results, performed better in classroom activities, completed the assigned tasks on time, and were more likely to attend classes regularly. Same as Greene (2015) also indicated in his study that there is a significant association between cognitive engagement and academic achievement of students. On the whole, cognitive engagement is related to information processing and understanding but it cannot be measured directly. Moreover, it is directly associated with students' academic achievement and behavioral engagement. This indicates that by improving students' engagement we might improve their grades, regularity to attend classes, and their participation in classroom activities.

2.14.2 Emotional engagement. Emotional engagement is referred to as students' feelings regarding learning materials, their teachers, and their peers. Emotional engagement includes students' interest, excitement, and positive feelings regarding learning and learning-related activities. It is also a subdomain of students' engagement. Same as Archambault et al., (2016); Lam et al., (2014) indicated in their studies that emotional engagement is very much concerned about how students feel regarding the learning material taught to them and their institute. Moreover, emotional

engagement is also defined as affective reactions of students within their classroom (Mahatmya et al., 2012).

There are different components of emotional engagement. Fredricks, Blumenfeld and Paris (2004) indicated three components for emotional engagement which are general arousal, physiological synchrony with the instructor, and momentary engagement. Moreover, three types of engagement are described by Trowler (2010) positive engagement, non-engagement, and negative engagement. In terms of emotional engagement if a student is positively emotionally engaged then he/she will take an interest within the class and learning activities. Whereas, non-emotional engagement means that students will show boredom within the class. In addition to this, the negative emotionally engaged students is referred to the student who shows rejection within the class.

There is an association between emotional and behavioral engagement. A research study conducted by Finn and Zimmer (2012) indicated that when students are emotionally engaged it motivates them to put more effort and energy into the tasks assigned to them and it is also an incentive for students to perform well in learning tasks. Moreover, emotional engagement is also associated with the cognitive and academic achievement of students. It is also indicated that a relationship between emotional engagement and cognitive engagement is cyclic, not linear or EE is a result of CE. Moreover, the importance of emotional engagement for cognitive engagement and academic achievement was also reported by the researcher (Manwaring, 2017). On the whole, emotional engagement is positive feelings of students towards the learning tasks/activities, peers, teachers, and institute. It is also associated with behavioral engagement, cognitive engagement, and academic achievement of students which

means that emotionally engaged students are more likely to think critically, take part in learning activities and perform well as compared to non-engaged students.

2.14.3 Behavioral engagement. Behavioral engagement is relevant to doing a task. It involves how well the students are taking part in learning activities. Same as Yu et al., (2019) indicated that behavioral engagement is the extent to which students take part in classroom activities. Furthermore, it is also relevant to the extent to which students may put their efforts into tasks as well as how many classes they are attending. Furthermore, Shernoff (2013) indicated that behavioral engagement is also related to how students behave in class, their interest in tasks, and their participation in learning tasks and activities.

There are three dimensions of behavioral engagement among students which are: behaviors, participation, and interest of students (Nguyen, Cannata & Miller, 2018). The behavioral dimension includes two types of behaviors positive behaviors and negative behaviors. A research study conducted by Finn and Rock (1997) indicated that within the class or school students usually show two types of behaviors either positive or negative. When a student follows the rules of the classroom and institutes it comes under the category of positive behavior which is an indicator of behavioral engagement. In contrary to this, the disruptive behavior showed by the students and disobeying teacher and rules of the institute is a type of negative behavior and it is an indicator of low or disengagement.

Participation in classroom activities is the second dimension of behavioral engagement. It includes both participation in institute-related activities and also in class-related activities. Institute-related participation involves the attendance of students, their interaction with the teacher, administration, their attendance, and participation in extracurricular or Institute-sponsored activities. Whereas, classroom-

related participation involves active participation in learning-related tasks (Wang, & Holcombe, 2010). Furthermore, the third dimension is students' interest in learning tasks and how much they are willing to take part in learning activities (Nguyen, Cannata & Miller, 2018). Moreover, it is indicated that students with keen interest frequently ask questions, contribute in class discussions, group activities, and are persistent in the learning tasks (Yazzie-Mintz & McCormick, 2012). On the whole, behavioral engagement involves students' positive behaviors, participation, and interest in learning tasks. It is necessary to plan such kind of activities within the class in which students' takes interest and shows their willingness to take part for making learning experience effective for students.

2.15 Association Between Teaching Through Video and Students' Engagement

Videos are different from the lecture method because in videos various attractive colors, graphics, animations, and sound can be used which serves an important role in grasping the attention of the students. Various research studies also indicated a strong association between teaching through videos and students' classroom engagement (Dash et al., 2016; Stockwell, 2015).

2.16 Use of Video and Students' Cognitive Engagement

Videos have various visuals and graphics that allow students to pay attention and concentrate on the video clips which facilitates their knowledge construction and make them able to remember and understand the concepts in less time. A research study conducted by Brame (2016) indicated that videos are the best replacement of long lectures because it makes students able to remember and understand the concept in less time. In addition to this, it is also highlighted that by watching videos students'

conceptual understanding gets enhanced and they become able to relate and apply the concept in real-life situations.

Science subjects have many abstract concepts and when a teacher teaches those concepts by just delivering lectures students lose their attention within the class which affects their learning negatively. The research study conducted by (Stockwell, 2015) indicates that instead of teaching science by using the lecture method if a teacher use video having visual stimuli, graphics, and eye-catching colors then students will pay more attention and concentration towards the content being taught in the video.

Most of the students get afraid of long and difficult concepts which teachers cover in the lecture of 40-45 minutes because it is difficult for students to understand the whole long concept at once. In the research study conducted by Bobek and Tversky (2016) it has been indicated that by using videos teachers can break long complex topics into smaller ones with the addition of pictures and graphics which not only assist students learning but also improves their conceptual understanding. On the whole, it is analyzed by reviewing the existing studies that videos are significant teaching tools for enhancing students' cognitive engagement because they are attention gaining, students pay concentration on videos because of their eye-catching interface. In addition to this, it helps students in remembering, understanding, and applying the concepts in real life by breaking the complex concepts into small and understandable parts.

2.17 Use of Video and Students' Emotional Engagement

Emotional engagement of students in class is one of the main dimensions of students' overall classroom engagement. Until a student will not be emotionally engaged we cannot say that student classroom engagement is high. Videos can serve an important role in enhancing students' engagement in the classroom by making the

learning experience exciting for them as well as by making learning interesting and fun for them. A research study conducted by Devlin, Feldhaus and Bentrem (2013) highlighted that in the traditional method of teaching students usually feel bored in classes but if a teacher uses videos in class students' feel excited and like to watch videos.

Science-relevant videos can be made more engaging by adding various animations and pictures to make this subject interesting for students. It has also been concluded by Dash et al., (2016) in their research study that students like to watch videos for learning science-relevant concepts because of their colorful backgrounds and animations which also stimulate their interest in science subjects.

Students' do not like to attend long lectures and avoid asking questions from their teachers because they lose their concentration in the class and do not listen to what their teacher told them during long lectures. Videos are indicated as an effective tool preferred by the students instead of the traditional lecture method because it improves students' learning and students feel more satisfied, they get the confidence to ask questions as well as they like to receive more instructions through videos (Rissanen, 2018). Overall, it is indicated by reviewing the previous studies that video-based teaching can enhance students' emotional engagement or their likeness towards the learning materials and their satisfaction towards the course being taught which might enhance students' overall classroom engagement.

2.18 Use of Video and Students' Behavioral Engagement

Students' Behavioral engagement is also one of the major dimensions of students' classroom engagement. Students usually like to skip classes because they do not like the teachers' way of teaching or either they found the subject not interesting

and boring. For enhancing the class attendance of students and making them able to follow the classroom instructions teachers can use videos in the classroom. A research study conducted by Devlin, Feldhaus and Bentrem (2013) concluded in his study that the students' taught by the traditional lecture method was more used to skip the class or their attendance was short as compared to those who taught by using the videos in class. Moreover, it is also indicated that students who taught by using videos were used to follow the teachers' instructions more as compared to those who taught by traditional lecture method.

Students' do not respond to teachers' questions in the classroom either because they do not have the confidence or they have not listened to their teacher because of which they are not aware of the correct response of the question. A research study conducted by Devlin, Feldhaus and Bentrem (2013) indicated that a group taught by videos asked more questions as compared to a group taught by traditional method of teaching. It is because video can enhance students' understanding and concept clarity because of which they not only respond to teachers' questions but also discuss their queries and confusions with their teachers.

It is difficult to handle distracted students within class and students usually distract other students when they found the lecture and learning environment boring. In traditional classrooms, students can distract other students' by passing written gossips notes to other peers within their class. Such kinds of distractions can be controlled by changing the classroom environment and approach for teaching and learning. Video-based teaching is the best way to avoid distractions in class because every student must have to learn independently and take part in learning activities. A research study conducted by Kuiper et al., (2015) indicated that when we change the teaching approach and use ICT-based or video-based teaching then students will take

interest in classroom activities, their behaviors in the classroom become more focused and they do not get time to distract other students. On the whole, it is concluded that how a student behaves in class also have an impact on their classroom engagement. By using modern teaching approaches including video-based teaching, we can enhance students' behavioral engagement which in turn contributes to enhancing their overall classroom engagement.

2.19 Association Between Teaching Biology Through Video and Students' Engagement

Students' learning can be enhanced if teachers can use technology effectively in the classroom (Schmid et al., 2014). Technological tools like multimedia, online games, and videos may engage students more as compare to traditional methods of teaching. Wankel and Blessinger (2013) mentioned in their book "Increasing Student Engagement and Retention using Classroom Technologies: Classroom Response" When we mix technology with teaching which is an art it improves engagement which is science. Video is a type of technological tool that can be used for educational purposes. In addition to this, multiple studies have indicated the effectiveness of video as an innovative educational tool (Kay, 2012; Stockwell et al., 2015). Video is of much importance for teaching various abstract concepts of Biology that require more conceptual clarity on the part of the students.

Teachers can also use videos in Biology classes because they are more engaging for students. Same as Stockwell et al., (2015) concluded in their study that videos are much engaging for students that is why these are of much importance for students' preparations in Biology classes. In addition to this, another major reason that makes videos as a vital tool for Biology classes is that it helps the instructor to convert

hard abstract concepts into more visualizing concepts that can be easily understandable and engaging for students (Dash et al., 2016).

A research study conducted by Cherif et al., (2014) on 350 college students indicated the perspectives of students regarding learning Biology and Chemistry concepts through YouTube videos. Results of the study indicated that students were engaged and liked to learn from YouTube videos but they wanted their teacher to provide them the link of most relevant YouTube videos weekly because when they search for videos they have to go through many of the videos to find the most relevant and understandable video which consumes a lot of time on the part of students. The results of the study also indicated that YouTube videos grasped students' attention, engaged them in learning activities, and also motivated low-performing students to show good results. It can be analyzed from the results of this study that if students search videos on their own it not only takes much time but also there will be more chances of students' distraction if they attract towards other videos which are not relevant to their course. Same as it is difficult and time consuming for the teacher to search for the most relevant video which is as per the caliber of his/her students.

In this case, Knowledge Clips are the best options because teachers' can make these clips on their own and she/he can inculcate their unique teaching style. Moreover, they can set the language and length of the video as per their own choice and it will also reduce the chances of students' distraction from the learning materials.

Conceptual understanding is one of the components of students' cognitive engagement which leads towards students' overall in-class engagement. A research study has been conducted by Fan, Salleh and Laxman (2018) in this study they conducted an experimental study in which the impact of videos has been investigated on students' conceptual understanding of topics relevant to Biology. The results of the

study indicated that by using video-based instructions a great improvement in students' Biology conceptual understanding has been observed. It is analyzed from this study that teachers can carefully inculcate videos in their Biology classes if they want to improve conceptual understanding of their students in return which might improve the overall classroom engagement of students.

The review of the literature indicated that modern technological pedagogies are getting common in educational institutes all over the world. One of the major forms of modern instruction is the blended learning approach in which both online and face-to-face interactions are involved. This approach is more student-centered and compels students for independent learning and knowledge construction. Within the blended learning approach, knowledge clips can be used as a content delivery tool. It is a 5-6 minutes' video clip through, which a teacher can introduce a topic instead of giving a long lecture in class. Students can watch video lectures in the form of Knowledge-clip online and teachers can utilize classroom time effectively for other collaborative activities. Moreover, a teacher can use her teaching style and can set the Knowledge Clip as per the needs and abilities of her students. To investigate the effectiveness of YouTube videos and Animated videos on students' academic performance and their engagement in Science classes including Biology' various researchers has been conducted both internationally and in the Pakistani context (Alam, Khurshid & Alam, 2017; Cherif et al., 2014; Dash et al, 2016; Fan, Salleh & Laxman, 2018; Stockwell et al., 2015). All of these researchers used third-party videos instead of Knowledge Clips and one of the studies also indicated that students were not satisfied with the YouTube videos because it takes a lot of time to search for the most relevant video. Moreover, instructor-created videos have been used to check their effectiveness in online and face-to-face interactions only in international contexts (Van Puffelen, Van Berkum &

Diederen, 2018). But, as per my limited knowledge, none of the research studies has been conducted which specifically investigated the effectiveness of using Knowledge-clip on students' engagement in the Pakistani context and for Biology students at the HSSC level. That is why the current research study will be conducted to investigate the effectiveness of using Knowledge-clip on students' engagement at the HSSC level.

CHAPTER 3

RESEARCH METHODOLOGY

This study used experimental research designs. Specifically, a quasi-experimental research design was used by following non-equivalent comparison group design and non-equivalent groups pretest, post-test design. Moreover, mix-method including questionnaires, observational checklists, and open-ended questions were used for data collection. The instruments were validated by two experts in the field. Factor analysis was used for checking the construct validity of the instrument. Whereas, reliability of the instrument was checked by doing pilot testing and calculating the Cronbach alpha coefficient by using IBM SPSS 21.0. The target population of the study was N=110. Whereas, the sample of the study was n= 86 selected through purposive and convenient sampling technique.

In this research study, quantitative data analysis was done by applying an independent t-test, dependent t-test, and percentages by using IBM SPSS 21.0. For checking either the independent t-test and dependent t-test are appropriate for the data set of this study researcher checked the assumptions for running both tests. For running independent t-test these assumptions were tested: One continuous dependent variable, unrelated groups, dependent variable should be approximately normally distributed which was checked by applying Shapiro-Wilk test, dependent variable should not contain any outlier it was tested by creating box plot in IBM SPSS and homogeneity of variance which was tested by using Levene's test. Whereas, for checking the suitability of data for running dependent t-test all of the above assumptions were tested except one which was homogeneity of variance as it was not the requirement for running this test. Whereas, for qualitative data thematic analysis was done.

3.1 Research Design

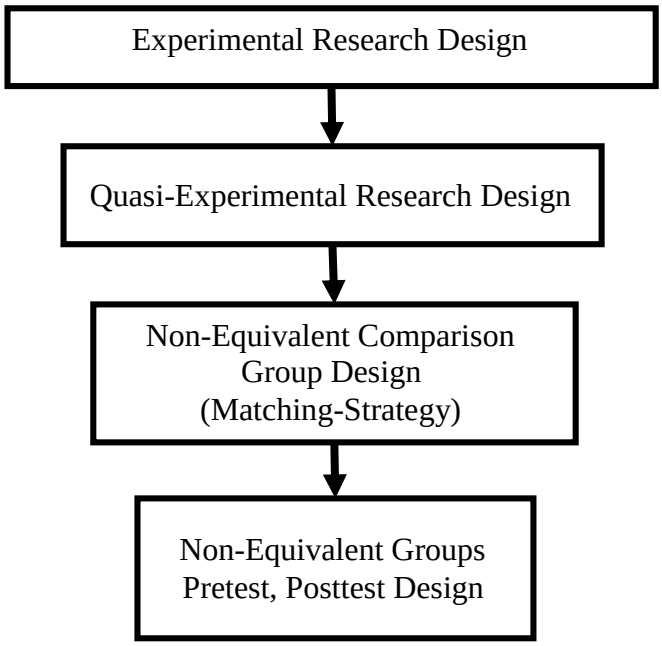

Figure 3 Research Design

A framework or a blueprint containing all the methods and techniques that can be combined for solving the research problem effectively is term as a research design (O'Leary, 2017). For the current research study, the researcher used experimental research designs. Within the experimental research, designs' researcher specifically used quasi-experimental designs. It is the most appropriate design when we select a sample through non-randomization. As per Creswell (2012) in a quasi-experimental research study researcher is unable to select participants by doing randomization.

Between two categories of quasi-experimental designs, the researcher picked non-equivalent comparison group designs. In a non-equivalent comparison group, design researchers were having an option to use naturally occurring groups or assign participants to groups by using a non-random method (Baker, 2017). For the current study, the matching strategy was used for assigning participants to the control and experimental group. The researcher matched participants based on their engagement

level scores by utilizing students' engagement survey as a pre-test (Attached as Annexure D). After matching there were 19 participants with below-average engagement levels and 24 participants with above-average engagement levels in both control and experimental group. The reason behind picking up both control and experimental groups is that when two groups with similar engagement level were taught by using different teaching methods then any change might occur in the experimental group can be visible (Creswell, 2012). Furthermore, for enhancing the internal validity of the study researcher tried her best to make both groups similar. The researcher selected both groups from the same college and the same learning situations were provided to both groups. In addition to this, both of the groups were taught in computer labs but the control group was not allowed to use computers whereas, the experimental group was allowed to use computers. In addition to this, both of the groups were involved in collaborative activities. Moreover, the same instructor (researcher herself) taught both of the groups. This shows that the researcher tried her best to remove all those factors which can be a threat to this experimental study.

Moreover, specifically in non-equivalent comparison, group designs' the researcher used pre-test and post-test design (O_1 X O_2). In this research design, both control and experimental groups took a pre-test, and then treatment was provided to the experimental group and at the end, both groups took a posttest. Howitt and Cramer (2016) in their book highlighted the reason for using this design and as per them non-equivalent groups pre-test, post-test design may not only tell the improvement of the group received treatment, it also tells that either the treatment group improved more than the control group or not. In addition to this Marczyk, DeMatteo and Festinger (2005) highlighted in their book two major advantages of using this design, one is by using both pre-test and post-test researchers become more confident in inferring

Independent variables as the cause of change within the dependent variable. In addition to this, the other benefit is Pre-test scores can highlight the group differences before intervention which could reduce the threats of selection biases by highlighting whether the two groups were different based on the dependent variable before and after the treatment. The researcher followed the following step and sequences in this study

Table 3.1

Steps Done During Quasi-Experiment

Steps for Quasi-Experiment
1. Gave a Pre-test (Students Course Engagement Survey) to 86 students.
2. Matched participants based on their engagement level scores. The range of scores was (Below Average 2.87-3.33, Average 3.34, Above Average 3.35-3.78).
3. Selected one group as a Treatment group through a non-random method Matching Strategy.
4. Selected one as a Control group through non-random method (matching strategy).
5. Taught Treatment group by using Knowledge clip.
6. Taught Control group without using Knowledge clip.
7. Another teacher did classroom observations (For avoiding Biasness).

3.1.1 Step 1. The first step in quasi-experimental research design was the selection of control and experimental group. For the current research study, the researcher took a pre-test by using Handelsman, Briggs, Sullivan and Towler's (2005) Student Course Engagement Questionnaire, created for college students and Liu and Elms (2019) students' experience of engaging with animated video. For avoiding selection biases, all of the students of one 11^{th} grade Biology class n=86 took a pre-test.

3.1.2 Step 2. After the pre-test researcher matched participants based on their engagement level scores by using a matching strategy. The pre-test scores were entered in IBM SPSS 21.0 and after computing the variables researcher calculated the mean

score which was M=3.34 mentioned in figure 1. The participants (38) scored below the mean value considered as having below-average engagement level and participants (48) who scored above the mean value were considered as having above-average engagement levels. The 38 below average participants were divided into two groups of 19 participants each and the 48 above average participants were divided into two groups of 24 each. The researcher equally divided the participants into both groups manually.

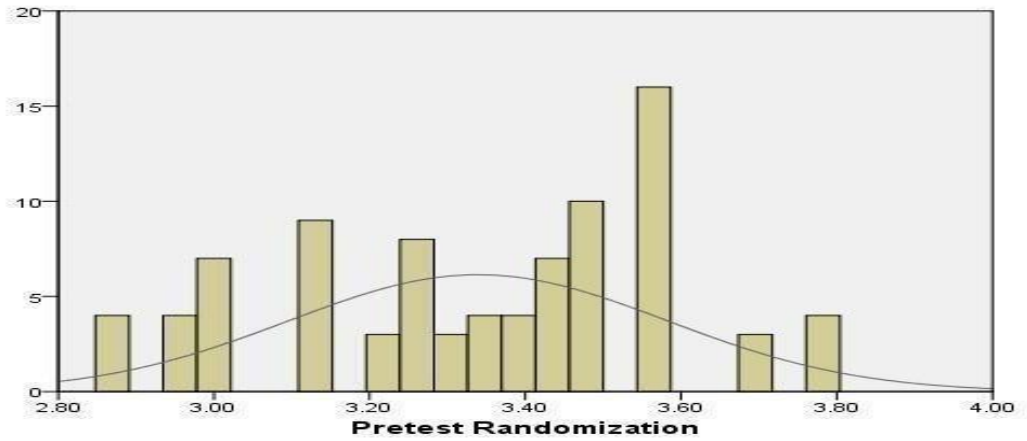

Figure 4 Matching Strategy

3.1.3 Step 3. For the control group researcher assigned 19 below-average participants and 24 above-average participants based on their engagement level. Same as for the treatment group researcher also assigned 19 below-average participants and 24 above-average participants based on their engagement level.

3.1.4 Step 4. After assigning the participants to the control and experimental group, the researcher personally taught the first ten topics of the Biology chapter 'Transport in plants and animals' (Attached as Annexure H) to both of the groups. The control group was taught by using the general lecture method and collaborative activities but without using 'Knowledge Clip'. Whereas, 'Knowledge clip' that was a treatment in this quasi-experimental study was used for teaching treatment group along with collaborative activities, (Screenshot of Knowledge Clips are attached as Annexure

I). Knowledge clips were designed by considering the attention span of students, easy to understand language, engaging and colorful interface, thought-provoking questions, and appropriate speed.

3.1.5 Step 5. The participants of the experimental group were also observed during the intervention. To avoid biases of the results another teacher of Biology recorded in-class observations for the treatment group. The reason for using both observations and questionnaires was to validate the results of one method with other and for making the research results more reliable.

3.1.6 Step 6. After providing intervention for 10 days to the treatment group researcher asked participants of both control and treatment groups to fill post-test. For taking post-test, same tools of Handelsman, Briggs, Sullivan, and Towler's (2005) Student Course Engagement Questionnaire, created for college students and Liu and Elms (2019) students' experience of engaging with animated video was used but for Treatment group questions related to Knowledge Clip was also included.

3.1.7 Step 7. based on the recorded responses of pre-test and post-test researcher analyzed the results by applying paired sample t-test and Independent t-test as a statistical test in IBM SPSS 21.0. Moreover, Percentages were calculated for analyzing the observation checklist and open-ended questions were analyzed manually by doing thematic coding.

3.2 Threats to the Validity of Experiment

As per the researcher's view, that two extraneous variables might be a major threat to the validity of the current experiment. The one was the teacher-student relationship and the other was the student-student relationship. For controlling the effect of these two variables researcher has planned to use the following strategies.

- The researcher herself taught the students instead of their Biology teacher, who was already teaching them. The researcher was a new teacher for them so students needed time to make a healthy relationship with the teacher and it might reduce the effect of Teacher and student relationship on students' classroom engagement.
- For reducing the effect of student-student relationships on students' engagement, the researcher promoted independent learning and tried her best to make random groups during collaborative tasks and shuffling of groups on regular basis. Whenever students worked in random groups, not with their friends, it reduced the effect of student and student relationships on the classroom engagement of students.

3.3 Research Method and Approach

The current research study was experimental and the researcher used the mixed-method approach for the current research study. The mixed-method includes both quantitative and qualitative approaches to data collection. The reason behind using this approach is that it is the requirement of the research objectives to use both quantitative and qualitative approaches. The researcher has used methodological triangulation in this study for making research results more valid and reliable. For investigating the effectiveness of Knowledge-clip on students' engagement researcher needs respondents to fill the questionnaire. Moreover, for validating those results and making them biasness free researcher used an observational checklist which was filled by another teacher instead of the researcher itself. Both of these tools come under the category of quantitative research methods. Whereas, for making research results more valid

researcher did a triangulation of data by using open-ended questions in the stage of post-test which comes under the category of qualitative method.

3.4 Population

For this research study, all 11th-grade Biology students of Rawalpindi city were considered as the population for this study. The target population for the current study was all 11th-grade Biology students of one F.G college of Rawalpindi, N= 110. The researcher has personally done telephonic calls to the relevant institute for getting the exact number of the target population.

At the very first step, the researcher got the authentic list of all Government colleges of Rawalpindi from the authorized website of Federal Government Educational Institutions C/G. It was a complete region-wise list so the researcher only considered the part of the list having colleges in the Rawalpindi Region (Attached as Annexure J).

3.5 Sample

For the current research study, the researcher selected one11th grade FSC pre-medical class of the college whose admin granted permission to conduct the research study. Furthermore, Cohen, Manion and Morrison (2007) indicated in the book "Research Methods in Education" that the minimum sample size for educational research is 30. The researcher used the table of sample determination for finite population by Krejcie and Morgan (1970) (Attached as Annexure P) for calculating sample size for this study. Details are mentioned below:

Table 3.2

Detail of Sample Selection (n=86)

N	***S***
110	86

The above-mentioned table is a part picked from the table of sample selection given by Krejcie and Morgan (1970) (Attached as Annexure P). This table is having two columns one is indicating population size and representing by a symbol (N) whereas, the other column is for sample size representing by the symbol (S). In parallel to the population size, its sample size is written. As per this table if a population is N= 110 then the sample size will be n= 86 so for the current research study sample size was n=86 which is 78.18% of the target population. Whereas, for both the control and the experimental group sample size was 43 for each group.

The reason behind selecting a sample for the experimental study is that there were two sections of Biology students in the selected college thus, the researcher firstly finds the target population and then selected a sample out of it.

3.5.1 Sampling Technique. For the current research study, the purposive and convenient sampling technique was adopted. The reason behind using the purposive sampling technique was that researcher needs computer labs to conduct an experiment and those students who have not yet studied the Biology chapter "Transport in plants and Animals" because of this, the researcher selected a college having computer lab and whose students have not read that chapter which is included in the experiment. Whereas, the reason behind using the convenience-sampling technique is that researcher needed the college whose admin allows the researcher to conduct an experimental study at their college.

3.6 Instrument

The researcher adapted and merged two questionnaires; one of them was Handelsman, Briggs, Sullivan and Towler's (2005) Student Course Engagement Questionnaire, created for college students. This tool was built on a five-point Likert scale with options from "Totally Agree" to "Totally Disagree". This scale was covering three constructs of students' engagement, which includes cognitive engagement, emotional engagement, and behavioral engagement. Moreover, another tool adapted was Liu and Elms (2019) Students' experience of engaging with the animated videos. It was also built on a Five-point Likert scale having response options from "Totally Agree" to Totally Disagree". The total number of items in the questionnaire was 23 and it was also having six open-ended questions two for each domain (cognitive, emotional, and behavioral engagement). (Attached as Annexure C & D). Researcher granted permission to use these tools for the study (Attached as Annexure M & N). The reason behind adapting the tool was that the researcher wanted to slightly change the instrument as per the need of the current study. As the research tools adapted were having the statements regarding students' engagement within the class and students' engagement with animated videos but researcher wanted to check the students' engagement within the class by using Knowledge Clips that is why the only word "Knowledge Clip" was added in the statements of the research instrument. No major changes were made in the statements of the existing instruments that is why for checking the construct validity of the tool pilot testing was done and CFA was run by using AMOS (See Table 3.5).

Table 3.3

Number of Statements in Each Dimension of Questionnaire

Sections	Variable	Item Number/s	Coding Ranges
1	Cognitive Engagement	7	C1-C7
2	Emotional Engagement	8	E1-E8
3	Behavioral Engagement	8	B1-B8

For making research results more valid researcher used an observation checklist. For the observation checklist researcher adapted a tool of Liu and Elms (2019) students' experience of engaging with animated video. The observation checklist consisted of 20 statements was used. (Attached as Annexure E).

Table 3.4

Number of Statements in Each Dimension of Observation Check List

Sections	Variable	Item Number/s	Coding Ranges
1	Cognitive Engagement	6	C1-C6
2	Emotional Engagement	6	E1-E6
3	Behavioral Engagement	8	B1-B8

3.7 Validity of an Instrument

The validity of the research tool was checked in two phases. Firstly, the researcher gave a research tool to two experts of the field with a request to check the construct and content validity. The researcher shuffled all of the statements within the tool and eliminated their major construct headings like cognitive engagement, emotional engagement, and behavioral engagement. Experts identified and placed the statements in more suitable categories and then the researcher matched those statements and categories within the tool and corrected the wrong placement of any statement. For checking the content validity of the tool experts have critically checked the sentence

structures and any grammatical or spelling errors. Instrument validity certificates are attached as Annexure F & G. In the second phase, the researcher has done confirmatory factor analysis (CFA) on data of pilot testing by using IBM SPSS 21.0. The reason behind using CFA was that the two research questionnaires were adapted to make a single instrument their sentence structure was same but the researcher only added the term "Knowledge Clip" to make it the best fit for the current study. CFA was run to check the construct validity of an instrument and to reduce the overall number of observed variables into latent factors based on their commonalities within the data. Research has done these steps for running CFA: Model Specification, Model Identification, Model Estimation, Model Assessment, and Model Re-specification. After taking data from pilot testing researcher entered all of the data into IBM SPSS 21.0 and connected a trial version of AMOS with it. There were twenty-three statements within the questionnaire for three major constructs. After Running CFA, the following results were drawn:

Table 3.5

Model Fit Results After Running Confirmatory Factor Analysis

Metric	**Observed Value**	**Recommended Value**
CFI	1.000	>0.90
GFI	.926	>0.90
RMR	.000	<0.05
RMSEA	.000	<0.05
P-Value	.746	>0.05

The above-mentioned table is indicating that CFI value= 1.000 and GFI value= .926 which is above the threshold value of 0.9. Whereas, RMR value= .000 and RMSEA value= .000 which is less than threshold value of 0.05. Whereas, the p-value= .746 which is insignificant. All of these values are indicating that the data fits the model.

Moreover, model-fit statistics indicate a good fit on the model and the hypothesized model is a good fit for the data that is why there was no need to make any modifications within the model or deleting any item. The model fit is attached as (Annexure L).

3.8 Reliability of an Instrument

As the researcher adapted tools of international context that is why it was needed to check the reliability of the tools. To check the reliability of the research tool researcher done pilot testing on 46 students who were excluded from the actual sample/target sample.

Firstly, a pretest tool was given to the participants and then a short Knowledge Clip was played for students. When students watched Knowledge Clip the posttest was given to the students. The researcher has recorded all of the responses of pretest and posttest in IBM SPSS 21.0 and to check the reliability of the instruments researcher used Cronbach's alpha reliability coefficient as a statistical test. Results of the reliability test are described as under:

3.8.1 Reliability statistics for the post-test tool.

Table 3.6

Reliability Statistics for Overall Post-test Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.931	.939	23

As mentioned in the above table Cronbach's Alpha value is .931 which is near to 1. Hence it is interpreted that overall the posttest instrument is highly reliable.

Furthermore, the reliability of every construct was also checked separately, Details of individual reliability of each construct is described as under:

Table 3.6.1

Reliability Statistics for Cognitive Engagement Post-test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.783	.821	7

The above table is representing an alpha value of .783 which is near to 1. It is indicating that statements within cognitive engagement posttest were relatively good. There is no need to exclude any item because the alpha value is .783 and near to 1 representing a good reliability value.

Table 3.6.2

Reliability Statistics for Emotional Engagement Post-test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.928	.932	8

The table above is indicating an alpha value for emotional engagement post-test as .928 which is near to 1. Hence it is interpreted that statements within the construct of Emotional engagement were highly reliable. It indicates that there is no need to exclude any item because alpha value is .928 and near to 1 representing an excellent reliability value for the given construct.

Table 3.6.3

Reliability Statistics for Behavioral Engagement Post-test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.701	.733	8

The above table is indicating an alpha value for the construct of Behavioral engagement as .701 which is near to 1. Hence it is interpreted that statements within the behavioral engagement construct were reliable. Furthermore, there is no need to exclude any item because the alpha value is .701 which is near to 1 and representing a good reliability value for the given construct.

3.8.2 Reliability statistics for pretest tool.

Table 3.7

Reliability Statistics for overall Pre-test Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.859	1.59	23

The above-mentioned table is indicating an alpha value of .859 which is near to 1 thus, it is interpreted that the overall pre-test tool is highly reliable. The individual reliability of every construct was also checked. Individual reliability statistics for each construct of the pre-test tool are described as under:

Table 3.7.1

Reliability Statistics for Cognitive Engagement of Pre-test Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.742	.749	7

The table above is indicating an alpha value of .742 for cognitive engagement items of pre-test tool. The alpha value is near 1 which indicates that the items within this construct are reliable. There is no need to exclude any item because the alpha value is .742 which is near to 1 and representing a good reliability value for the given construct.

Table 3.7.2

Reliability Statistics for Emotional Engagement of Pre-test Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.766	.775	8

The above table is representing the alpha value as .766 which is near to 1 thus, it can be interpreted that all of the 8 items within the construct of emotional engagement for the pre-test tool are reliable. It is not required to exclude any item because the alpha value is .766 and representing a good reliability value for the given construct.

Table 3.7.3

Reliability Statistics for Behavioral Engagement of Pre-test Instrument

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.792	.824	8

The above-mentioned table is highlighting an alpha value of .792 which is near to 1. It is indicating that all of the items within the construct of behavioral engagement for the pre-test tool are reliable. Moreover, it is not required to exclude any item because the alpha value is .792 and representing a high-reliability value for the given construct.

3.9 Data Collection Procedure

The current study was quasi-experimental and needed a lot of pre-planning. The researcher wanted to teach students by using Knowledge Clip for checking its effectiveness on students' engagement. Whereas for teaching, there was a need to develop a Biology module for implementing intervention successfully.

First of all, the researcher searched a Textbook of Biology for 11^{th}-grade students from the website of elearn. Punjab. From the textbook, the chapter on Transport in plants was selected and divided into units for making effective Knowledge Clips. The next step was creating a knowledge clip. The researcher tried out different video-creating software's but all of them were paid. The free trial version of the software was producing a video with a big watermark that cannot be used.

After checking out much video-creating software's researcher randomly got an idea that she can create PowerPoint slides, record them and export them in video form. The researcher searched different colorful backgrounds, and animated images relevant

to the first topic. The researcher created PowerPoint slides by using text, pictures, animations, and colorful backgrounds. After creating PowerPoint slides she wrote a script and recorded the first Knowledge clip. It was so easy to create effective eye-catching Knowledge Clips in PowerPoint within less time and without spending a single penny. The researcher did the same for creating all of the 10 Knowledge clips by changing the shape, colors, text, and animated pictures.

After creating Knowledge Clip (KC) now it was a challenge that how to display KC for every student separately and by using Online means. For displaying a knowledge clip researcher has created a Google Classroom and uploaded all of the Knowledge clips and online quizzes on Google classroom. It was a great platform because when students solved online quizzes after watching every KC it generates automatic scoring and also pie charts for showing students' overall progress.

For creating a complete Biology Module researcher has developed lesson plans by following standardized patterns. The lesson plans were having a detailed description of both online/in-class activities and the duration of those activities. The researcher wanted to create Biology modules for the whole chapter “Transport in plants and Animals” but due to less time researcher skipped the part transport in animals and only created Knowledge Clips for the first ten topics of the chapter Transport in Plants.

After module development researcher granted the permission from the desired college to conduct an experimental study for 15 days. Unfortunately, college management only allowed the researcher to conduct the experiment only for 10 days. After getting permission from the college management researcher used the students’ engagement survey as a pre-test and matched participants based on their engagement level scores. Moreover, an equal number of below and above average participants based on their engagement level were assigned to both the treatment and experimental groups.

There were 43 participants each for both experimental and control groups. The researcher has also provided participants with confidential surety to get honest responses of participants.

After dividing participants into the control and treatment group researcher herself taught the experimental group by using Knowledge-Clip and the control group without using Knowledge Clip. While conducting an experiment researcher faced the problem of internet connectivity. Instead of wasting time researcher created day-wise folders consisting of one Knowledge Clip each and related quiz into the computers for each student. This way, the researcher has shifted the online part of her blended learning module to computer-assisted instructions.

After 10 days of teaching, the researcher gave a student' engagement survey as a post-test to both of the groups and recorded their responses. For the treatment group, the students' engagement survey consisted of statements relevant to Knowledge Clip. Whereas, for the control group same pre-test tool was used as a post-test without including statements regarding knowledge clips.

While teaching students of both control and experimental group, the Biology class teacher of the students observed them and filled observation checklists. Instead of taking this responsibility by the researcher herself, she gave this responsibility to another teacher to reduce the chances of biasness. The observer teacher observed the participants continuously for ten days and recorded her responses on observation checklist. After taking all of the data researcher said thank you to college management and also research participants for their time and facilitation they have provided throughout this experiment.

Table 3.8

Ten Days Activities Along with Topics

Days	Topics	Activities Sequence
Day 1	Introduction to transport in plants	Watching Knowledge-Clip on Topic, Notes Taking, Filling Quiz, Preparing Presentation in Groups, Presenting work, On-spot feedback by teacher
Day 2	Role of roots in the transport of nutrients in plants	
Day 3	Absorption of water in plants	
Day 4	Absorption of minerals in plants	
Day 5	Ascent of sap	
Day 6	Transpiration pull in cohesion tension theory	
Day 7	Root imbibition and Bleeding	
Day 8	Types of Transpiration	
Day 9	Cuticular & Lenticular Transpiration	
Day 10	Phloem Transport	

The above table is indicating that in ten days for each topic researcher used a lesson plan in which at the very first step students watched knowledge clips and took notes. Then they filled the online quiz. After taking the quiz they worked in groups and prepared a short presentation on the same topic and presented it in front of the whole class. In the end, the researcher provided on-the-spot feedback to the students.

3.10 Data Analysis

The study was experimental and used mix-method. For the current study, an independent t-test was used for comparing the students' engagement of both groups. Whereas for comparing the engagement of students within group dependent t-test was used and data were analyzed by using SPSS 21.0. Whereas, percentages were calculated for observation checklists, and for open-ended questions thematic analysis was used. After data collection, the researcher typed the responses and generated themes for data analysis by doing manual coding.

CHAPTER 4

DATA ANALYSIS

This Chapter includes the data analysis process researcher has used to interpret the results of the study. There are two major sections; quantitative analysis and qualitative analysis. Furthermore, within the quantitative analysis section three types of analysis are present including; between-group comparison, within-group comparison, and observation checklist analysis. This study used two research methods one of those is the quantitative method in which the researcher adapted a questionnaire to get the participants' responses regarding their engagement in Biology class and used it for both control and experimental group with few modifications (Attached as Annexure C & Annexure D). Moreover, open-ended questions were also used in the questionnaire for getting unrestricted responses of participants regarding their cognitive, emotional, and behavioral engagement. These type of open-ended questions comes under the category of qualitative method. On the other hand, the researcher has used observation checklists (Attached as Annexure E) as a quantitative research method for crosschecking the students' responses with real in-class observations. The reason behind using mix method was to make the research results more valid and authentic. Furthermore, the current study was experimental and inferential having a control group/treatment group and both groups took pre-test and post-test. To analyze the research results researcher used IBM SPSS 21.0. All of the data including pre-test and posttest scores were first entered into SPSS manually, then data cleaning was done to check any missing response or any errors. After data cleaning researcher checked the assumptions for running ANCOVA and ANOVA but the data set was not accomplishing some of the assumptions for running these tests.

Furthermore, different tests indicated that the research data was accomplishing the assumptions of paired sample t-test and independent t-test. The researcher used a dependent t-test or paired sample t-test for analyzing the difference in the pretest and post-test scores within-group and an independent sample t-test was used to check the difference of pretest and post-test scores between control and treatment groups. A detailed table including objectives, hypotheses, research questions, and treatment/statistical tests used is given below:

Table 4.1

Table for Statistical Tests

Objectives	**Hypotheses**	**Research Questions**	**Treatment**
1. To investigate the effectiveness of Knowledge-Clip on students' engagement at the HSSC level.	There is statistically no effectiveness of Knowledge-Clip on students' engagement at the HSSC level.	What is the effectiveness of Knowledge Clips on students' engagement at the HSSC level?	Independent t-test, Dependent t-test (for Questionnaire) Percentages (for observational checklist) Thematic analysis (for open-ended questions)
2. To compare in-class engagement of Control and Experimental group	There is statistically no significant difference in students' engagement for control & experimental group.		Independent t-test
3. To assess the difference in pre-test and post-test scores of the control group.	There is statistically no significant difference in pre- and post-test scores of control group.		Dependent t-test
4. To compare engagement scores of the experimental group before and after the intervention.	There is statistically no significant difference in engagement of the experimental group before and after the intervention.		Dependent t-test

Section 1

4.1 Data Analysis for Quantitative Part (Questionnaire)

4.1.1 Matching strategy used before conducting pre-test. To divide the participants into control and experimental group researcher took a pre-test and entered their scores in IBM SPSS 21.0. The researcher calculated the mean scores and by utilizing a matching strategy divided the participants into two groups. The researcher matched participants based on their engagement level scores by utilizing students' engagement survey as a pre-test (Attached as Annexure D). The table below is representing the results of the matching strategy:

Table 4.2

Matching Strategy for Dividing Participants into Control and Treatment Groups (n=86)

Ranges of Mean Scores	Mean Values	Groups	No. of Participants	No. of Participants with Above Average Mean Scores	No. of Participants with Below Average Mean Scores
Above Average	3.35-3.78	Control	43	24	19
Average	3.34	Treatment	43	24	19
Below Average	2.87-3.33				

As per the above-mentioned table, the mean score was M=3.34. The Scores were divided into three ranges; Below Average (2.87-3.33) Average (3.34) and Above Average (3.35-3.78). Moreover, the number of participants who scored below the mean value was 38 and they were considered as having below-average engagement levels. Whereas the number of participants who scored above the mean value was 48 and they

were considered as having above-average engagement levels. Furthermore, the researcher constituted the control group having 19 below-average participants and 24 above-average participants based on their engagement level. Same as researcher created an experimental group having 19 below-average participants and 24 above-average participants based on their engagement level. The researcher considered the mean scores of participants and divided them manually into control and experiential groups. After matching participants' intervention was given to the experimental group for ten days and a post-test was conducted after the intervention. The detailed analysis of post-test results is described as under:

4.2 Between Group Post-Test Comparison

After conducting the post-test researcher applied an in-dependent t-test by using IBM SPSS 21.0 for comparing the mean scores between the control and experimental group. Firstly, the researcher tested five assumptions for running an independent t-test. The details of assumptions testing are described as under:

4.2.1 Assumptions for running independent t-test.

• **One continuous dependent variable.** The dependent variable in the current study was students' engagement which is a continuous type variable hence, the data is accomplishing the first assumption for running Paired-Sample t-test.

• **Unrelated groups.** The two groups control and experimental groups in this study were unrelated because the participant of the control group was not part of an experimental group or vice versa. The assumption of unrelated groups is fulfilled by the data set.

• **The dependent variable should be approximately normally distributed.** for checking the normality of data research has run a normality test named

as “Shapiro-Wilk Test” by using IBM SPSS 21.0. The Null hypothesis for running this test was: H0: There is statistically no significant departure from normality is present within the research data set. Details for running this test are mentioned in below table:

Table 4.3

Shapiro-Wilk Test for Checking Normality of Data

	Shapiro-Wilk		
	Statistic	Df	Sig.
Difference2	.956	85	.100

As the above table is indicating that the Significant value or p-value is greater than 0.05 indicating that the data set is normally distributed. Thus, the null hypothesis There is statistically no significant departure from normality is present within the research data set is failed to reject.

For checking the normality of the dependent variable Normal Q-Q Plot was also created by using IBM SPSS 21.0. The explanation of this Normal Q-Q Plot is given below:

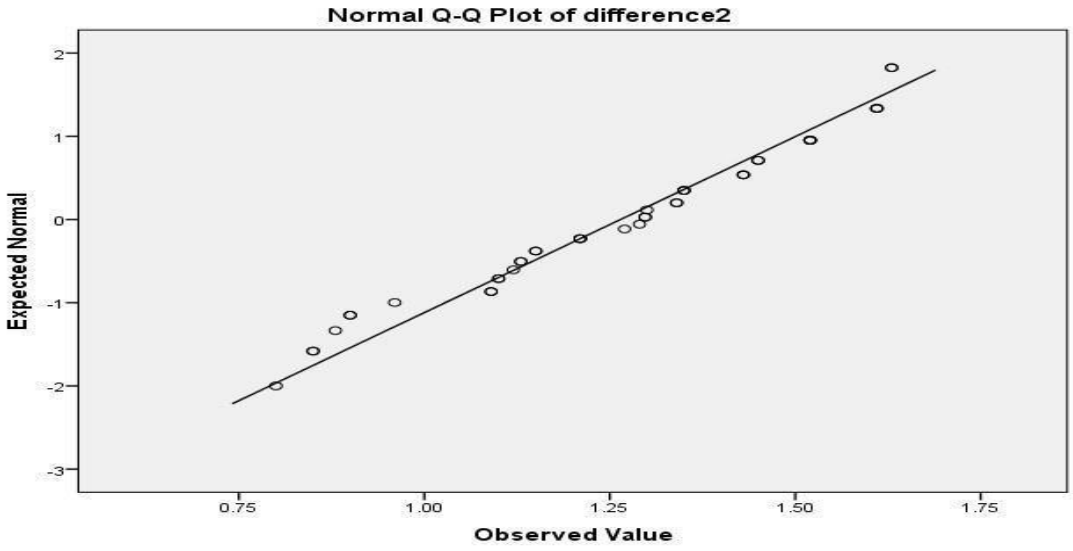

Figure 5 Normal Q-Q Plot

The above-mentioned Normal Q-Q Plot is also representing that the date is near the line so it is not ideally normally distributed but approximately normally distributed hence, the data is accomplishing the third assumption for running an Independent t-test.

• **The dependent variable should not contain any outlier.** For checking this assumption Box plot was created by using IBM SPSS 21.0. The details are described as under:

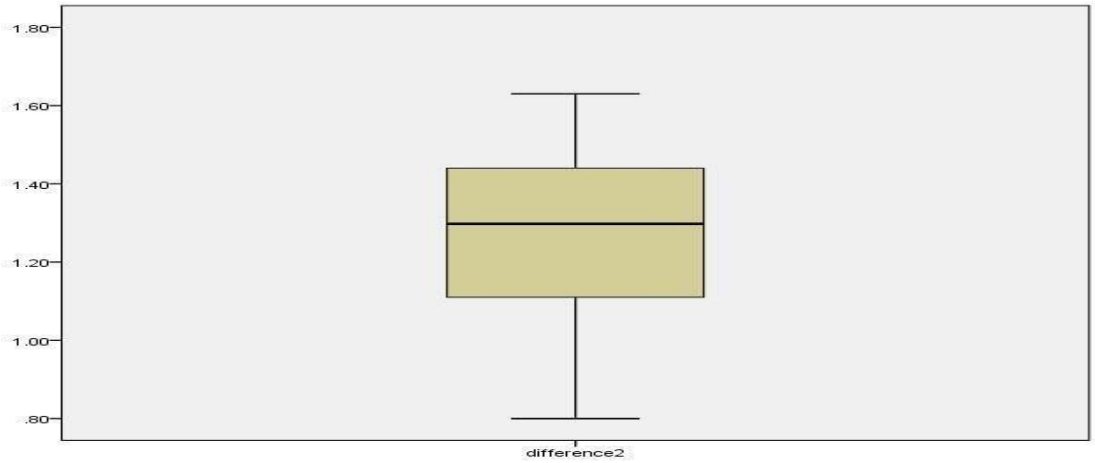

Figure 6 Identification of Outliers

The above figure is indicating that the lowest value is .80 whereas, the maximum value is 1.65 in the mean difference between the control and experimental group. Moreover, there is no value above the top whisker and the bottom whisker indicating that there is no outlier in the given data set. Hence, the data is accomplishing the fourth assumption for running an independent t-test.

• **Homogeneity of Variance.** For checking the homogeneity of variance among samples/groups researcher used Levene's test by using IBM SPSS 21.0. Homogeneity of variance was investigated among the control and experimental group whereas, the variables were cognitive engagement, emotional engagement, and behavioral engagement. The Null hypothesis for running this test was: $H_{0:}$ There is

statistically no significant difference in variance between one group and the other group. The details of the results are described as under:

Table 4.4

Levene's Test for Checking Homogeneity of Variance

F	df1	df2	Sig.
28.780	1	84	1.00

The significant value in the above table is 1.00 which is greater than the p-value=0.05 is indicating that in two situations the variability is not much different. Thus the null hypothesis there is statistically no significant difference in the variance of one group and other group is failed to reject. Hence, the data set is accomplishing the fifth assumption for running an independent t-test. Based on the above results researcher has used an independent t-test for the current study.

To compare the students' engagement after teaching one group (treatment group) by using Knowledge Clip and the other group (control group) by using the traditional lecture method researcher compared post-test scores of both control and treatment group by applying Independent t-test by using IBM SPSS 21.0. The results of the post-est comparison between groups are described below:

Table 4.5

Independent Sample t-test Results for Post-test of Students' Engagement

Variable	N	Mean	Df	t-value	p
Control group	43	3.26	84	-8.504	.000
Experimental group	43	4.15			

In the above-mentioned table, a clear difference is visible in the mean scores of post-test between the control and treatment groups. For the control group mean score

was M=3.26 and for the treatment group mean score was M=4.15 which is higher than the mean score of the control group. In addition to this the p-value is .000 or $p< 0.05$ thus, we reject the main null hypothesis which was there is statistically no effectiveness of Knowledge-Clip on students' engagement at the HSSC level or it can be interpreted as students' who taught by using Knowledge Clip were more engaged as compared to students' who taught by using Traditional lecture method.

4.3 Within Group Comparison

A dependent t-test was used for comparing mean scores of pre-test and post-test for the control group. In addition to this, the dependent t-test was also used for comparing the mean scores for the experimental group before and after giving an intervention. The researcher tested assumptions for running Paired-Sample. There were four assumptions for the paired-sample t-test. The details of assumption testing are described as under:

4.3.1 Assumptions for running paired-sample t-test.

- **The dependent variable must be continuous.** The dependent variable in the current study was students' engagement which is a continuous type variable hence, the data is accomplishing the first assumption for running a Paired-Sample t-test.

- **The observations are independent of one another.** For the current study two groups were treated differently and took observations independently hence, the data is accomplishing the second assumption for running the paired-sample t-test.

- **The dependent variable should be approximately normally distributed.** For checking the normality of data research has run a normality test named as "Shapiro-Wilk Test" by using IBM SPSS 21.0. The Null hypothesis for running this

test was: H0: There is statistically no significant departure from normality is present within the research data set. Details for running this test are mentioned in below table:

Table 4.6

Shapiro-Wilk Test for Checking Normality of Data

	Shapiro-Wilk		
	Statistic	Df	Sig.
Difference2	.956	85	1.00

The above table is indicating that the significant value or p-value is greater than 0.05 indicating that the data set is normally distributed. Thus, the null hypothesis There is statistically no significant departure from normality is present within the research data set is failed to reject.

For checking the normality of the dependent variable Normal Q-Q Plot was also created by using IBM SPSS 21.0. The explanation of this Normal Q-Q Plot is given below:

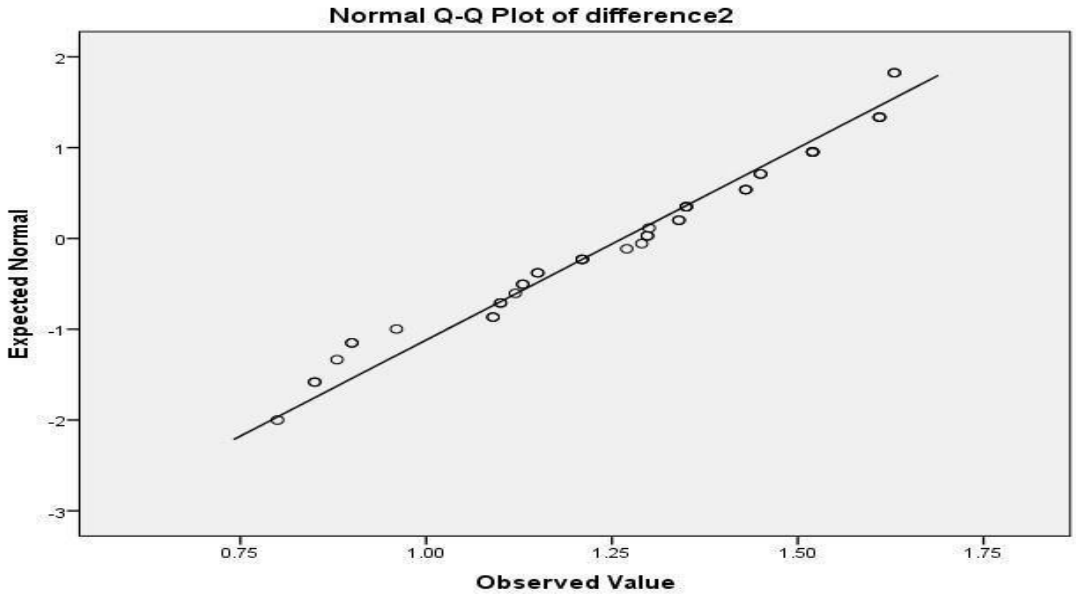

Figure 7 Normal Q-Q Plot

The above-mentioned Normal Q-Q Plot is also representing that the date is near the line so it is not ideally normally distributed but approximately normally distributed hence, the data is accomplishing the third assumption for running Paired Sample t-test.

- **The dependent variable should not contain any Outliers.** For checking this assumption Box plot was created by using IBM SPSS 21.0. The details are described as under:

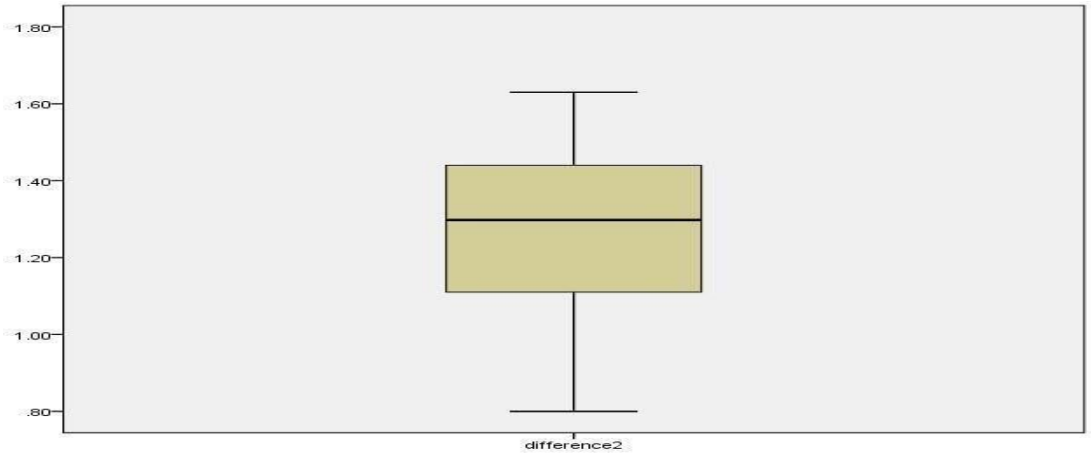

Figure 8 Identification of Outliers

The above figure shows that the lowest value is .80 whereas, the maximum value is 1.65 in the mean difference of control and experimental group. Moreover, there is no value above the top whisker and the bottom whisker indicating that there is no outlier in the given data set. Hence, the data is accomplishing the fourth assumption for using the paired-sample t-test. The researcher has used this test for within-group comparison for both Control and Experimental groups. Detailed analysis is mentioned below:

4.4 Within Group Comparison for Control Group

The control group for the current study was a group whose participants took a pretest and posttest but have not received treatment. For the current research study to check the difference in students' engagement by using pretest and post-test scores

researcher used IBM SPSS 21.0 and applied paired sample t-test or dependent t-test. The difference in the mean score of pretest and posttest are described as under:

Table 4.7

Paired Sample t-test Results for Control Group

		Mean Difference	**SD**	**T**	**Sig. 2Tailed**
Pair 1	Cognitive pretest & post-test	.16944	.77826	-1.428	.161
Pair 2	Emotional pretest & post-test	.29070	.73483	-2.594	.113
Pair 3	Behavioral pretest & post-test	.04070	.97884	-.273	.786

As mentioned in the above table p-value for cognitive pre-test and cognitive post-test is .161 and p>0.05 thus, the researcher was failed to reject the null hypothesis which means that the results of pre-test and post-test indicated no significant difference in students' cognitive engagement for the control group (M=1.69, SD=.78), t (42) = -1.43, p=.161.

The table above indicated that the p-value for emotional engagement is P=.113 and p>0.05 thus, the researcher was failed to reject the null hypothesis for the control group. It means that pre and post-test results highlighted no significant difference in emotional engagement of students for the control group (M=.30, SD=.73), t (42) = -2.60, p=.113.

Within the above table p-value for behavioral engagement is .786 and p>0.05 thus, the researcher was failed to reject the null hypothesis for the control group, which indicates that as per pre and post-test results there is statistically no significant

difference in students' behavioral engagement for the control group (M=.04, SD=.98), t (42) =-.273, p=.786.

From the above-mentioned results, it is indicated that there is no significant difference in the engagement of students for the control group who taught by using the regular traditional method of teaching or it can be interpreted that engagement of the students who taught by using traditional lecture method remained same in pretest and posttest.

4.5 Within Group Comparison for Experimental/Treatment Group

In this research, the treatment group first took a pretest and then received intervention or treatment and at the end took the post-test. For analyzing the difference in the students' engagement scores before and after treatment researcher has used paired sample t-test or Dependent t-test by using IBM SPSS 21.0. The difference in the mean scores of pre-test and post-test for the treatment group is described in the table below:

Table 4.8

Paired Sample t-test Results for Treatment Group

		Mean Difference	SD	T	Sig. 2Tailed
Pair 1	Cognitive pretest & Cognitive posttest	1.00332	.58611	11.225	.000
Pair 2	Emotional pretest & Emotional posttest	1.94477	.36218	35.211	.000
Pair 3	Behavioral pretest & Behavioral post-test	.67442	.29773	14.854	.000

The above-mentioned table is indicating the difference in the cognitive, emotional, and behavioral engagement of students' before and after the intervention. It is highlighted that for cognitive engagement pre and cognitive engagement post the p-value is .000 and $p<0.05$ thus, the null hypothesis was rejected. It is indicated that there is a significant difference in the cognitive engagement of students' before and after receiving an intervention ($M= 1.00$, $SD= .59$), $t (42) =11.23$, $p=.000$.

The above table also indicated that for emotional engagement-pre and emotional engagement-post p-value is .000 and $p< 0.05$ thus, the null hypothesis was rejected. It is indicated that there is a statistically significant difference in the emotional engagement of students' before and after the treatment provided ($M= 1.94$, $SD= .36$), $t (42) = 35.21$, $p=.000$.

The values within the above table highlights that for behavioral engagement-pre and behavioral engagement-post p-value is .000 and $p< 0.05$ thus, the researcher rejected the null hypothesis. It means that there is a significant difference among the students' behavioral engagement before and after receiving an intervention ($M= .67$, $SD= .30$), $t (42) = 14.85$, $p=.000$.

From the above-mentioned results, it is visible that there is a significant difference in the pre-test scores and post-test scores of participants in terms of their cognitive, emotional, and behavioral engagement before and after giving an intervention. It is also concluded that the effectiveness of Knowledge Clip (treatment) is significant on students cognitive, emotional and behavioral engagement Thus, the researcher rejected the following null hypotheses:

$H0^1$. There is statistically no effectiveness of Knowledge-Clip on students' engagement at the HSSC level.

$H0_{1a}$. There is statistically no effectiveness of Knowledge-Clip on students' cognitive engagement at the HSSC level.

$H0_{1b}$. There is statistically no effectiveness of Knowledge-Clip on the emotional engagement of students at the HSSC level.

$H0_{1c}$. There is statistically no effectiveness of Knowledge-Clip on students' behavioral engagement at the HSSC level.

4.6 Analysis for Observation Checklist

For validating the results of the current study researcher used an observation checklist (Attached as Annexure E) because sometimes, students show their agreement towards every statement of the questionnaire whereas in actual their behavior is not the same. For validating the participants' responses which they have selected within the questionnaire researcher asked their subject teacher to take in-class observations by utilizing observation checklists. The researcher gave this responsibility to their subject teacher to avoid biasness because it might be possible that if the researcher herself takes in-class observations she becomes biased for showing positive results of the study. The researcher has divided the observation checklist into three main constructs including cognitive engagement, emotional engagement, and behavioral engagement. Moreover, the researcher has used an observation checklist for the treatment group having 20 statements each based on which participants were observed. The detailed analysis of the observation checklist is described as under:

4.6.1 Cognitive engagement. For the first construct remembering, understanding, applying, attention, interest, and concentration were considered as indicators of cognitive engagement. The detailed analysis of cognitive engagement based on observation checklist is given below:

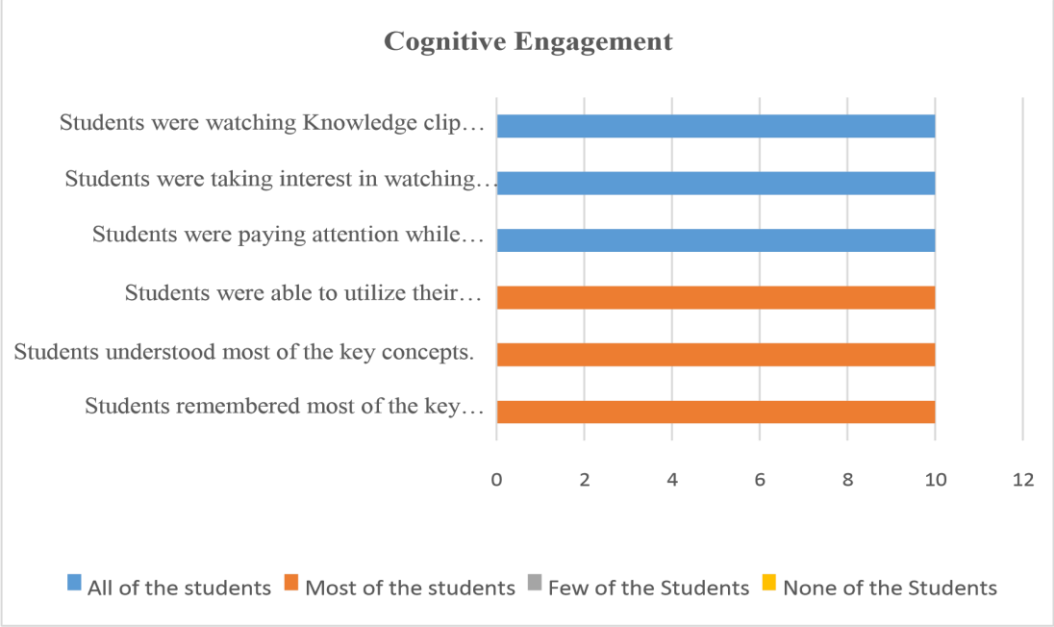

Figure 9 Cognitive Engagement

The above figure 2 illustrates that the majority of the participants were cognitively engaged within the Biology class. Furthermore, it is also indicated by observations that all of the participants were watching KC's with concentration. It has been analyzed because participants were watching clips attentively and whenever their teacher asked questions most of the participants' were knowing the answers. In addition to this, it has been observed through in-class observations that all of the participants were taking interest in watching KC's. It has been indicated because participants' were always ready to watch KC's. They were listening and watching KC's carefully. Moreover, it has been observed that all of the participants were paying attention while watching KC's. It is indicated because during sessions of watching KC's participants' were fully focused, paying their attention to KC's and not distracting other students. Furthermore, for the indicator of applying it has been observed that most of the participants were able to apply the knowledge which they have gained through watching KC's. It has been indicated because the majority of the participants 'were utilized their knowledge and understanding regarding the concept for making effective

presentations. In addition to this, as per in-class observations, most of the participants' understood the key concepts which they have seen within the KC's. It has been indicated because participants performed well in online quizzes and were also able to explain the concept during group discussions and presentations. Moreover, most of the participants were remembered the key concepts which they watched through KC's. It has been analyzed because whenever the researcher asked a question to check how much participants' have remembered, most of the participants raised their hands and give correct responses. On the whole, it has been indicated by in-class observations that participants were cognitively engaged within the class.

4.6.1.1 Cross analysis. The researcher has done a cross-analysis of participants' responses which they have selected within the questionnaire with the in-class observations taken by their subject teacher during treatment. Cross analysis for the construct of Cognitive Engagement indicated that results of in-class observations of participants are similar with individual responses of participants which indicated that there was the effectiveness of KC's on students' cognitive engagement at Higher Secondary School level.

4.6.2 Emotional engagement. For the second construct of emotional engagement, the indicators were: excitement, enjoyment, happiness, and likeness. The detailed analysis for emotional engagement based on the observation checklist is given as under:

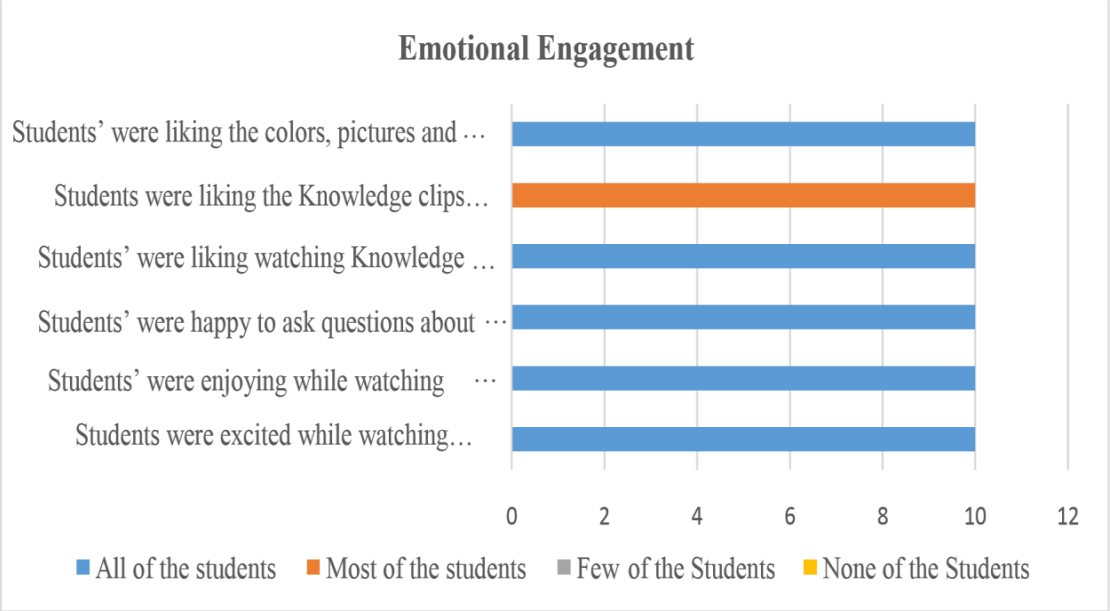

Figure 10 Emotional Engagement

The above figure is illustrating that all of the participants were liking the colors pictures and animations used in the Knowledge clips. It is indicated because whenever the teacher asked students that either they are liking the colors and pictures of knowledge clips or not they responded yes. Their facial expressions and excitement and interest also indicated that they are liking the interface of the KC's. In addition to this, the results of observations also indicated that most of the participants' were liking KC's instead of the traditional method of teaching. It has been indicated because whenever the researcher gave an option to participants' that either they want to learn from a book or KC's they always selected KC's and asked the researcher to share this idea of using Knowledge Clip with their other subject teachers too. Furthermore, observations also indicated that all of the participants' were liking KC's for learning Biology and wanted to see more KC's. It has been indicated because whenever the researcher asked them that are they were happy with learning Biology by using KC's they always responded yes and their excitement within the class also indicated that they are liking this new way of learning. Whereas, they usually insisted their teacher show

another clip after watching one clip which indicated that they liked KC's that is why they want to see more KC's. Moreover, the results of observations also indicated that all of the participants were enjoying and they were happy while watching KC's. It has been indicated because participants were having a smile on their faces, they look fresh and excited, they do not seem dull, they were active while taking notes and following instructions given in KC's. In addition to this, they liked to ask questions regarding the concept from their teacher. Moreover, the above figure is also representing that all of the participants were excited while watching KC's. It has been indicated because the majority of the participants were having positive facial expressions, they came into the class before time, open their systems and follow teachers' instructions quickly. Overall, the results of the observations indicated that participants were emotionally engaged within the class.

4.6.2.1 Cross analysis. Cross Analysis for the construct of emotional engagement indicated that the results of individual responses of students are the same as the results of in-class observations which are free from biasness because instead of the researcher herself the subject teacher of participants took observations during treatment sessions. It has been indicated by the cross-analysis of two types of results that there was significant effectiveness of KC's on students' emotional engagement at the HSSC level.

4.6.3 Behavioral Engagement. For the third construct of behavioral engagement: regularity in watching clips, completeness of clips, regularity in Biology class, follow instructions, responding to questions and no distractions were the indicators. The detailed results of behavioral engagement based on the observation checklist are mentioned as under:

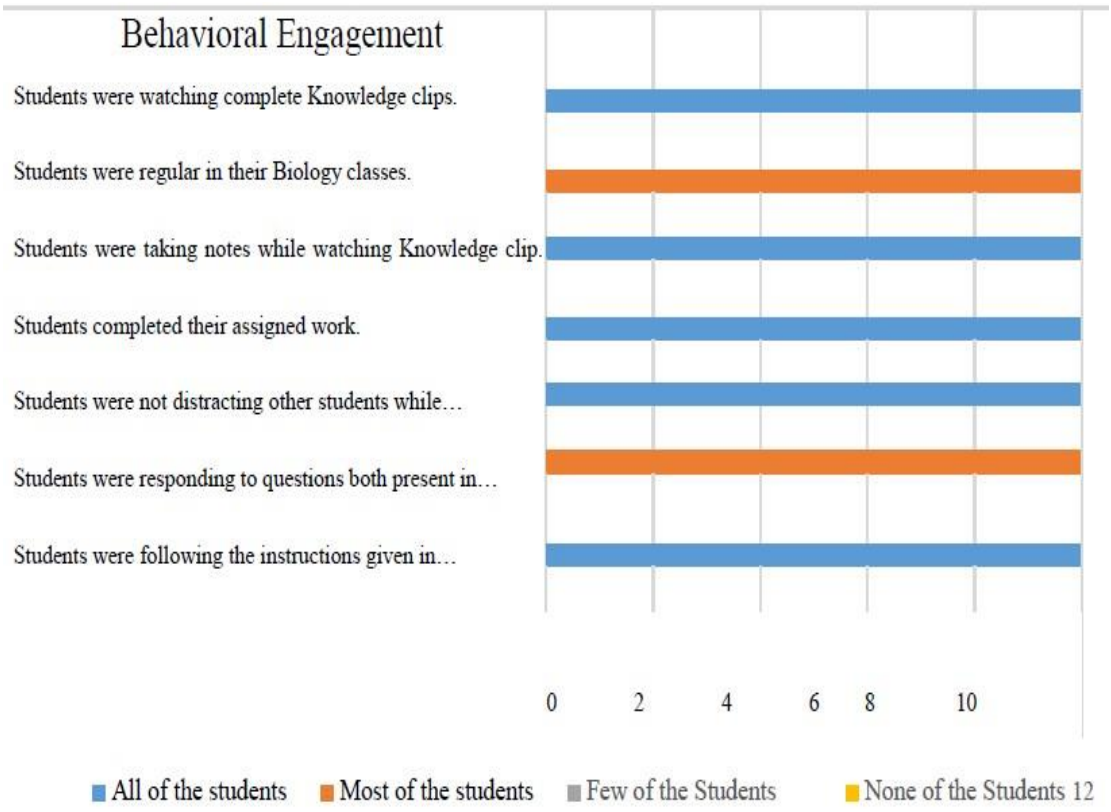

Figure 11 Behavioral Engagement

The above figure is illustrating that majority of the participants were behaviorally engaged within the class. Results of the in-class observations indicated that all of the participants were watching KC's regularly and were watching complete KC's without skipping some parts of the clips. It has been indicated because observers personally observed participants' and they also performed well in quizzes, discussions, and presentations which was not possible until they do not watch complete KC's. Furthermore, the results of the observations also indicated that most of the participants were attending their biology class regularly due to Knowledge Clip. It has been indicated because the attendance rate of participants for the Biology class was 98%. It is also indicated that all of the participants were taking notes while watching Knowledge Clips and all of the participants have completed the assigned tasks. It has been indicated because all of the students were having their notes and submitted the quizzes and participated in group discussions and making presentations. Moreover, the

results of in-class observations also indicated that all of the participants were focused and not distracting other participants while watching KC's. It is indicated because students' were not talking to other students' not making noise and watching KC's with concentration and attention. Furthermore, the results of the observations also indicated that most of the participants were responding to the questions within the KC's. It has been indicated because the participants were required to submit the responses to the questions they seen in KC's and the teacher asked to them and they have submitted those responses. In addition to this, as per the results of the observation checklist, all of the participants were following the instructions given within the KC's. It has been indicated because the observer personally observed that participants' were following the instructions and taking notes while watching KC's. On the whole, results of the in class observations indicated that participants were behaviorally engaged within the class.

4.6.3.1 Cross analysis. Cross analysis of students' responses and observations taken by using an observation checklist for the construct of behavioral engagement indicated that all of the individual responses of participants and observations are similar which indicated the effectiveness of KC's on students' behavioral engagement at the HSSC level.

On the whole, for all of the three constructs cognitive engagement, emotional engagement, and behavioral engagement results extracted from questionnaires and results extracted from observation checklists are similar which indicated that whatever the students' responded within the questionnaires was true and reliable. Moreover, results also indicated the effectiveness of KCs on students' cognitive, emotional and behavioral engagement that is why it has been analyzed that there is the effectiveness of KCs on students' in-class engagement.

Section 2

4.7 Data Analysis for Qualitative Part

There were two tools used for this study one of them was the questionnaire having both open-ended and close-ended questions and the other tool was an observation checklist. For open-ended questions, the researcher word to word transcribed all responses, generated open codes from that responses, done axial coding, and generated major themes for further analysis.

There were six open ended-questions within the questionnaire including two questions each for cognitive engagement, emotional engagement, and behavioral engagement. Detailed analysis of qualitative part is described as under:

Table 4.9

Themes Generated from Open-ended Questions

Constructs	Major Themes	Sub-Themes
Cognitive Engagement	Conceptual Understanding	Abstract to Visual conversion
	Engaging Attention	Visual Attraction
Emotional Engagement	Best Aspects of Knowledge Clips	Combination of Pictures and Written text Different from YouTube videos Less duration Easy to remember Pictures and Animations.
	Reasons for Likeness Towards Pictures Animations of Knowledge Clips	Engaging interface Interest in Biology class Quick Speed of Knowledge clips
Behavioral Engagement	Quantity of KC's watched	
	Reasons for watching complete Knowledge Clips	Interesting KCs Preparation for Quiz and Group discussion Informative & Short Duration

4.8 Cognitive Engagement

The first two open-ended questions for cognitive Engagement were: Do you think Knowledge clip enhances your concept understanding? How? and If no, then suggest any improvements and the other question was Do you think the Knowledge clip engaged your attention in Biology class? How? If no, then suggest any improvements. For the first two Open-ended questions major themes generated were:

- Abstract to Visual Conversion
- Visual Attraction

4.8.1 Abstract to visual conversion. Participants responded that Yes! Knowledge clip engaged their attention and enhanced their conceptual understanding because in the chapter Transport in plants they cannot see anything in reality and are unable to understand that how transport occurs in the plant but within Knowledge clip pictures and good explanation of concepts were present which helped them in understanding the concept within less time. One of the participants responded:

"For me knowledge clip was interesting and the teacher used pictures and explained every concept by using arrows or pointer with every picture which enhanced my conceptual understanding"

It is analyzed from the above responses that KC enhanced the concept clarity and understanding of students because instead of just listening about the concept that how different materials move within the plant students want to see that in visual form. That is why when the teacher presented that abstract concepts into visual form by making KC's students took interest in them, put their attention on clips, watched clips properly which in turn improved their conceptual understanding.

4.8.2 Visual attraction. Majority of the students also said that pictures used within the KC's and the way of presentation also attracted them, grabbed their attention, and improved their conceptual understanding. They responded that usually in Biology class they only listen to their teacher and node their heads in yes! even though they do not understand a single concept and usually it happens in Biology class because most of the time they imagine concepts and while imagining those concepts they distract from the original concept and start thinking about irrelevant things but within KC's the case was not like that because the sound of the teacher was present in the clip aligning with the visuals and pictures which grabbed their attention. Moreover, they also said that animated pictures within the KC's were also attracted their attention and compelled them to watch the KC's carefully. In addition to this, respondents also said that while listening to the lecture they felt bore and distracted but they were excited about watching knowledge clips in every class because it grasps their attention and does not let them feel bore and distracted. One of the participants responded that:

"The animated pictures within the Knowledge Clips took my attention because instead of imagining concepts and distracting from original concept these animated pictures seems like original and made my concepts clear"

It is analyzed from the above responses that students' got attracted towards the visuals of the KC's and watched clips because for them imagining concepts is difficult and distracting whereas, watching animated pictures and other pictures seems more original to them and that is why they found knowledge clips useful in improving their conceptual understanding. Moreover, watching KC's is a change for them that is why they feel excited and more attracted towards KC's instead of long lectures in which they usually lose their attention.

4.9 Emotional Engagement

The open-ended questions for emotional engagement were: What do you think are the best aspects of the Knowledge clip? And did you like the animations/ pictures in the Knowledge Clip? Why? If no, then suggest any improvements. Following is the detailed analysis of these two open–ended questions:

4.9.1 Best aspects of knowledge clips. In response to the question asked regarding the best aspects of Knowledge Clips major themes generated were:

- Combination of Pictures and Text
- Written text
- Different from YouTube Videos
- Less duration
- Easy to remember
- Pictures and Animations.

4.9.1.1 Combination of picture and text. The majority of the students responded that the best aspect of the knowledge clip was a combination of picture and text which they like the most because it helped them in understanding the concepts. Only reading a text is not that useful in understanding a concept until there is no exact image in front of the eye, same as watching an image alone without explanation is also useless. Most of the time while imagining concepts students lose their attention that is why combining pictures and text is a useful combination which not only helps students in learning but also helps them in improving their understanding regarding abstract concepts.

4.9.1.2 Written text. Some of the students' specifically mentioned that they liked the written text within the KC's because voice-over within the clips was speedy

and sometimes they found difficulty in understanding the words pronounced by the teachers but the written text used within the clips has resolved this problem. In addition to this respondent also said that written text within the Knowledge Clips also helped them in taking notes and reduced spelling errors within their notes. One of the respondents said:

"Sometimes while taking notes from KC's I do not pay attention to the voice of the teacher used in the clips at that time written text used in the clips helped me in understanding the spoken phrase"

Another respondent said that:

"I used to commit spelling errors while taking notes in class but because of the written text present in the KC's I stopped committing spelling errors while taking notes"

4.9.1.3 Knowledge clips are different from YouTube videos. Majority of the participants responded that for them the best aspect of KC's is that these clips are different from the YouTube videos. They said they do not like YouTube videos much for learning because instructors of those videos use difficult language and usually these videos do not contain written text. Moreover, within YouTube videos only pictures and sound is present and it causes trouble for them to understand difficult English in the foreign accent. They also said that some videos are totally in Urdu they are easy to understand but they are unable to make notes from them in English without making any errors in sentence structure and grammar. In contrary to this, their teacher made Knowledge Clips in easy language and she explained the concept very well by using sound, text, and animations which helped them in understanding the concept.

4.9.1.4 Less duration. All of the participants responded that that are very happy with the short duration of Knowledge Clips because when their teacher teaches them a single concept in the class of 45 minutes only through lecture method they lose their interest in that concept and feel boredom because no one knows either they are listening and understanding the concept or not. In contrary to this, because KC's are of short duration that is why participants' felt excited, liked to watched Knowledge clips, took notes by watching those clips, and do not felt bore and lose their attention within the class. Moreover, participants also said that because KC's are short videos that is why their teacher found time to involve them in different in-class activities which not only improved their conceptual understanding but also enhanced their excitement for attending Biology class.

4.9.1.5 Easy to remember. Majority of the participants also responded that KC's has made it easy for them to remember the concepts quickly. They said that through only listening to something it takes time to remember it but within KC's sound, text and picture, animations are also present which helped them in remembering the concept more quickly. Moreover, they also responded that after watching a Knowledge Clip they always felt confident that even though if they are not able to explain the concept watched within the Knowledge Clip word to word but they can explain the same concept within their own words. Participants also responded that they are able to pause a video and watch it over and over again which also helped them in remembering a concept. One of the respondents said that:

"I do not like only to listen to my teacher for remembering a concept that is why I loved the Pictures, animations, Sound, Text, and Colors of the Knowledge Clips"

4.9.1.6 Animations & pictures. All of the participants responded that the animations and pictures used in the Knowledge Clips were the best aspects of it which

helped them in learning the concept quickly. Moreover, they also said that Knowledge Clip is different from the lecture method and, visuals used within these clips made them excited and it also helped them in putting their attention towards the concept instead of thinking about irrelevant things. Moreover, by watching visuals and pictures used in the clips students were happy because it improved their understanding of the concepts and stops them from doing rote memorization. The majority of the respondents said that they found their textbooks traditional and boring that is why for them Knowledge Clips are unique because these are the combination of sound, pictures, text, and visuals which is one of the best aspects of KC's for them.

4.9.2 Reasons for likeness towards pictures/animations of knowledge clips.

In response to the question asked regarding likeness of pictures/Animations towards Knowledge Clips major themes generated were:

- Engaging interface
- Interest in Biology Class
- Quick Speed of Knowledge Clips

4.9.2.1 Engaging interface. Majority of the respondents said that they liked pictures/ animations used within the Knowledge Clips because it engages students' attention and compels them to put their attention towards the concepts taught within the Knowledge Clips. Moreover, students also said that they like to watch colorful things and usually, within the traditional class, they do not found many colorful things because of which they avoid coming into their classes.

Moreover, respondents also said that they liked the colorful backgrounds used within the KC's, the color combination of the clips was attention grasping and by watching those colorful clips they felt fresh and always ready to learn within the class.

Participants also responded that because of an amazing interface of Knowledge Clips they wanted to watch more Knowledge Clips. Furthermore, the font size of the clips was visible and readable which helped them in taking notes. In addition to this, they also responded that they liked the colorful and engaging concept maps at the end of every Knowledge Clip which provides a summary of the whole concept and also helped them in taking notes and remembering concepts. They also said that these concept maps helped them in preparing for quizzes which they need to solve right after watching KC's.

4.9.2.2 Interest in biology class. It is also extracted from the responses of the students that most of the students' found KCs' attention grasping in Biology Classes. They also said that their new Biology class is totally different and interesting from the older one in which they were least attentive and mostly felt sleepy because they only have to listen to their teacher, now they not only listen but also watch pictures and colors in KC's that is why they pay more attention towards whatever they listened and watched in KC's. One of the respondents also said that:

"Before watching Knowledge Clips I was personally not much interested in Biology but KC's enhanced my interest in this subject and now Biology is my favorite subject"

4.9.2.3 Quick speed of knowledge clips. Some of the respondents said that they liked the colors, pictures, and overall interface of the KC's but they are not happy with the speed of those clips. Their responses indicated that because of the fast speed of clips sometimes, they are unable to understand the voice and pronunciation of the words. Moreover, they also said that due to the fast speed of clips they faced difficulties in taking notes and they have to watch the same clip over and over again for taking exact notes. One of the respondents said:

"I liked the way of concept presentation and colors of Knowledge Clips but do not like the speed of the clips because I need more time for writing when I am listening, watching, and writing at the same time that is why the quick speed of KC's sometimes created trouble for me in taking notes and understanding concepts"

4.10 Behavioral Engagement

The open-ended questions for behavioral engagement were: How many videos you have watched out of total? And have you watched complete videos or some part of the videos? Why? Following is the detailed analysis of these two open-ended questions.

4.10.1 How many kc's watched. The majority of the students responded that they watched all of the 10 Knowledge Clips. Whereas few students' responded that due to their absenteeism in one or two classes they watched eight or nine Knowledge Clips out of total of ten Knowledge Clips. It is indicated that they were behaviorally engaged within their Biology class.

4.10.2 Reasons for watching complete or some parts of KC's. In responses to the question regarding watching complete KC's and Some parts of the KC's all of the respondents responded that they watched complete KC's instead of some parts of KC's. For discussing the reasons for watching complete KC's following themes were generated:

- Interesting KC's
- Preparation for Quiz and Group discussion
- Informative & Short Duration

4.10.2.1 Interesting kc's. The majority of the respondents said that they watched complete KC's instead of skipping some parts of the clips because they found KC's interesting. The way the teacher presented the concept in KC's by using pictures,

text, and sound was interesting and attention-gaining for them that is why instead of skipping the clips they preferred to watched complete clips. Moreover, they also said that because for the very first time they were learning by using computers' that was so interesting for them and compelled them to watch complete clips.

4.10.2.2 Preparation for quiz and group discussion. Majority of the respondents also said that one of the reasons behind watching complete KC's is that they want a clear conceptual understanding of the concept and also try to remember the concept explained within the KC because right after watching a KC they have to fill an online quiz regarding that KC and if they watched videos by skipping some parts then they are unable to solve the quiz properly. In addition to this, participants also responded that they watched complete KC's because after watching a clip firstly, they have to fill quiz and then must have to take part in group discussions and until they do not watch complete clips they do not have enough knowledge to take part in group discussions. One of the respondents said:

"Once I came late in class and decided to skip some parts of KC but then I realized that right after this I need to solve quiz and take part in a group discussion so I took some extra time from teacher and watched complete KC"

4.10.2.3 Informative & short duration. The majority of the participants responded that they watched complete KC's because they found them informative which helped them in improving their understanding of the concept. Moreover, a concept which their teacher used to cover in a long lecture of 45 minutes was covered in 6-7 minutes clips that is why they preferred to watch complete clips instead of skipping them.

After analyzing the Observation Checklist and responses of participants gained through Questionnaire and Open-ended questions, it has been indicated that responses of participants and in-class observations were showing similar results. It is analyzed that the effectiveness of knowledge-clip on students' cognitive, emotional and behavioral engagement at the HSSC level is significant.

CHAPTER 5

SUMMARY, FINDINGS, DISCUSSION, CONCLUSION & RECOMMENDATIONS

5.1 Summary

With the advancements in the domain of Technology where all of the fields get affected it also affected the educational field positively and compelled educational authorities to bring innovations in curriculum and to develop Technology based pedagogies to make our students eligible to cope with the demands of the modern era. In Pakistan, traditional pedagogies are in greater use but now technology-based pedagogies are also introducing in secondary and higher secondary school levels whereas, at the university level technological tools are part of almost every class. Students at the college level or HSSC level are usually taught by lecture method and students get bore because of those long lectures moreover, boredom creates a lack of interest in the topic and students show less engagement within the class. Moreover, Students' engagement is positively associated with their performance and grades (Hughes, 2012) which indicates that lack of engagement affects students' understanding which in turn affects their performance negatively.

To enhance students engagement within the class technology-based pedagogies can be used effectively. Many of the studies highlighted that videos can be used as a technological tool to enhance students' in-class engagement (Hung, 2015; Roodt & Peier, 2013). Moreover, Various research studies used YouTube videos for teaching but the drawback of Youtube videos is that these videos are made for international students whose caliber is different and it does not contain teachers' teaching style.

Moreover, at the HSSC level teachers use long lectures which might cause a lack of engagement on the part of students within the class. For the Pakistani context it is necessary that the teacher can create a video according to her students' caliber and use the language and way of teaching which is easy to understand for the students. Such kinds of instructor-made videos are known as Knowledge Clip that is why the researcher wanted to investigate the effectiveness of Knowledge-Clip on students cognitive, emotional and behavioral engagement at the HSSC level, especially in Biology class because it contains abstract and difficult concepts. Moreover, through only lecture, it is difficult for a teacher to engage students within Biology class. The researcher used a quasi-experimental research design by following a non-equivalent comparison group design and pre-test post-test design for getting more valid results. The comparison group was added to make sure that the change in the dependent variable (students' engagement) is because of the independent variable (Knowledge Clips). The researcher has tried the level best to control the extraneous variables where possible. Furthermore, the researcher adopted both quantitative, and qualitative methods for data collection including questionnaires, observation checklists, and open-ended questions. Both content and construct validity of the questionnaire was checked. Content validity was checked by two experts whereas, pilot testing was done and CFA was calculated by using AMOS for checking the construct validity of the instrument. For reliability checking of instrument researcher calculated Cronbach alpha coefficient through IBM SPSS 21.0. Furthermore, for data analysis, both inferential and descriptive statistics were used. The researcher firstly tested the assumptions for running the statistical tests before applying them to the actual data set. The results of assumptions testing indicated that independent t-test and dependent t-test are the most

appropriate statistical tests for the data set of this study. Furthermore, the details of the findings extracted from both quantitative and qualitative means are discussed as under:

5.2 Findings

1. The participants were divided based on the mean scores they got on the pre-test. There were 24 above average and 19 below average students in each control and experimental group. (See Table 4.2)
2. The normality of the dependent variable was checked for running an independent t-test by using the Shapiro-Wilk test. The results showed that the data set of this study was normally distributed and fulfilling the requirement. (See Table 4.3)
3. The homogeneity of variance among groups was checked by using Leven's test. The results indicated that there is no difference in the variance of one group to the other group. (See Table 4.4)
4. The results of the study indicated the effectiveness of Knowledge-Clip on students' engagement at the HSSC level. Because the $p<0.05$ and the mean score of the experimental group after post-test is greater than the mean score of the control group (See Table 4.5)
5. It has been analyzed from the results that the students in the experimental group who were taught by using Knowledge Clip were more engaged as compared to students in the control group who taught without using Knowledge Clips. Because mean scores of the experimental group (M=4.15) was greater than the mean score of the control group (M=3.26) in post-test. (See Table. 4.5)

6. The normality of the dependent variable was checked for running dependent t-test by using the Shapiro-Wilk test. The results showed that the data set of this study was normally distributed and fulfilling the requirement. (See Table 4.6)
7. It is indicated that the engagement level of participants remained the same in pre-test and post-test for the control group. Because the $p>0.05$ for all of the three pairs cognitive engagement pre & post-test, emotional engagement pre & post-test, and behavioral engagement pre & post-test in the control group. (See Table 4.7)
8. The results also indicated the effectiveness of Knowledge-Clip on students' cognitive engagement at the HSSC level. Because the $p<0.05$ indicating the significant difference in the scores of cognitive engagement pre-test and cognitive engagement post-test for the experimental group. (See Table 4.8)
9. Results of the study also highlighted the effectiveness of Knowledge-Clip on students' emotional engagement at the HSSC level. The results indicated that $p<0.05$ which indicates that the scores of emotional engagement post-test were better than the scores of emotional engagement pre-test in the experimental group. (See Table. 4.8)
10. Results of the study also indicated the effectiveness of Knowledge-Clip on students' behavioral engagement. Because the $p<0.05$ highlighting that there was a difference in the pre-test scores and post-test scores of behavioral engagement for the experimental group. (See Table. 4.8)
11. It is analyzed that there is a significant difference in pre-test and post-test scores of experimental groups. Because $p<0.05$ for all three domains cognitive engagement pre & post-test, emotional engagement pre & post-test, and

behavioral engagement pre & post-test for the experimental group. Thus, it is indicated that the students' engagement level was improved after giving an intervention by using Knowledge Clips. (See Table. 4.8)

12. Results of the study highlighted that majority of the participants were cognitively engaged within the Biology class (See Fig 9). It is concluded because participants were focused, paying full concentration, and taking interest in watching KCs'. They understood the concepts properly by watching Knowledge Clips. They remembered most of the key concepts they watched through KCs' which was indicated through their good performance in quizzes, group discussions, presentations, and question-answer sessions.

13. It has been extracted from the results that most of the students' found KCs' attention grasping in Biology Classes. They said that their new Biology class is different from the older one in which they were least attentive and mostly felt sleepy because they only have to listen to their teacher, now they not only listen but also watch pictures and colors in KCs' that is why they pay more attention towards whatever they listen and whatever they watched in KCs. One of the respondents also claimed that before watching Knowledge clips he was personally not much interested in Biology but after learning through KCs' Biology is now his favorite subject.

14. Results of the study also showed that most of the students were emotionally engaged within the Biology Class (See Fig 10) because they liked the Knowledge Clips for learning Biology and they wanted to see more Knowledge Clips in the future. Moreover, students' excitement, students' positive facial expressions, enjoyment within Biology class, and happiness also indicated their emotional engagement within Biology Class.

15. The results of the study also highlighted that for students' the best aspects of the knowledge clips were a combination of pictures, text, and animations, engaging interface, and short duration of clips which enhanced their excitement as well as understanding. On contrary, some of the students also responded that they liked the interface of KCs' but not their speed. Their responses indicated that because of the fast speed of Knowledge Clips they found difficulty in taking notes.

16. Results also showed that students' liked Knowledge Clips more as compared to YouTube videos because as per their opinion their teacher made Knowledge Clips in easy language and she explained the concept very well by using sound, text, and animations whereas in YouTube videos only pictures and sound is present and it causes trouble for them to understand difficult English in foreign accent. They also said that some videos are totally in Urdu they are easy to understand but they are unable to make notes from them in English without making any errors in sentence structure and grammar.

17. It has been analyzed from the results of the study that most of the students were behaviorally engaged within the Biology class (See Fig 11) because they attended Biology classes regularly and the attendance rate was 98%, they watched KCs' regularly, they watched complete clips without skipping parts or selecting some parts, they participated in question/answer sessions, quizzes, group discussions, and presentations. Moreover, they followed the instructions mentioned in KCs' and also took notes while watching clips and most of the participants were; focused on their work, not distracting other students, not making noise and were not talking to each other while watching KCs.

18. Results of the study indicated reasons identified by students for watching complete KCs' which were: students watched complete KCs' because they found these interesting and as they have to fill the quiz at the end of every KC so, they could not skip any part of the KC. In addition to this, students also responded that due to the short duration of KCs' they watched these completely and found them effective and informative for improving their understanding.

As per the above-mentioned results it is indicated that the effectiveness of Knowledge-clip for enhancing students' classroom engagement at the HSSC level is significant. Same as Griffiths (2010) also indicated that instructor-generated videos can enhance the overall engagement of students. Furthermore, literature also supported that teachers who used technology-based pedagogies and integrated technology (including video) in class have seen a great enhancement in students' classroom engagement (Lee & Hannafin, 2016; White, McGowan & McDonald, 2019).

5.3 Discussion

5.3.1 Cognitive engagement. Results of the study highlighted the effectiveness of Knowledge Clips on students' cognitive engagement in Biology class at the HSSC level. It might be because when students watch KCs' visuals, animations, and colors of the clips compel them to pay attention, concentrate, understand, remember and apply the concept they learned as well as enhanced their cognitive engagement within the class. Same as, Fan, Salleh and Laxman (2018) have used videos for teaching Biology and indicated that videos have improved conceptual understanding of students related to Biology concepts.

Most of the students also showed an agreement towards the statement that Knowledge Clip helps them in paying attention in Biology classes. It might be because

it is a new approach of teaching and learning for students and instead of reading through textbooks when they watched Knowledge clips with the attractive interface it grabbed their attention and they paid much attention and concentration on clips. In addition to this, students not only watched KCs' with full concentration and attention but also made enough efforts to understand and remember the concepts. It has been indicated that students usually raised their hands for responding to teachers' questions it might because they watched the clips with attention and concentration which made them able to answer the questions. These results of the study are akin to the previous research study conducted by (Stockwell, 2015) which indicated that instead of teaching science by using lecture method if a teacher use videos having visual stimuli, graphics, and eye-catching colors then students will pay more attention and concentration towards the content being taught in those videos. These results of the study are still unique because within the current study researcher specifically used Knowledge Clips instead of third-party videos.

As per the findings of this research study, most of the students were shown their agreement on a statement that they remember, understand, and apply whatever they see in a Knowledge Clip. It is because Knowledge Clips convert difficult concepts in an easy way and pictures used in those clips improved concept clarity of students and enabled them to remember, understand and apply the concepts instead of rote memorizing. These results of the study are similar to the previous research study conducted by Bobek and Tversky (2016) which highlighted that instructors can easily break down complex concepts into easy, small, and simple concepts through videos by utilizing eye-catching colors and interface which might help students in getting a better conceptual understanding of the concepts taught. In addition to this, another research study indicated that we can use videos instead of long lectures which might help

students in remembering, understanding, and applying the concept they learned in less time (Brame, 2016). Furthermore, these results of the study are also akin to the previous research study conducted by Alpert (2016) in which the researcher used VIDS (instructor created videos same as knowledge clip) and got students perceptions regarding those videos. As per the results of the study, students indicated that these instructor-created videos were interesting, engaging, enhanced enjoyment, and helped them in understanding and learning.

5.3.2 Emotional engagement. Results of the study also highlighted the noteworthy effectiveness of Knowledge-Clip on students' emotional engagement in Biology class at the HSSC level. It might be because Knowledge Clips enhanced students' excitement, satisfaction, interest, and likeness towards Biology course. Most of the respondents replied that they felt excited while watching Knowledge Clips because in routine lectures they used to listen to their teacher without engagement which is quite boring for them but watching Knowledge Clip with colors, pictures and sound were more excited for them. These results are akin to a research study that indicated that students face boredom in traditional classes and their excitement within the class can be enhanced by using videos (Devlin, Feldhaus & Bentrem, 2013). The results are still unique because the researcher specifically used first-party videos (Knowledge Clips) in the current study.

Participants also responded that they liked watching Knowledge Clip for assisting Biology instructions it might be because Biology has many abstract concepts and for learning those concepts students want to see a relevant sample in picture or graphic form and KC is having a combination of Sound, text, pictures and a specific teaching style of their teacher that is why students preferred Knowledge Clips over lecture method. Same as, Dash et al., (2016) indicated that converting hard abstract

concepts into visuals has made videos a vital teaching tool for Biology. These results of the study are unique because as per my little knowledge no previous researches investigated students' opinions specifically regarding using Knowledge Clips for learning Biology.

Participants of the study responded that the Knowledge Clip stimulates their interest in Biology class because of two reasons one was that traditional Biology class was boring and based on lectures but the Knowledge clips and the overall interface of the clips were engaging, interesting and attention grasping. These results are akin to the study which highlighted that students' interest and their likeness towards learning Science through videos is because of colorful backgrounds and animations used within the videos (Dash et al., 2016). In contrary to this, one of the participants responded that she liked the interface of the KC but do not like the speed of the video because she is slow in taking notes and the fast speed of the video requires him to pause the video again and again because of which she left behind as compared to his other classmates and sometimes this compelled her to skip some parts of the video because of which her quiz scores get affected negatively. These results are also a unique contribution of the current study. Moreover, another reason due to which Knowledge Clip stimulates students' interest in Biology class was that students were bound to solve the quiz at the end of every KC that is why they took extra interest in watching Knowledge Clips. This finding is also a unique contribution of this study.

Participants preferred KCs' over the traditional lecture method. These results are contradicting with the study of Jill, Wang and Mattia (2019) which highlighted that students liked to learn through instructor-generated YouTube videos but do not want to replace traditional classes with complete video-based classes. In addition to this, participants wanted to see more KCs' in the future for the Biology course because it

helped them in understanding and remembering the content in less time. These results are akin to the study of Uohua Pan et al., (2012) which indicated that students' understood and remembered the concepts through instructor-made videos. Moreover, other reasons for likeness were attention grasping colors, pictures, animations, sounds, and short duration of KCs which compelled students to see complete videos and also engaged them in the learning process. These results of the study are contradicting with the study conducted by Uohua Pan et al., (2012) which indicated that students do not like the short duration of instructor-made videos.

Most of the participants also indicated that learning with Knowledge Clip increased their satisfaction. It might be because they feel confident that instead of rote memorizing a concept they have understood the concept properly by watching KCs and can reproduce that concept in their exam or to apply that concept in real-life situations this inner feeling gives them satisfaction. Same as Rissanen (2018); Yousef, Chatti and Schroeder (2014) highlighted in their studies that using educational videos within the class can enhance students' satisfaction. Moreover, these results are unique as well because the researcher has specifically used Knowledge Clips instead of third-party videos.

Participant's responses also showed that they found pictures, written text of Knowledge Clips, easy language, concept map, and short duration of clips as the best aspects of Knowledge Clips because it compels them to remember, understand and apply the concept in less time. Same as Woolfit (2015) also indicated that teaching through videos is not only cost-effective but also less time-consuming and a means of enjoyment for students. These results are unique because the researcher analyzed these results specifically by using Knowledge Clips.

5.3.3 Behavioral engagement. As per the results of the study, there is the effectiveness of Knowledge-Clip on students' behavioral engagement in Biology class at the HSSC level. It might be because Knowledge Clips were new for students and they found these interesting which enhanced their engagement and they showed positive behaviors within Biology class. Moreover, students' showed regularity in watching KCs', they watched complete clips instead of skipping some parts, they were regular in their Biology class, they followed teacher instructions, they responded to teachers' questions and also the questions presented within the clips and they were made no distractions within the Biology class which might because of integration of Knowledge Clips within the Biology course. In contrary to this, a study conducted by Luo and Kalman (2018) utilized summary videos and indicated that there was no effect of these videos on students' behavioral engagement.

Responses of the participants and their daily attendance record also indicated that they attended their Biology classes regularly. The reason behind this might be that they liked to watch Knowledge Clips and these clips were interesting as compare to long lectures that is why they attended their Biology classes regularly. These results of the study are akin to the previous research conducted by Alpert (2016); Devlin, Feldhaus and Bentrem (2013) which indicated that when they used instructor-based videos the attendance rate of students enhanced as well. Moreover, students who taught by traditional lecture method were less regular in their classes as compared to students which taught by using videos.

Responses of the research participants also indicated that they followed the instructions given in the KCs. It might be because for students' Knowledge Clips were interesting and attention gaining that is why they watched clips carefully which compels them to act according to the instructions given in a KCs. These results are

similar to the study conducted by Devlin, Feldhaus and Bentrem (2013) which indicated that the students who taught by using videos were more likely to follow the instructions as compared to those who taught by using the traditional lecture method. Irrespective of this, these results of the study are unique because as per my knowledge no previous study has investigated the effectiveness of Knowledge Clips on students' engagement by considering "following instructions" as an indicator for behavioral engagement.

Responses of the participants also indicated that while watching Knowledge Clips students' tried to ask questions from their teacher which helped them in understanding the concept. It might be because in the traditional lecture method teacher is the complete source of knowledge and due to attention lost in long lectures students do not ask questions because they do not listen to their teacher carefully. In contrary to this, when students watch Knowledge Clips attentively they try to understand the concept, and wherever they find any ambiguity they ask questions from their teacher to make their concepts clear. In addition to this, it is also indicated from the responses of the participants that they responded to all of the questions which were present in the Knowledge Clips.

It might be because knowledge clips enhanced their concepts clarity and understanding which compels them to respond to all of the questions which were present in the Knowledge clips. These results are akin to the research study of Devlin, Feldhaus and Bentrem (2013) which indicated that more questions were responded to and asked by the students who taught by using videos as compared to those who taught by using the lecture method. These findings of the study are still distinctive from other studies because as per my little knowledge no previous study has specifically investigated the effectiveness of Knowledge Clips on students' engagement by

considering “Responding to questions” and “Asking Questions” as an indicator for behavioral engagement.

Respondents also highlighted that they watched Knowledge Clips carefully and watched all of the clips till the end without skipping parts in Biology classes. It might be because they found Knowledge Clips interesting, colors, pictures, and animations of the KCs’ attracted them and also improved their understanding of concepts and ads on to their knowledge. Moreover, they watched complete videos till the end because if they skip any part of the clip they will not be able to solve the quiz attached after every Knowledge Clip. These results are similar to the findings of the study conducted by Al Mamun, Lawrie and Wright (2016) which indicated that high behavioral engagement of students was shown while watching videos in an online course because they watched all of the videos and completed all of the videos. Irrespective of this, these results are unique as well because the researcher specifically used Knowledge clips in the current study.

Most of the respondents were agreed that they do not distract other students while watching Knowledge Clips. It might be because students usually distract others when they feel bore in the class but for them KCs’ were interesting and attention gaining that is why they paid all of their attention and do not get time to distract other students. These results are akin to the study of Kuiper, Carver, Posner, and Everson (2015) highlighted that by utilizing ICT or video-based teaching approaches teachers can develop the interest of students within class and activities which makes them more focused and non-distracting. These results of the study are still unique because as per my knowledge no previous study has investigated the effectiveness of Knowledge Clips on students’ engagement by considering “Making Distractions” as an indicator for behavioral engagement.

The overall findings of the study are new and unique because in previous researches the authors either used third-party videos including You-Tub videos for exploring students' engagement within the class or used instructor-generated videos in some studies but utilized these videos for online courses only. In this study, the researcher adopted a blended learning approach for utilizing Knowledge Clips which was not used before. Moreover, the researcher has also investigated the effectiveness of Knowledge-Clip on each dimension of students' in-class engagement including cognitive, emotional, and behavioral which was also a unique aspect of the current study. In addition to this, the current study is a pioneer one in the Pakistani context that is why its results are unique in comparison to the existing researches held in Pakistan regarding the effectiveness of videos on Students' in-class engagement at the HSSC level. Moreover, the current study has introduced the new approach of teaching in the form of Knowledge Clip which is a way forward for future researchers and they can also explore this area in other aspects and geographical contexts.

5.4 Conclusion

Traditional approaches of teaching are getting replaced with new and innovative approaches among those most common these days are online approaches of teaching and learning which include blended learning, e-learning, and flipped classrooms. These new approaches are different from traditional ones and more effective in terms of enhancing students' engagement within the classroom. The most common ingredient of all these approaches is "video" and videos are of two major types either first-party videos which are made by instructors themselves and third-party videos which are made by other persons and are available on YouTube or other platforms. The major disadvantage associated with third-party videos is that teacher is unable to add her teaching style and is unable to alter the video as per its goals/objectives and learning

needs of his/her students which might play the least role in improving students' engagement within the class. As compared to this, first-party videos such as Knowledge Clips are short duration clips which instructor made by his/her self as per the learning needs of the students as well as an instructor is also able to incorporate his/her teaching style within the video which is more convenient for students to understand. In this study, the researcher developed a blended Learning Biology module by using Knowledge Clips for HSSC students and investigated the effectiveness on students' in-class engagement. Students' in-class engagement has been explored in three dimensions including cognitive engagement, emotional engagement, and behavioral engagement. The results of the study indicated the effectiveness of Knowledge-Clip on students' engagement in Biology class at the HSSC level. Moreover, it is analyzed that the in-class engagement of students who taught by using KCs was more as compared to those who taught without using KCs. In addition to this, it is also indicated that Knowledge Clip is having the effectiveness on students' cognitive, emotional and behavioral engagement.

5.5 Recommendations

Based on the findings of the current study following recommendations were drawn:

1. The effectiveness of Knowledge Clips is significant for enhancing the cognitive engagement of students thus, teachers may use Knowledge Clips as introductory clips in their lessons for improving the in-class engagement of their students at the Higher Secondary School level.
2. Teachers may include thought-provoking questions in Knowledge Clips for improving the cognitive engagement of their students at the Higher Secondary School level.

3. The effectiveness of Knowledge Clips is significant for enhancing the emotional engagement of students thus, teachers may use appealing color schemes, pictures, texts, and animations in Knowledge Clips for improving the emotional engagement of their students at the Higher Secondary School level.
4. The effectiveness of Knowledge Clips is significant for enhancing behavioral engagement of students thus, teachers may plan their instructions by using Knowledge Clips of 5-6 minutes instead of long lectures for improving behavioral engagement of their students at the Higher Secondary School level.
5. Teachers may create Knowledge Clips by keeping in mind the attention span of the students.
6. Teachers may create interesting Knowledge Clips for improving the behavioral engagement of their students at the Higher Secondary School level.
7. Teachers may create Knowledge Clips with normal speed so the students can easily decode them and get enough time for taking notes.
8. The biology curriculum at the Higher Secondary School level may be designed in a way that includes both Knowledge Clips and in-class activities.
9. Teachers may design blended learning modules by using Knowledge Clips for science subject.
10. Training may be provided by the experts in the field of Education Technology or ICT in education to the teachers regarding making Knowledge Clips by utilizing easy software like PowerPoint.
11. For avoiding internet connectivity issues teachers may add all Knowledge Clips of a course in Compact Disk (CD) and provide it to students along with their syllabus in soft form.

12. For avoiding internet connectivity issues teachers may make day-wise folders in computers of every student containing Knowledge clips and their quiz/activity of the day.
13. Curriculum developers may restrict teachers to include at least one knowledge clip for each lesson. It can be introductory clip, skill demonstration clip or problem solving clip.
14. Teachers may use knowledge clips as a problem solving clips for improving higher order thinking skills of students.
15. Teachers may create scenario based Knowledge clips for improving higher order thinking skills of students.

5.6 Limitations

For the current research study researcher was only able to experiment either on girls' or boys' students. The researcher only conducts this experiment in only one boys' college because in Pakistan most of the government colleges are not coeducational. In addition to this, the researcher wanted to conduct an experimental study for fifteen days but she got permission to conduct her experiment for only 10 days. Moreover, after three days of the experiment researcher faced some internet connectivity issues because of which instead of utilizing Google classroom for watching Knowledge Clips and solving quizzes researcher saved Knowledge Clips and quizzes on the computers of every student by creating Day-wise folders.

5.7 Recommendations for Future Research

In continuation of this study following are the suggestions for future researchers:

1. Future researchers can investigate the effectiveness of Knowledge Clips on other variables such as students' campus engagement, students' performance, students' motivation, and students' satisfaction with the course.
2. Future researchers can replicate the current study within different geographical contexts.
3. They can investigate the effectiveness of Knowledge Clips for teaching other subjects like English, Mathematics, and History, etc.
4. They can replicate the current study on different grade levels such as primary, Secondary or higher.
5. They can investigate the effectiveness of Knowledge Clips on different variables by following a flipped-classroom approach.
6. Future researcher can use Knowledge Clips as skill demonstration and problem solving skills.

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ANNEXURE A

Topic Approval Letter

NATIONAL UNIVERSITY OF MODERN LANGUAGES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF EDUCATION

ML.1-4/2020/Edu

Dated: 20-01-2020

To: **Nida Shahzad,**
1510-MPhil/Edu/S18

Subject: **APPROVAL OF MPHIL THESIS TOPIC AND SUPERVISOR**

1. Reference to Minute Sheet No. ML.1-2/2020-Edu dated 02-1 -2020, the Higher Authority has approved your topic and supervisor/s on the recommendation of Faculty Board of Studies vide its meeting held on 15th Oct 2019.

a. **Supervisor's Name & Designation**
Dr. Wajeeha Aurangzeb
Assistant Professor, Department of Education
NUML, Islamabad.

b. **Topic of Thesis**

Effectiveness of Using Knowledge Clip on Students' Engagement at Higher Secondary School Level

2. You may carry out research on the given topic under the guidance of your Supervisor/s and submit the thesis for further evaluation within the stipulated time. It is to inform you that your thesis should be submitted within the prescribed period by **31st Jan 2021** positively for further necessary action please.

3. As per policy of NUML, all MPhil/PhD theses are to be run through Turnitin by QEC of NUML before being sent for evaluation. The university shall not take any responsibility for high similarity resulting due to thesis prior run by any other individual.

4. Thesis is to be prepared strictly on NUML's format that can be taken from the MPhil & PhD Coordinator, Department of Education.

Telephone No: 051-9265100-110 Ext: 2090
E-mail: mdin@numl.edu.pk

Dr. Hukam Dad Malik
Head,
Department of Education

Cc to:
Dr. Wajeeha Aurangzeb

ANNEXURE B

Permission Letter for Data Collection

DEPARTMENT OF EDUCATION
FACULTY OF SOCIAL SCIENCES
National University of Modern Languages
Sector H-9, Islamabad
Tel. No: 051-9265100 Ext: 2090

ML.1-5/2020-Edu

Dated: 10-02-2020

WHOM SO EVER IT MAY CONCERN

Ms. Nida Shahzad, student of MPhil, Department of Education, National University of Modern Languages is engaged in the Research Work.

She may please be allowed to visit you to obtain the required information for her Research Work.

This information shall not be divulged to any unauthorized person or agency. It shall be kept confidential.

Dr. Hukam Dad Malik
Head,
Department of Education.

ANNEXURE C

Students' Engagement Tool for Post Test

STUDENT ENGAGEMENT SCALE Students' Engagement is the extent to which a student can put efforts, take part in learning activities and have positive feelings towards their teachers and peers.		Totally Disagree	Disagree	Neutral	Agree	Totally Agree
CLASS ENGAGEMENT						
Cognitive Engagement						
1	The Knowledge clip helps me in remembering the key concept.	1	2	3	4	5
2	The Knowledge clip helps me in understanding the key concept.	1	2	3	4	5
3	The Knowledge clip helps me in applying the key concepts in real life.	1	2	3	4	5
4	The Knowledge clip engage my Attention in Biology class.	1	2	3	4	5
5	The Knowledge clip helps me to concentrate on topic	1	2	3	4	5
6	The Knowledge clip assists me in learning by simplifying complex concepts.	1	2	3	4	5
7	The Knowledge clip enhances my understanding by providing visual stimuli of abstract concepts.	1	2	3	4	5
Emotional Engagement						
8	I feel excited while watching a Knowledge Clip.	1	2	3	4	5
9	I like watching Knowledge clip for learning Biology.	1	2	3	4	5
10	The Knowledge clip stimulates my interest in Biology subject.	1	2	3	4	5
11	I like to ask questions about the content presented in Knowledge Clip.	1	2	3	4	5
12	I like Knowledge clip because it assists in Biology Learning.	1	2	3	4	5
13	I would like to see more Knowledge clips in every Biology class.	1	2	3	4	5
14	I like lecture with Knowledge clip more than traditional lecture method.	1	2	3	4	5

15	Learning with knowledge clip increases my satisfaction within Biology Class.	1	2	3	4	5
Behavioral Engagement						
16	I attend my Biology classes regularly because of Knowledge Clip.	1	2	3	4	5
17	I follow the instructions given in Knowledge clip.	1	2	3	4	5
18	Because of Knowledge Clip I try to connect my knowledge with real situations.	1	2	3	4	5
19	I do respond to all questions asked in Knowledge clip.	1	2	3	4	5
20	I carefully watch Knowledge clip in Biology class.	1	2	3	4	5
21	I easily memorize Biology concepts by watching Knowledge clip.	1	2	3	4	5
22	While watching Knowledge clip I try to ask questions to my teacher that help me in understanding the concept.	1	2	3	4	5
23	I do not distract other students while watching Knowledge clip.	1	2	3	4	5

QC1: Do you think Knowledge clip enhances your concept understanding? If no, then suggest how your concept understanding could be enhanced?

_____
_____

QC2: Do you think Knowledge clip engaged your attention in Biology class? If no, then suggest how your attention in Biology classes could be attracted and retained?

_____
_____

QE1: What do you think are the best aspects of the Knowledge clip?

_____
_____

QE2: Did you like the animations/ pictures in the Knowledge Clip? If no, then suggest how it could be improved to make it catchy?

_____
_____

QB1: How many Knowledge Clips you have watched out of total 10?

_____
_____

QB2: Have you watched complete Knowledge Clips or some part of the clips presented in your Google classroom?

_____
_____

ANNEXURE D

Students' Engagement Tool for Pre Test

STUDENT ENGAGEMENT SCALE Students' Engagement is the extent to which a student can put efforts, take part in learning activities and have positive feelings towards their teachers and peers.		Totally Disagree	Disagree	Neutral	Agree	Totally Agree
CLASS ENGAGEMENT						
Cognitive Engagement						
1	I can remember what I have learned in my Biology Class	1	2	3	4	5
2	I can understand the Key concepts I have learned in my Biology class.	1	2	3	4	5
3	I am able to apply the knowledge I have learned in Biology class to real problems.	1	2	3	4	5
4	I Pay attention in my Biology class.	1	2	3	4	5
5	I concentrate on what my teacher said during Biology Class	1	2	3	4	5
6	I make enough effort to understand Biology concepts.	1	2	3	4	5
7	I try to remember the Biology concepts by understanding instead of rote memorizing.	1	2	3	4	5
Emotional Engagement						
8	I feel excited in my Biology class.	1	2	3	4	5
9	I like to attend my Biology class.	1	2	3	4	5
10	Learning through lectures increases my satisfaction within Biology Class.	1	2	3	4	5
11	I like to ask questions about the Biology content I learned in class.	1	2	3	4	5
12	I like traditional lecture method to assist Biology instructions.	1	2	3	4	5
13	I like traditional lecture method for learning Biology.	1	2	3	4	5
14	Traditional Lecture method enhanced my interest in Biology course.	1	2	3	4	5
15	I like to share my learning problems with my Biology teacher.	1	2	3	4	5
Behavioral Engagement						

16	I attend my Biology classes regularly.	1	2	3	4	5
17	I used to follow the rules and instructions in Biology class.	1	2	3	4	5
18	I try to connect my knowledge I received in Biology lecture with real situations.	1	2	3	4	5
19	I do respond to every question my teacher asked during Biology lecture.	1	2	3	4	5
20	I carefully listen to my teacher in Biology class.	1	2	3	4	5
21	I memorize Biology concepts by listening to my teachers' lecture.	1	2	3	4	5
22	I try to ask questions to my teacher in Biology class.	1	2	3	4	5
23	I do not distract other students in Biology class.	1	2	3	4	5

ANNEXURE E

Observational Checklist for Treatment Group

Topic: _____

Time: _____ Duration: _____

Sr #	Observations	All of the students/ Most of the students/ Few of the students/ None of the students	Remarks
C1.	Students remembered most of the key concepts.	☐ ☐ ☐ ☐	
C2.	Students understood most of the key concepts.	☐ ☐ ☐ ☐	
C3.	Students were able to utilize their understanding in making their presentations and solving quiz.	☐ ☐ ☐ ☐	
C4.	Students were paying attention while watching Knowledge clip.	☐ ☐ ☐ ☐	
C5.	Students were taking interest in watching Knowledge clip.	☐ ☐ ☐ ☐	
C6.	Students were watching Knowledge clip with concentration.	☐ ☐ ☐ ☐	
E1.	Students were excited while watching Knowledge clip.	☐ ☐ ☐ ☐	
E2.	Students' were enjoying while watching Knowledge Clips.	☐ ☐ ☐ ☐	
E3.	Students' were happy to ask questions about the content presented in Knowledge Clip.	☐ ☐ ☐ ☐	
E4.	Students' were liking watching Knowledge Clips.	☐ ☐ ☐ ☐	
E5.	Students were liking the Knowledge clips more than traditional lecture method.	☐ ☐ ☐ ☐	
E6.	Students' were liking the colors, pictures and animations used in Knowledge Clips.	☐ ☐ ☐ ☐	
B1.	Students were following the instructions given in Knowledge clip	☐ ☐ ☐ ☐	
B2.	Students were responding to questions both present in	☐ ☐ ☐ ☐	

	Knowledge clips and teacher asked.		
B3.	Students were not distracting other students while watching Knowledge clip.	☐ ☐ ☐ ☐	
B4.	Students completed their assigned work.	☐ ☐ ☐ ☐	
B5.	Students were taking notes while watching Knowledge clip.	☐ ☐ ☐ ☐	
B6.	Students were regular in their Biology classes.	☐ ☐ ☐ ☐	
B7.	Students were watching complete Knowledge clips.	☐ ☐ ☐ ☐	
B8,	Students were persistent while watching Knowledge clip.	☐ ☐ ☐ ☐	

ANNEXURE F

Request Letter for Validation of Research Instrument

Certificate of Validity

EFFECTIVENESS OF USING KNOWLEDGE CLIP ON STUDENTS' ENGAGEMENT AT HIGHER SECONDARY SCHOOL LEVEL

By Ms Nida Shahzad

M.Phil Scholar, Department of Education, National University of Modern Languages, H-9, Islamabad, Pakistan.

This is to clarify that the questionnaire adapted by the scholar towards her thesis has been assessed by me and I find it to have been designed adequately to assess the effectiveness of Knowledge Clip on Students' engagement. The questionnaire has been organized in two major parts including close-ended and also open- ended statements to explore effectiveness of using knowledge clip on 3 dimensions of students' engagement.

It is considered that the research instrument, developed for the research above titled is according to the objectives and hypothesis of the research and can be used for data collection by the researcher with fair amount of confidence.

Name: Dr Muhammad Amin

Designation: Assistant Professor

Institute: University of Education

Signature *Muhammad Amin*

ANNEXURE G

Request Letter for Validation of Research Instrument

Certificate of Validity

EFFECTIVENESS OF USING KNOWLEDGE CLIP ON STUDENTS' ENGAGEMENT AT HIGHER SECONDARY SCHOOL LEVEL

By Ms Nida Shahzad

M.Phil Scholar, Department of Education, National University of Modern Languages, H-9, Islamabad, Pakistan.

This is to clarify that the questionnaire adapted by the scholar towards her thesis has been assessed by me and I find it to have been designed adequately to assess the effectiveness of Knowledge Clip on Students' engagement. The questionnaire has been organized in two major parts including close-ended and also open- ended statements to explore effectiveness of using knowledge clip on 3 dimensions of students' engagement.

It is considered that the research instrument, developed for the research above titled is according to the objectives and hypothesis of the research and can be used for data collection by the researcher with fair amount of confidence.

M. Shahzad Mughal
Lecturer
Institute of Education and Research
University of the Punjab, Lahore

Name M. Shahzad Mughal

Designation Lecturer

Institute IER, Punjab University Lahore

Signature

ANNEXURE H

List of Topics Covered in Module

Topic 1: Introduction to transport in plants

Topic 2: Role of roots in transport of nutrients in plants

Topic 3: Absorption of water in plants

Topic 4: Absorption of minerals in plants

Topic 5: Ascent of sap

Topic 6: Transpiration pull in cohesion tension theory

Topic 7: Root imbibition and Bleeding

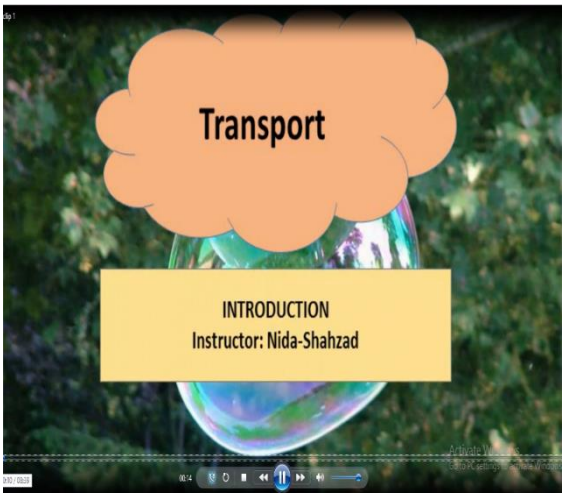
Topic 8: Types of Transpiration

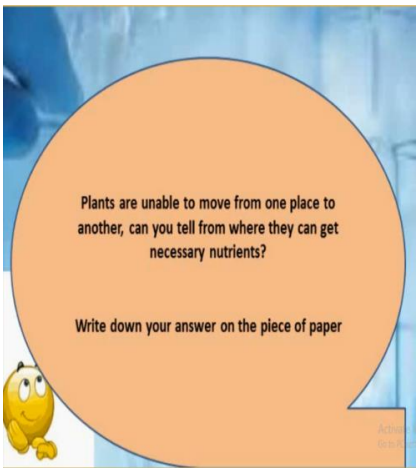
Topic 9: Cuticular & Lenticular Transpiration

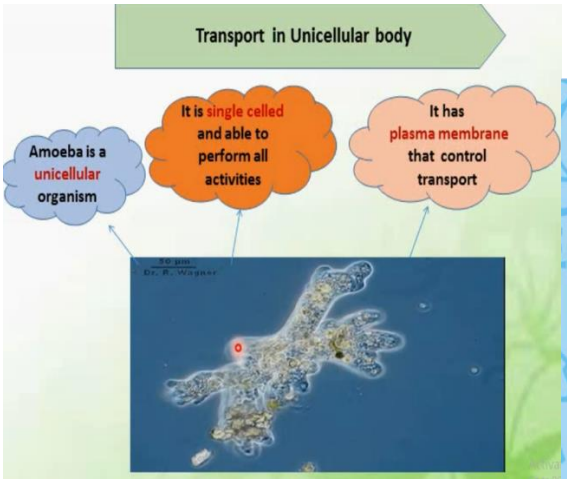
Topic 10: Phloem Transport

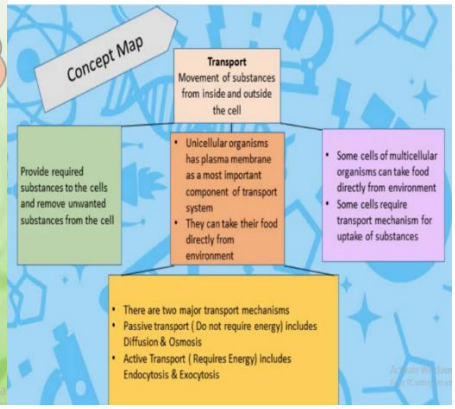
ANNEXURE I

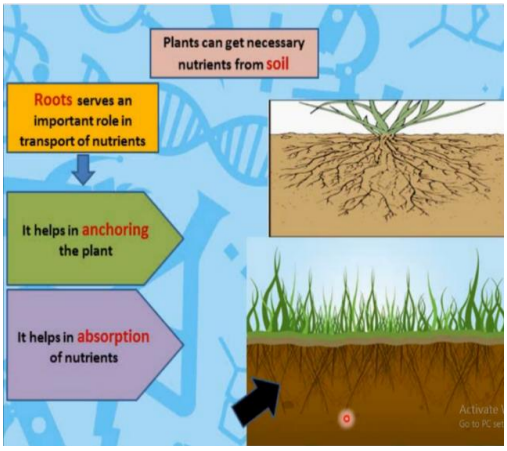
Screenshots of Knowledge Clips

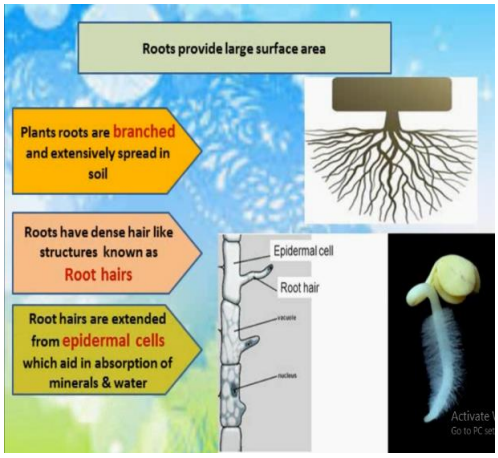


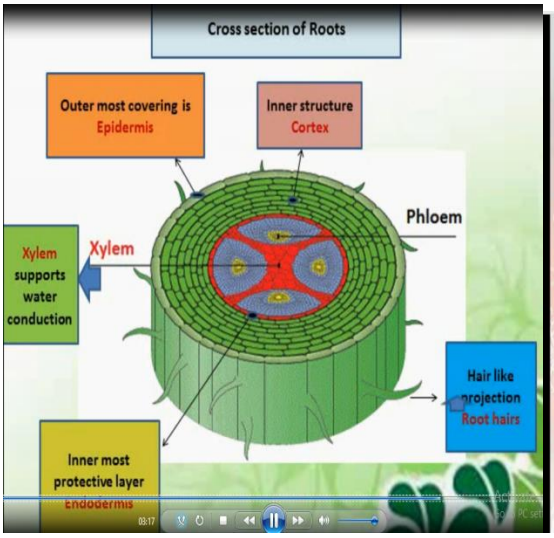


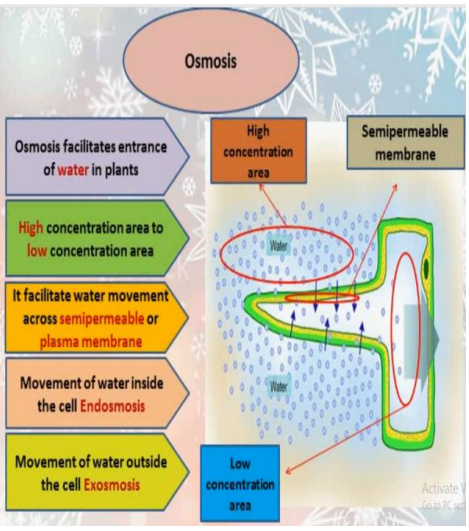


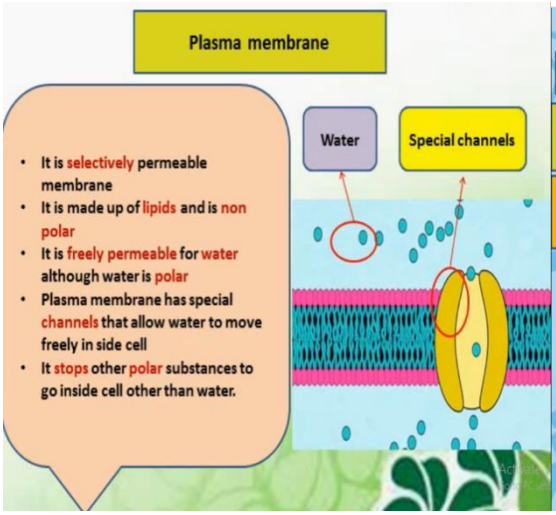


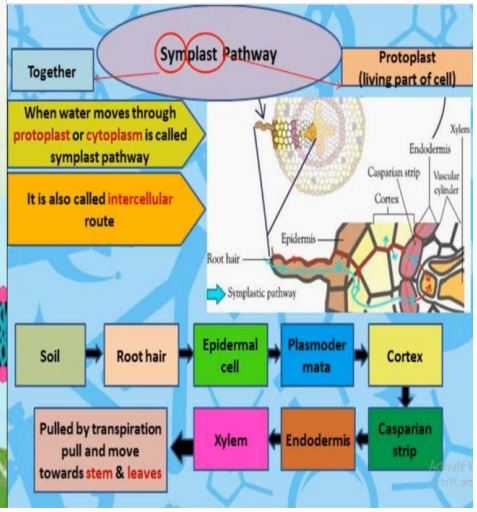


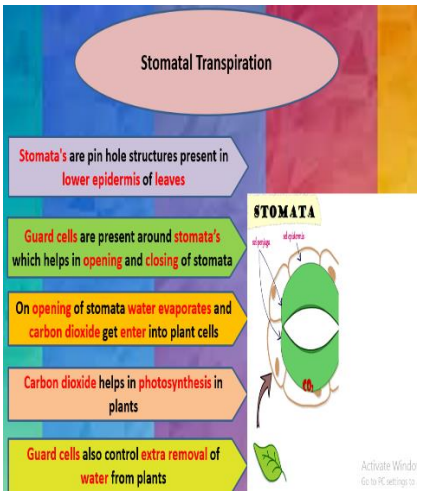


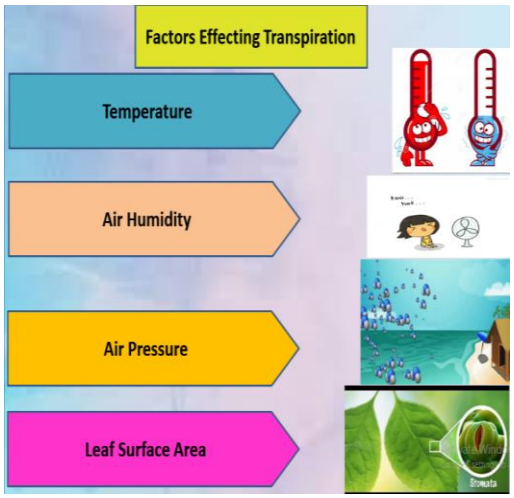

Cross section of Roots
Outer most covering is Epidermis
Inner structure Cortex
Phloem
Xylem
Xylem supports water conduction
Hair like projection Root hairs
Inner most protective layer Endodermis


Osmosis
Osmosis facilitates entrance of water in plants
High concentration area
Semipermeable membrane
High concentration area to low concentration area
It facilitate water movement across semipermeable or plasma membrane
Movement of water inside the cell Endosmosis
Movement of water outside the cell Exosmosis
Low concentration area
Water
Water


Plasma membrane
It is selectively permeable membrane
It is made up of lipids and is non polar
It is freely permeable for water although water is polar
Plasma membrane has special channels that allow water to move freely in side cell
It stops other polar substances to go inside cell other than water.
Water
Special channels


Symplast Pathway
Together
Protoplast (living part of cell)
When water moves through protoplast or cytoplasm is called symplast pathway
It is also called intercellular route
Xylem
Endodermis
Casparian strip
Vascular cylinder
Cortex
Epidermis
Root hair
Symplastic pathway
Soil
Root hair
Epidermal cell
Plasmodermata
Cortex
Pulled by transpiration pull and move towards stem & leaves
Xylem
Endodermis
Casparian strip


Stomatal Transpiration
Stomata's are pin hole structures present in lower epidermis of leaves
Guard cells are present around stomata's which helps in opening and closing of stomata
On opening of stomata water evaporates and carbon dioxide get enter into plant cells
Carbon dioxide helps in photosynthesis in plants
Guard cells also control extra removal of water from plants
STOMATA


Factors Effecting Transpiration
Temperature
Air Humidity
Air Pressure
Leaf Surface Area

ANNEXURE J

Lesson Plan

Instructor: Nida-Shahzad

Lesson Plan for Class: 11th

Topic: Introduction to Transport in Plants

Course /Subject: Biology

Time: 45mins

Resource Materials: Knowledge Clip, Computer lab, Internet, Online Quiz, Writing Board, Paper quiz

Instructional Plan

Lesson Objectives (Content/skills):

1. To develop the interest of students in subject of "Biology"

2. To develop the interest of students in Lesson "Transport in Plants"

3. To tell the students about the transport mechanism in plants

4. To engage the students in the class

Student Outcomes (Remembering, Understanding and Applying Knowledge): After completing this lesson, students will be able to:

1. Define the term transport in plants.
2. Comprehend the introductory clip, which they have seen in their own words.
3. Make a small presentation on a topic, which they have learnt through knowledge clip.

Time	Plan	Content and Instructional Strategy
7mins	**Lesson Introduction (Online)**	Teacher will take the students in Computer lab and ask them to watch an introductory knowledge clip alone. Teacher will also ask them to jot down the notes and their queries relevant to the topic.

5mins	**Online Assessment**	Teacher will ask the students to fill an Online Quiz on Google forms.
5mins	**In-Class** **Teaching Method**	After taking a quiz, teacher will discuss the queries regarding introductory clip that students have seen alone. Discussion method will be specifically used within class.

In-Class-Activity Plan

Activity Design: **Time: 23mins**	**Activity:** Teacher will make small groups of students and ask them to discuss whatever they have learnt through the concept introductory clip (Knowledge Clip). After discussion, students are required to make a concept map covering all-important points, which they have learnt. Any member of every group will present their work and teacher will give on spot feedback to them.
Activity Instructions for Students:	1. Raise your hands before speaking. 2. Raise your hands after completing the task. 3. Write your explanation in clear and neat handwriting. 4. Manage your time properly.
Materials needed by teacher/student:	Paper, Pencil or Pen

In-Class Evaluation Plan

Evaluation **5mins**	Teacher will evaluate the students through their presentations.

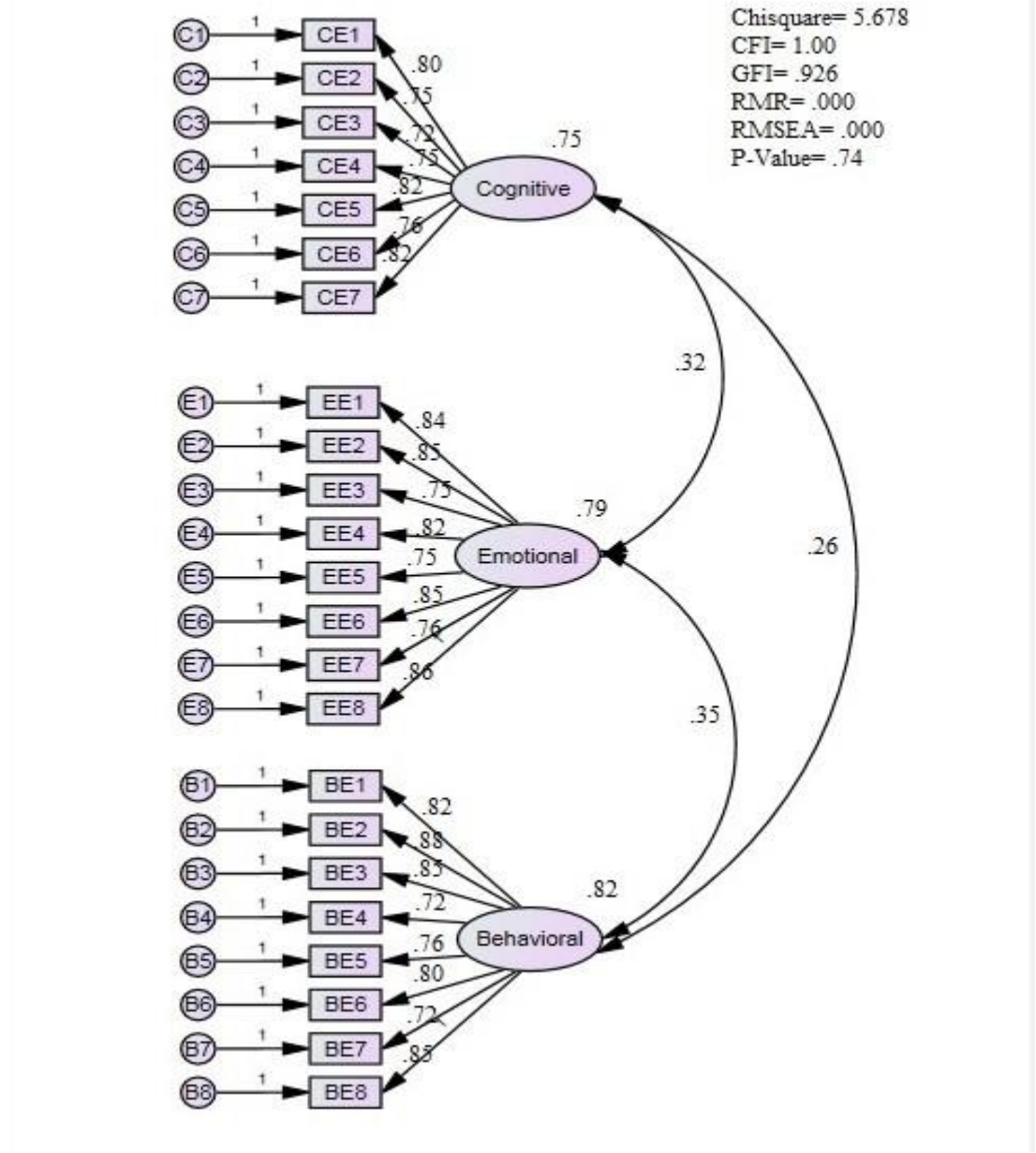
ANNEXURE K

List of Colleges in Rawalpindi

1	Rawalpindi Region	FG Post Graduate College for Women, Kashmir Road, Rawalpindi	College-Post Graduate	fgpcw.cb1@gmail.com
2	Rawalpindi Region	FG Post Graduate College for Women (2nd Shift), Kashmir Road, Rawalpindi	College-Post Graduate	fgpcw.cb1@gmail.com
3	Rawalpindi Region	FG Liaquat Ali Degree College for Boys, Peshawar Road, Rawalpindi	College-Degree	fgladc@gmail.com
4	Rawalpindi Region	FG Degree College for Women, Abid Majeed Road, Rawalpindi	College-Degree	fgdcamr@gmail.com
5	Rawalpindi Region	FG Degree College for Women, (2nd Shift) Abid Majeed Road, Rawalpindi	College-Degree	fgdcamr@gmail.com
6	Rawalpindi Region	FG Girls Inter College, Abbottabad	College-Intermediate	fgcollege.atd@gmail.com
7	Rawalpindi Region	FG Degree College, Attock	College-Degree	fgcollegeatk@yahoo.com

ANNEXURE L

AMOS Figure for Confirmatory Factor Analysis



ANNEXURE P

Table for Sample Selection

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970