Video-based Learning of the Concept of Plant Tissue Culture during Covid19 among Higher Secondary Students – An Empirical Study

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Abstract

Plant tissue culture has great significance in plant biotechnology,especially in crop improvement. Video may have a positive impact on student performance in biology classes, as they find it more engaging. Enormous studies have shown that video can be a highly effective educational tool. Over the past few years, videos are being widely used in classrooms for supporting a curriculum and helping students learn the material faster than ever. The objective of this study was to improve the academic achievement in the concept of 'Plant Tissue Culture' among the Class 12 students through Video content in three parts with different strategies.The single-group test-retest experiment design wasadopted for the study.The data were collected from Class 12 standard students of higher secondary school Thirunageswaram, Thiruvidaimarudur, Thanjavur, Tamil Nadu by the researcher for the study. The researcher took 17 (male 7 and female 10) as the sample size which was the total strength of the class 12 Biology stream.The magnitude of the difference between the pretest and posttest for achievement in 'Plant Tissue Culture' was estimated to be 2.893 through Cohen's d effect size analysis, which was found to be very large.Thus it was clear that the video lesson with interaction gave a nearly five times better result than without any interaction and discussion. When the video was played in the classroom at a stretch students performed four times better than the video given as a home assignment. This research study hasstrengthened the argument that video can be a highly effective educational tool.

Keywords: *Academic Achievement, Botany concept, Cohen's d effect size, Video-based learning at home assignment, Video sessions, Video with interaction*

Introduction

Video-based learning can be considered one of the effective teaching-learning methods. Students studying in standard 12 under Tamil Nadu State board in government schools are getting the laptops free of cost through their respective schools, which is a wonderful scheme from students' perspective to learn their subjects and compete globally in future endeavours. The TN government, School Education Department, and TN SCERT are jointly taking efforts to provide e-content in the form of videos so that they can learn through their laptops. During this Covid19 pandemic period schools were closed thus direct face-to-face teaching learning becomes impossible. These videos played a vital role in the learning of the students and that too at their own pace. Hence the investigator intends to witness the effect of such videos through a small study with the help of videos developed by the school education department, government of Tamil Nadu.

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The school education department has prepared enormous video lessons across subjects as learning resources for plus two students. As part of this initiative, video lessons were given to students as learning resources. Government and government-aided schools were instructed to transfer these video lessons to students' laptops through hi-tech labs in schools during the distribution of textbooks. Moreover, the State Council of Educational Research and Training (SCERT) and Kalvi TV have together prepared exhaustive video lessons in all the subjects for both the Tamil and English media. During the Covid 19 pandemic, not more than 20 students were asked to come to the school at any given point of time to get the video resources on their laptops. Since the schools in Tamil Nadu remain shut, the School Education Department has been taking steps to ensure that students have access to resources and can continue their learning.

Plant Tissue Culture

Plant tissue culture has great significance in plant biotechnology, especially in crop improvement. The term tissue culture may be defined as the process of the in-vitro culture of explants (pieces of living differentiated tissues) in a nutrient medium under aseptic conditions. However, in general, tissue culture includes the term tissue culture as well as cell culture, organ culture, and suspension culture. Plant tissue culture is a fundamental aspect of plant biotechnology. It is evident now that plant biotechnology is one of the most beneficial of all the sciences. The products of plant biotechnology are being transferred rapidly from laboratories to the fields. Also, the plant tissue culture has become of great interest to molecular biologists, plant breeders, and even industrialists, as it helps in improving plants of economic importance.

There were six videos developed for Chapter 5, Plant Tissue Culture. The whole lesson was covered using these 4 videos. The resource person in that video was Mr. K. Sirajudeen (as shown in Fig 1), Post Graduate Teacher from the Government Higher Secondary School, Suriyur, Pudukkottai District of Tamil Nadu. He used many PowerPoint slides in his explanations (as shown in Fig 2). Moreover, there were two more videos exclusively for the examination purpose, which covered book back and enriched questions so that the students can prepare for the competitive examinations. The digital video content production team has done wonderful work in presenting plant tissue culture to the anticipated learners.

Fig.1: Presenter of Video Lesson

Fig.2: Still from the Video Lesson

Review of Literature

Video may have a positive impact on student performance in biology classes, as they find it more engaging (Stockwell et al., 2015). As biology educators, we have abundant evidence that active learning like videos in

the classroom provides clear advantages over passive encounters with course material through lectures (Haak et al., 2011; Freeman et al., 2014). Schacter and Szpunar (2015) propose a conceptual framework for enhancing learning from educational videos that identifies online learning as a type of self-regulated learning. When new information is delivered via video, students report it as easier to learn and more memorable than text (Salomon, 2012; Choi & Johnson, 2005). Although much video-based education is still top-down and teacher-centered (Yousef et al., 2014; Kay, 2012) there is an increasing trend toward combining both teaching-focused and learning-focused methods (Kirkwood & Price, 2013). Video provides that opportunity for students to take fuller control over their learning. Poquet et al., (2018), emphasized the video characteristics that have been analyzed in research with specific regard to their influence on learning effectiveness. Student performances had a significant influence when integrating questions into videos (Obodo & Baskauf, 1995). On the other hand, video is not inherently effective, however; Guo et al., (2014) have shown that students often disregard large segments of educational videos. Some videos contribute little to student performance (Machardy & Pardos, 2015). Inspite of these arguments several research studies have shown that video can be a highly effective educational tool (Moore & Smith, 2012; Kay, 2012; Lloyd et al., 2012; Rackaway, 2012; Hsin & Cigas, 2013; Stockwell et al., 2015).

Need and Significance of the Study

Over the past few years, videos are being widely used in classrooms for supporting a curriculum and helping students learn the material faster. Research shows that most teachers have effectively used videos during the academic year and they have found video learning quite effective, it is even better than teaching students through traditional textbooks. The majority of part of the human brain is devoted to processing visual information. The brain responds to visuals fast, better than text or any other kind of learning material. Remembering stuff from the picture is retained in the mind for a longer time. Abstract concepts that are difficult to understand in any other way are learned by watching people perform or demonstrate the process through videos. This demonstration makes learning fast. Through videos, anybody can do self-study. The videos, audios, and webinars help students to learn something for which a teacher would be required otherwise. The best part is, this self-study technique leaves a powerful impact on the brain, better than reading the same lesson from a book.

Videos have now become a dominant part of classroom learning. They are widely used in both physical and online classrooms. As videos give the power to make a visual representation of the real world, this form of contextualization is incredibly useful in converting abstract theories into visuals. The students get to develop a connection between the knowledge that is being transferred and its practical implementation. Students get to learn through illustration. The visual analogy clarifies the concept better than any other thing. Video learning creates a sense of presence which supports cognitive as well as social presence. All these components are critical for successful learning. Lectures are conducted using video tutorials to make the learning process fun, effective, responsive, and fruitful.

Keeping the view of learning in the Covid-19 pandemic situation, digital video content is one of the best methods to learn and reach students. Standard 12 students have laptops issued by the government of Tamil Nadu in a free learning scheme. Many video contents were downloaded and transferred to the laptops through Hi-Tech labs by the school. There are resources on YouTube but most of the students cannot afford to have internet facilities. Moreover, in many villages, there is no internet facility at all or near the student's residence. As these standard 12 students are going for higher education it becomes very essential for them to have a clear idea about the concepts in their syllabus. Moreover, they must be ready to face many competitive

examinations. Hence the investigator decided to study the impact of such video content on learning among standard 12 students by taking the concept of plant tissue culture.

Objective of the Study

Improving the academic achievement in the concept of 'Plant Tissue Culture' among the Class 12 students through Video content in three parts with different strategies.

Hypothesis of the Study

In this study, the researcher used an alternative hypothesis instead of a null, which also contains three sub-hypotheses.

1) **Alternative Hypothesis (H1):** There is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test in the entire chapter on plant tissue culture.
   - **a) Sub-hypothesis (H1a):** There isa significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test 1 of part 1 of plant tissue culture using one time at a stretch video lesson in the classroom.
   - **b) Sub-hypothesis (H1b):** There is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test 2 of part 2 of plant tissue culture using the pause, rewind, and interaction with the video lesson.
   - **c) Sub-hypothesis (H1c):** There is a significant mean difference between the pre-test and post-test scores of Class12 students with respect to achievement test 3 of part 3 of plant tissue culture using a video lesson given as homework.

Sampling Size and Technique

The data were collected from Class 12 students of higher secondary school Thirunageswaram, Thiruvidaimarudur, Thanjavur, Tamil Nadu by the researcher for the study. The researcher took 17 (male 7 and female 10) as the sample size which was the total strength of the class 12 Tamil Medium Bio Math's stream. The technique adopted by an investigator for sampling was purposive as the availability of laptops among Class12 students, moreover convenience of the sampling was also considered.

Research Design and Intervention Applied

The single-group test-retest experiment design was adopted for the study. To determine the initial level of the student in Plant Tissue Culture, a pre-test (as shown in fig.3) was conducted on the students at beginning of the treatment through a paper pen test which comprises 45 MCQs in Tamil medium with four options.

Fig.3

Pre-test conduction

The intervention comprises of three levels. In the first level, Pre-test 1 comprised of 15 questions was administered, then part-1 video was exposed at a stretch with no discussion, and clarification (as shown in fig 4a and 4b), immediately after that Post-test 1 was administered.

Fig.4a

First Intervention

Fig.4b

First Intervention

On a successive day Pre-test 2 comprises 15 questions, part 2 video was exposed with interaction, discussion, pause, and replay of video portions, if required, by the students (fig 5a and 5b), immediately after that Post-test 2 was administered in intervention level 2. Then next day only Pre-test 3 comprised of 15 questions was administered. Video 3 (part 3) was written on DVD and was given to each individual for learning at home. In continuation the next day only Post-test 3 was administered as intervention level 3.

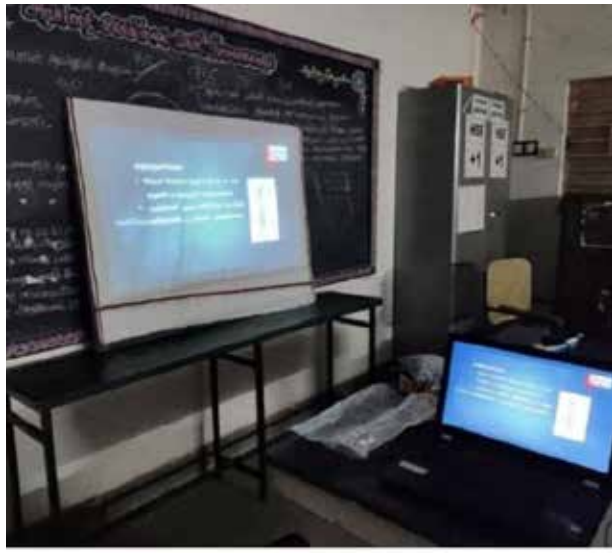
Finally, to understand the effects of video content a post-test was given to the students

Fig.5a

Second Intervention

Fig.5b

Second Intervention



at end of the treatment (as shown in fig 6), which was the same 45 MCQs used in the pretest.

The data obtained were subjected to the calculation of paired sample t-test through SPSS ver. 24 and Cohen's d effect size through the formula given below.

Cohen's d effect size=((M2 - M1))/((σ2 - σ1))

Fig.6

Post-test conduction

Where M1 is the mean of the pretest, M2 is the mean of the posttest, σ1 is the standard deviation of the pretest and σ2 is the standard deviation of the posttest. Cohen's d effect size is determined by calculating the mean difference between two groups, and then dividing the result by the difference between the standard deviation of the those two groups, if each group has a different standard deviation (Wasserman et al., 1988).

1) Alternative Hypothesis (H1)

Finally, the mean of the pre-test and post-test academic achievement scores are found to be 12.29 and 33.12 respectively. The t-value for the scores on the academic achievement for the pre-test and post-test was determined to be 14.06 which is found to be significant at 0.01 level for the df 16. Hence for the hypothesis (H1) there is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test in the entire chapter on plant tissue culture was accepted. The posttest score was found to be higher than the pretest of Class 12 in academic achievement in Plant Tissue Culture. The magnitude of the difference between the pretest and posttest for academic achievement in 'Plant Tissue Culture' was estimated to be 2.893 through Cohen's d effect size analysis, which was found to be very large (Sawilowsky, 2009).

a) Sub-Hypothesis (H1a)

The mean of the pre-test and post-test of achievement test 1 scores are found to be 3.59 and 11.47 respectively. The t-value for the scores on achievement test 1 for the pre-test and post-test was determined to be 14.94 which is found to be significant at 0.01 level for the df 16. Hence the sub-hypothesis (H1a) there is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test 1 of part 1 of plant tissue

Table 1

The Mean, Standard Deviation, Paired Sample t-value, and Cohen's d effect size were tabulated for different Pre-test and Post-test

Variable	n	Pre-test		Post-test		t - value	df	Level of Sig.	Cohen's d effect size
		Mean	S. D.	Mean	S. D.				
Achievement Test 1	17	3.59	1.18	11.47	1.91	14.94	16	0.001**	10.795
Achievement Test 2	17	4.24	2.02	12.35	2.18	13.54	16	0.001**	50.688
Achievement Test 3	17	3.65	1.17	8.88	3.18	7.12	16	0.001**	2.602
Academic Achievement	17	12.29	3.64	33.12	6.61	14.06	16	0.001**	7.013

Significant at 0.01 level

culture using one time at a stretch video lesson in the classroom was accepted. The post-test score was found to be higher than the pretest of Class 12 in achievement test 1. The magnitude of the difference between the pre-test and post-test for achievement test 1 in 'Plant Tissue Culture' was estimated to be 10.795 through Cohen's d effect size analysis, which was found to be very large (Sawilowsky, 2009).

(b) Sub-Hypothesis (H1b)

Similarly, the mean of the pretest and post test of achievement test 2 scores are found to be 4.24 and 12.35 respectively. The t-value for the scores on achievement test 2 for the pre-test and post-test was determined to be 13.54 which is found to be significant at 0.01 level for the df 16. Hence the sub-hypothesis (H1b) there is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test 2 of part 2 of plant tissue culture using the pause, rewind, and interaction with the video lesson was accepted. The post-test score was found to be higher than the pretest of Class 12 in achievement test 2.The magnitude of the difference between the pre-test and post-test for achievement test 2 in 'Plant Tissue Culture' was estimated to be 50.688 through Cohen's d effect size analysis, which was found to be very large (Sawilowsky, 2009).

c) Sub-Hypothesis (H1c)

Likewise, the mean of the pre-test and post-test of achievement test 3 scores are found to be 3.65 and 8.88 respectively. The t-value for the scores on achievement test 3 for the pre-test and post-test was determined to be 7.12 which is found to be significant at 0.01 level for the df 16. Hence the sub-hypothesis (H1c)there is a significant mean difference between the pre-test and post-test scores of Class 12 students with respect to achievement test 3 of part 3 of plant tissue culture using a video lesson given as home work was accepted. The post-test score was found to be higher than the pre-test of Class 12 in achievement test 3.The magnitude of the difference between the pretest and post-test for achievement test 3 in 'Plant Tissue Culture' was estimated to be 7.013 through Cohen's d effect size analysis, which was found to be very large (Sawilowsky, 2009). This research paper also indicates that in an experimental study it is useful to find out effect size, which is the magnitude of the effect rather than simply comparing the t-values between the pre-test and the post-test.

Findings and discussion

The magnitude of the difference between the pre-test and post-test for achievement in 'Plant Tissue Culture' was estimated to be 2.893 through Cohen's d effect size analysis, which was found to be very large (Sawilowsky, 2009).

Delimitations of the Study

The concept of Plant Tissue Culture given in the Class 12 book of Tamil Nadu State Board alone was taken for the study.

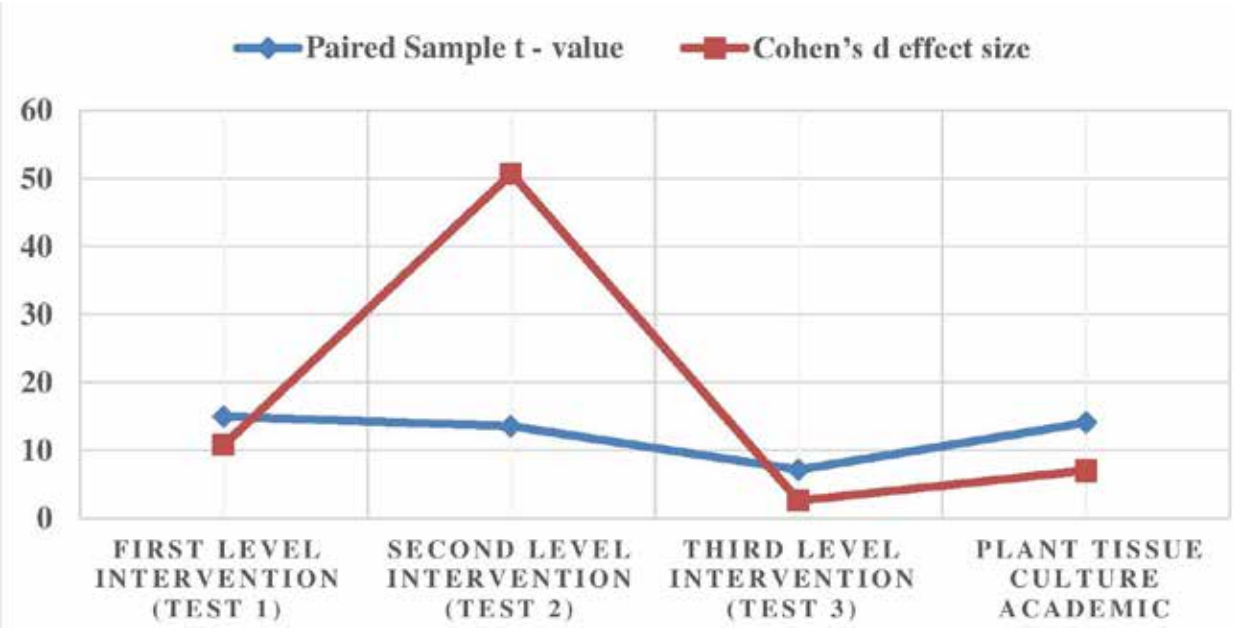
- Of three out of 6 available videos from YouTube,only 3 were taken for the study.
- The treatment is carried out only for 5 working days.

Conclusion

Videos of teachers with great experience and in-depth knowledge will be a boon for the students in preparing for their exams as well as academic competitions in near future. The government of Tamil Nadu has taken an effort to provide learning opportunities through the Kalvi TV channel with their best available resources, which the students and parents should realize and make use of this platform of learning especially for government students during this Covid19 pandemic situation. Extremely helpful for the preparation for

Fig. 7.

Line Graph showing t-value and Cohen's d effect size



the competitive exam like NEET. This video content will be provided by the school to students so that it can be well taken as the alternative for the online classes of the self-financing school. In the video mode of learning repetition, pause, and forward for self-paced learning can be done by the learner for a better understanding of the concept. Government should initiate this video into small meaningful episodes in the form of a learning management system like Byju's. Supplement materials can also be given like worksheets, bridge courses, etc.

In this study, the investigator used video content as the strategy for the experimental design. The video content prepared by the Government of Tamil Nadu in collaboration with Kalvi TV, SCERT, DIETs, School education department and given to the students through a laptop was taken for the study. The strategy has got a very positive impact on learning for Class 12 students. The students would have used this video content for their learning during this Covid 19 pandemic situation. Wonderful effort from the TN Government side in terms of creating a learning environment for the poor students studying in government schools. Now all in the hands of students to make them utilize their deeper learning and for future endeavours.

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