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The Effects of Using Videos on Teaching Selected Topics in Physics Towards the Development of Higher-Order Thinking Skills

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Abstract *– This study tried to answer the following: What are the mean scores of the experimental group and control group in the pretest in terms of HOTS: application, analysis, synthesis and evaluation? Is there a significant difference between the mean scores of the two groups in the specified HOTS? What are the mean scores of two (2) groups in the posttest in terms of HOTS: application, analysis, synthesis, and evaluation? Is there a significant difference between the mean scores of both groups in the specified HOTS? What is the percentage gain in terms of HOTS based on the results of the pre and posttest in the experimental/control groups? What is the level of proficiency of both groups in terms of the mean scores in the posttest on the given skills? It utilized quasi-experimental, mean, percentage, standard deviation, and T-test for independent sample means. The following were drawn: Students performed better in analysis, synthesis, and evaluation levels even before the use of videos based on the pretest .The experimental and control groups had the same posttest performance in the application and synthesis levels. But, the experimental group performed better at the analysis and evaluation levels. Students in the control group had a greater percentage gain at the analysis and synthesis levels based on pre and posttest results. The level of proficiency of both groups in the application, analysis, and synthesis skills was average in the evaluation skill for the experimental group. Instructions using both the traditional approach and using videos developed the students' HOTS.*

Keywords *– videos, higher-order thinking skills, physics, pre-test, post-test*

I. INTRODUCTION

Science and Technology has become an integral part of the world's culture and this is evidenced by its tremendous impact on society as a whole. It cannot be denied that rapid modernization through technological breakthroughs and inventions has affected everyone's daily life. More than just being aware of these innovations, along with the growth of science and technology it behoves every individual to respond to the demands of the changes, hence make life better.

Schools today are rapidly adapting technology like computers, tablets, laptops, smart phones, and internet technologies. This fast-changing technology really made a disparity in the way schools are delivering knowledge to the students. In spite of this innovation, some stakeholders do not fully understand how this instructional investment can affect the performance of the learners (Bombase, Nuga &Sobrevega, 2014).

The study of Physics in the secondary schools remains a challenge to both the teacher and the students. In order to teach the subject effectively, the teachers need to acquire a working knowledge of modem instructional technologies that will contribute to the development of Higher-Order Thinking Skills (HOTS).

Realizing the increasing impact of technology on vitalizing classroom instruction, the researcher decided to investigate the effect of the use of videos on teaching selected topics in Physics towards the development of Higher-Order Thinking Skills (HOTS).

II. OBJECTIVES OF THE STUDY

This study attempted to ascertain the effects of videos in teaching selected topics in Physics towards the Development of Higher-Order Thinking Skills (HOTS) among fourth-year high school students. The study specifically aimed to determine the mean scores of the experimental group and control group' in the pre-test and post-test in terms of HOTS: application, analysis, synthesis and evaluation; to test if there is a significant difference between the mean scores of the two groups in the specified HOTS in the pre-test and post test; to determine the percentage gain in terms of HOTS based on the results of the pre and post-tests in the experimental /control groups; to determine the level of proficiency of both groups in terms of the mean scores in the post-test on the following skills: application, analysis, synthesis and evaluation.

Ho_1: There is no significant difference between the mean scores of the experimental and the control groups in relation to HOTS in the pre-test.
Ho_2: There is no significant difference between the mean scores in the post-test of the experimental group and control group in relation to HOTS after using video tapes and the traditional approach.

Related Literature

Costa (1995) studies the effects of thinking skills instructions on test performance and on the transfer of cognitive skills to new and different situations. Result of the study reveal that thinking skills instructions improved the academic performance of the subjects and enabled the subjects to become better problem - solvers in other situations, in and outside of school.

He emphasizes that the goal is not memorization or imitation of any given thinking skills model. Rather, it is the use of a skill model as springboard to student's own conceptions of .these operations. It is neither prescriptive nor limiting, rather, it is instructive. It shows and explains to students what was involved in executing any thinking skills or strategy and how to do it by providing instruction, modeling, feedbacking, and considerable guided practice.

In reality, however, most, if not all schools offer a separate course to teach thinking skills. It becomes, therefore, the objective of every school teacher to teach thinking skills in the context of the subject-matter he/she teaches.

Clarke (1995), on the other hand, advocates developing thinking skills across the content areas because skills taught without the subject areas are not likely to be reinforced during teaching. Without content on which to operate, general strategies may appear meaningless to students. Students want to succeed in their regular content courses where they associate meaning to an organized body of facts and concepts (Perkins and Salomon, 1997). Thinking about organized subjects invites the application of specific kinds of organized thinking processes. The investigation of Ellingwood (1997) on the effects of logo computer programming instruction on the higher order thinking skills and mathematical achievement of first grade students is based on this school of thought. The study reveals no significant differences in the higher - order thinking skills between the logo and non—logo groups. The logo group, however, demonstrates higher mean gains than the non-logo group. Likewise, the study reveals that after the treatment, the logo group reported using logo and computers as their favorite way to learn mathematics.

According to Glaser (In Van Tassel-Baska, 1998), the process of teaching thinking skills is coterminous with the teaching of concepts and principles, for both must take place simultaneously. There is no teaching of thinking skills in isolation from a knowledge base, nor is a knowledge base developed without the dynamic type of interaction with the content.

This interaction with content was looked into by Kaplan (1997), who assesses the infusion of critical thinking skills in content instruction. In this experimental study, one group was taught with content via the infusion of critical thinking skills while another group was taught with similar content without the infusion of critical thinking skills. Teacher's anecdotal comments corroborated by the posttest survey results revealed that learning was more effective within the group taught with the infusion of critical thinking skills.

Lierman (1997) suggested that teachers should be cognizant of factors which could affect the development of critical thinking in students such as how and when the material was to be presented, the amount of positive reinforcements given to students as well as the teachers' characteristics. Whether one decides to teach thinking skills directly as specific skills and then apply them to the curriculum, or whether they are taught as part of the existing curriculum, or as a combination of both, there is no doubt that thinking skills should be developed to the highest possible levels.

Related studies in the Philippines, though still at its infancy, are making an impressive impact on research and education. Reyes (1997) found out several ways in which the respondents performed each of the different skills based on their familiarity or knowledge about the organism given for study and also based on their priorities. Likewise, the findings provide evidence to support the constructivist view that individual learners have certain procedural knowledge and able to perform these in their own ways. Also, the study found evidence of the complementation of manipulative skills and thinking skills in the performance of a task.

Martin (1999) also made a study on the relationship between teachers' thinking skills practices and students' performance in biology. The study reveals that the teachers had a very satisfactory rating in all identified thinking skills compared with the students' moderately satisfactory performance in all skills except remembering skills which was satisfactory. The findings further reveal a positive correlation between the teachers' thinking skills practices and students' performance in Biology on the skills of remembering, analyzing, generating and integrating. On the other hand, a negative significant and non - significant correlation on the skills of organizing and focusing, information gathering and evaluating, respectively, was noted.

Another related study was conducted by Hernandez et al. (1994). This study focus on the thinking skills practices of private as well as public school teachers who were mostly teaching science, language and social sciences.

The investigation done by Escalada and Zollman (1997) which dealt with the effects of using interactive digital video on a physics classroom on students learning and attitudes, found that the majority of participants felt that the activities were either effective or very effective in helping them learn the physics concepts related to reference frames. The majority of participants felt that the activities/ computer programs, video analyze and visual space-time, used in the activities were not difficult to use. Also the majority of participants felt the visualization techniques provided by these programs, in addition to discussion, were very effective in helping them learn the concepts related to reference frames.

Harwood and Mcmahon (1997) explore the effects of an integrated video media curriculum enhancement on student's achievement and attitudes in a First -Year- General- high- school chemistry course. Results show that all students who received the integrated video medium scored significantly higher than those students who received no video intervention. Student interviews indicated that video enhancement was able to provide for visual and verbal information that was novel, meaningful, and relevant to students' lives outside of school.

A study conducted by Barredo (1997) determined whether the use of videotapes increased the level of interest and achievement of students than the use of one dimensional picture in learning selected biology concepts. This study concluded that the use of videotapes was effective in increasing the level of achievement and students in learning Photosynthesis, Protein Synthesis, and Cellular Reproduction. Moreover, this effect was true among slow learners. However, the interest level of the students was the same whether exposed to videotapes or to one-dimensional pictures. Variables such as genders, ethnicity, family monthly income, and educational qualification of parents had no effect on the level of interest and achievement of the students. The study also concluded that science interest was not correlated with performance or achievement of students.

Lorenzo (1998) measure the difference of the effects of use and non-use of videotaped lessons on students' classroom interaction, achievement and retention in Math. Although it signified that students learned something from the videotaped lessons, there was no significant difference in the achievement and retention of the experimental and control group in Math.

Alvarez (1998) found out there was no significant difference in the pre-test mean scores of the experimental and control groups while there was a significant difference in the post-test mean scores between those which were exposed to video-aided instruction and those taught using the traditional lecture method. There was no significant difference between the evaluation of videotapes lessons by teachers and students.

Another study conducted by Canada (1998), found out that the mean gain score of the experimental group who were exposed to lecture coupled with videotape viewing was greater than the control group who were exposed to pure lecture method of instruction. It was evident that lecture coupled with videotape viewing was effective in improving the academic performance of the students.

III. METHODS

This study utilized a quasi- experimental design. In particular, the pre-test post-test non-equivalent group experimental design is employed and the statistical tools used to analyze and interpret the data the following: mean, which was used to compare the scores of the experimental group and control group in the pre and post-tests in terms of higher-order thinking skills; percentages, it was used to find out the percentage gain in terms of HOTS based on the resulted pre and post-tests of the experimental and control groups; standard deviation, it was used to find out the significant differences among scores of the experimental group and control group in the specified higher -order thinking skills; and the T-Test for independent sample means, which was used to determine the significant differences in the mean scores of experimental group and control group in the pre and post-tests in terms of HOTS: application, analysis,• synthesis; and evaluation.

IV. RESULTS AND DISCUSSION

Table 1 shows the pre-test mean scores and standard deviations in Science and Technology IV of the experimental and the control groups.

Table 1. Pretest Mean Scores and Standard Deviations in Science and Technology IV of the Experimental and Control Groups before the Treatment

HOTS	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Application	5.93	2.02	5.47	1.98
Analysis	5.49	1.97	3.81	1.64
Synthesis	3.93	1.54	3.13	1.26
Evaluation	4.41	2.02	2.62	1.14
Average	4.94	1.89	3.76	1.51

In the application level, the mean score of the experimental group (5 .93) was slightly higher than the mean score of the control group (5.47).The standard deviation of the first group was 2.02, slightly higher than that of the second group (1.98). This could indicate that in the experimental group the individual scores were more slightly spread out than in the control group in relation to the mean.

In the analysis level, the mean score of the experimental group (5.49) was higher than the mean score of the control group (3.81). The standard deviation of the first group was 1.97 slightly higher than that of the second group (1.64).

In the synthesis level, the mean score of the experimental group (3.93) was slightly higher than the mean score of the control group (3.13). The standard deviation of the first group was 1.54 slightly higher than that of the second group (1.26).

In the evaluation level, the mean score of the experimental group (**4.41)** was much higher than the mean score of the control group (2. 62). The standard deviation of the first group (2.02) was higher than that of the second group (1.14).

The mean score of the experimental group in the four (4) HOTS was 4.94 and its standard deviation 1.89; the control group had a mean score of 3.76 and a standard deviation of 1.51. Although the performance of the experimental group in HOTS was higher than the control group, the individual skills of the students tended to be more dispersed in relation to the mean.

Table 2 shows the difference between the pre-test mean scores of the experimental and control groups in the specified higher-order thinking skills (HOTS). The t-test applied to the mean scores of the two groups in each HOTS at 5% significance level revealed the following:

Table 2. Difference between the Pretest Mean Scores of Experimental and Control groups in the Specified Higher-Order Thinking Skills (HOTS)

HOTS	Experimental Group		Control Group		
	t	df	t	df	Interpretation
Application	1.46	158	1.46	155	NS
Analysis	5.89	158	5.82	115	S
Synthesis	3.63	158	3.59	143	S
Evaluation	7.00	158	6.77	114	S

Critical Value = 1.96; NS – Not Significant; S - Significant

In the application level, a comparison of the mean scores of the experimental and the control groups had no significant difference since the t-values of 1.46 (experimental) and 1.46 (control) were less than (<) the critical value of 1.96 using 158 and 155 degrees of freedom. The findings revealed that the two groups did not differ significantly in their mean scores and they were statistically equivalent in relation to the application level.

In the analysis, synthesis, and evaluation levels, the experimental and the control groups showed significant difference since the t—values of 5.89, 3.63 and 7.00 respectively (experimental) using 158 degrees of freedom and 5.82, 3.59 and 6.77 (control) using 115, 143 and 143 degrees of freedom (df) were respectively greater than (>) the critical value of 1.96. These findings showed the 2 groups had the same level of HOTS as far as prior knowledge in selected topics in Physics was concerned.

In view of these, the null hypothesis of no significant difference in the mean scores of the experimental and control groups was **accepted** for the application level and **rejected** for the analysis, synthesis and evaluation levels.

Table 3. Post-test Mean Scores and Standard Deviations in Physics of the Experimental and Control Groups After the Treatment

HOTS	Experimental Group		Control Group	
	Mean	SD	Mean	SD
Application	9.41	2.35	8.68	2.34
Analysis	9.93	2.48	8.89	2.35
Synthesis	7.80	2.11	7.47	1.94
Evaluation	10.41	2.70	8.44	2.50
Average	8.90	2.41	8.87	2.28

In the application level, the mean score of the experimental group (9 .41) was higher than the mean score of the control group (8.68). This could be probably due to the positive effect of using videos which showed application of concepts in everyday life. The standard deviation of the first group was 2.35 which were almost the same as that of the second group (2.34) indicating that the developments of application skill in both groups were practically the same.

In the analysis level, the mean score of the experimental group (9.93) was higher than the mean score of the control group (8.89). This result signified a deeper understanding of the concepts taught which was enhanced by the videotape viewing. The standard deviation of the first group was also 2.48 slightly higher than that of the second group (2.35) which might be explained by the greater variance in HOTS even within the experimental group sustained by using videos in teaching.

In the synthesis level, the mean score of the experimental group (7.80) was slightly higher than the mean score of the control group (7.47). This could mean that both approaches were effective in developing the synthesis skills of the students .The standard deviation of the first group (2.11), was slightly higher than that of the second group (1.94), indicating that both groups were really good in this level.

In the evaluation level, the mean score of the experimental group (10.41) was much higher than the mean score of the control group (8.44). This revealed that using videos was really effective in developing this skill. The standard deviation of the first group (2.70) was slightly much higher than that of the second group (2.50), which might be probably explained by the almost uniform distribution of score of both groups as far as the evaluation skill was concerned, notwithstanding the use of videos for the experimental group.

Overall, the mean score of the experimental group in the four (4) HOTS was 8.90 and its standard deviation 2.41 indicated that this group performed slightly better than the control group with a mean score of 8.87 and a standard deviation of 2.28.

Table 4 shows the difference in the post-test mean scores of the experimental and control groups in the specified higher-order thinking skills (HOTS).

In the application and synthesis levels, a comparison of the mean scores of the experimental and the control groups revealed no significant difference since the t-value of 1.97 and 1.03 (experimental) using 58 degrees of freedom and 1.9 7 and 1.03 (control) were less than (‹) the critical value of 1.96 using 155 and 151 degrees of freedom. The findings revealed that the two groups did not differ significantly in performance and they were statistically equivalent in relation to the application and synthesis levels. This could indicate that both approaches in teaching Science and Technology IV were effective in developing these levels.

In the analysis and evaluation levels, the experimental and the control groups showed a significant difference since the t—values of 2.72 and 4.80 (experimental) using 158 degrees of freedom and 2.71 and 4.81 (control) using 153 and 151 degrees of freedom (df) were greater than (>) the critical value of 1.96. The data showed that the post-test mean scores of the 2 groups had the same results indicating the same level of HOTS in selected topics in Physics was concerned.

In view of these, the null hypothesis of no significant difference in the mean scores of the experimental and control groups was accepted for the application and synthesis levels and rejected for the analysis and evaluation levels.

Overall, the average t-values of the experimental and control groups showed a significant difference since the t-value of 2.63 using 158 degree of freedom (df) was greater than the critical value of 1.96. The results indicated that videotapes were effective in the development of higher-order thinking skills of the students compared with the traditional approach to teaching some selected topics in Physics.

Table 4. Difference between the Post-test Mean Scores of Experimental and Control groups in the Specified Higher-Order Thinking Skills (HOTS)

HOTS	Experimental Group		Control Group		
	t	df	t	df	Interpretation
Application	1.97	158	1.97	155	NS
Analysis	2.72	158	2.71	153	S
Synthesis	1.03	158	1.03	151	NS
Evaluation	4.79	158	4.81	158	S
Average	2.63	158	2.63	158	S

Critical Value = 1.96; NS – Not Significant; S - Significant

Table 5 shows the percentage gain of both the experimental and control groups in terms of HOTS. For the experimental group, the percentage gains in the scores in HOTS were the following: Application, 23.20 percent; Analysis, 29.60percent; Synthesis,25.78 percent; and Evaluation;40.00 percent.

Table 5. Percentage Gain of Experimental and Control Groups in Terms of HOTS in the Pre and Post-Tests

HOTS	**Experimental**	**Control**
Application	23.20%	21.41%
Analysis	29.60%	33.88%
Synthesis	25.78%	28.94%
Evaluation	40.00%	38.75%
Average	29.65%	30.75%

Application, 21.41 percent; Analysis, 33.88 percent; Synthesis, 28.94 percent; and Evaluation, 38.75 percent. Higher gain was registered in the application and evaluation levels for the experimental group. This could be probably due to the visual impact of the tapes. Analysis and synthesis levels registered a higher gain in the control group perhaps; abstract thinking was further developed in this group. Due to some experiments performed which lead the control group to discover, analyze and synthesize the given concepts.

The data on table 6 showed that the level of proficiency in the application skill of the experimental group is 9.41(average) while8.68 (average) for the control group. In the analysis skill, 9.93 (average) in experimental group while 8.89 (average) in control group.

Table 6. Level of Proficiency of Experimental and Control Group in Terms of the Mean Score in the Post-test

HOTS	Experimental Group		Control Group	
	Mean	Interpretation	Mean	Interpretation
Application	9.41	Average	8.68	Average
Analysis	9.93	Average	8.89	Average
Synthesis	7.80	Average	7.47	Average
Evaluation	10.41	High	8.44	Average

In the synthesis skill, the level of proficiency was7.80 (average) for the experimental group and 7.47 (average) for the control group. This meant that whether videotape or traditional approach in teaching Science and Technology IV was used, both groups had the same level of proficiency in application, analysis, and synthesis. However, in evaluation, the level of proficiency was 10.41 (High) for the experimental group and 8.43 (average) for the control group. This could indicate that video presentations was effective in developing evaluation skill of the students compared with the traditional approach in teaching Physics because visual images created more clear impact on the students than plain words.

The results indicated that the students in the experimental and control groups had an average level of proficiency with regard to application, analysis and synthesis but scored high in the valuation level after the intervention. These further showed that there was higher mean gain in learning after instruction with or without the use of videos.

V. CONCLUSIONS

Students performed better in analysis, synthesis and evaluation levels even before the use of videotapes in specific lessons in Physics based on the pre-test results. The experimental and control groups had the same post-test performance in the application and synthesis levels, but the experimental group performed better at the analysis and evaluation levels. Students in the control group had a greater percentage gain at the analysis and synthesis levels based on pre and post-test results. The level of proficiency of both groups in the application, analysis and synthesis skills was average but high average in the evaluation skill for the experimental group. Instruction using both the traditional approach and videotapes developed the students' higher-order thinking skills in Physics.

VI. RECOMMENDATIONS

Physics teachers should complement the traditional approach of teaching with videotape instruction to develop further the higher- order Thinking skills of fourth year students in the aforesaid learning area. Secondary school administrators and Science department heads should exert efforts to make videos available to promote the development of HOTS in students. More video lesson should be prepared for other topics in Physics. A similar investigation should be conducted for a longer period of time using more video lessons.

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