

EFFECT OF THE FIVE-STEP LEARNING CYCLE MODEL ON STUDENT'S UNDERSTANDING RELATED TO SIMPLE HARMONIC MOTION'S CONCEPT

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ABSTRACT

This study explores the effectiveness of the 5-step learning cycle model on students understanding related to SHM. 103 students (53 experimental group and 50 in the control group) are taken as sample. The research is an experimental research design that is based on pre and post-test. Students' answers were analyzed based on qualitative and quantitative. First, the student's responses were analyzed by determining the number of students, who possess sound understanding, partial understanding, and alternative ideas of the concepts. According to pre-test and post-test results, it was observed that most of the students shifted their level of understanding from alternative conception to partial or sound understanding. In the second the student is analyzed quantitatively and compared with the students' mean score of the group. It was also found that the students understand most of the concepts except the concept of amplitude and frequency. The 5-e step learning cycle model is better than the conventional method.

Keywords: Five-Step Learning, Harmonic Motion's, SHM, Pre and post-Test.

Introduction

There are many types of creatures on our earth, among them there is the one with a brain that is Human. The human brain is the most complex organ in our body. The human brain does different functions like thought, action, memory feeling, and experience of the world. A human's function "thought" is different from others. In the process of thought, we always want to know why the incidents happen in our nature and what is the reason behind every incident. As civilization developed, the thinking ability and understanding increased. From developing the stone wheel in the stone age to today's technological world where we approach other planets. We always follow scientific thinking.

In the development of science, many people and scientists have an important role but here we started with ancient Greek scientists who explained what the world was made up of and how it works. In 494-434 BC scientist Empedocles explained the world is made from four elements, earth, fire, water, and air. In the 2nd century, Ptolemy stated that the earth is the center of the universe Another great astronomer of the 16th century was Tycho Brahe that said that changes and decay only happen on earth. And also, in the 16th century, Kepler published three laws of planetary motion. Then in 1609 a man Hans Lippershey invented a telescope (Lambert and Chapman, 2004).

In the 17th century greatest scientist Isaac Newton invented a reflecting telescope. Newton give the theory of gravity and the laws of motions in 1687(Anderson, 2008).

First time in science a rule was made by humans that worked both on earth and in heaven. On the earth, different types of motion happen. In the study of motion, we can divide the motion into periodic and non periodic based on time. In periodic motion, there is a special type of motion called Simple Harmonic Motion.

In teaching any subject, we always want effective teaching and all-round development of students. That helps the student in understanding the concept and constructing the knowledge. Every subject has different types of objectives, we always teach according to the objective. All the objectives are set according to society and industrial needs. Educational objectives indicate the nature of the education system. The educational system shows the direction in which it acts. A few educators

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classified the educational objective. All the objectives are reported in "Taxonomy of Educational Objective". The word taxonomy-taxis nomos where the meaning of taxis is 'arrangement' and 'nomos' meaning 'law' (Kumar and Hassan, 2015).

The educational objective is broadly divided into 3 main domains:

- Cognitive Domain(knowing)
- Affective Domain(feeling)
- Psycho-Motter (doing)

These domains are hierarchical. For learning, the first activity is a mental process of trying to understand, analyse, synthesize, and associate the previous knowledge. All types of thought processes come under the cognitive domain (Simpson, 1966).

In the second stage, the acquired knowledge begins to change in the interest, attitude, and feelings of the individual. All behavior changes take place.

In the third stage, the domains focus on demonstrating motor skill and manipulative skill. All changes are in the third stage.

In active and effective teaching, it is important that all the objectives are acquired by the students. In the teaching of a topic, S.H.M students do not have a conceptual understanding. So inactive teaching-learning always uses techniques like reflections, discussion, and problem-solving activities. The activities promote analysis, synthesis, and evaluation that take students towards active learning. These are the types of active learning-

4E: Exploration, Explanation, Expansion, and Evaluation.

5E: Engage, Explore, Explain, Elaboration, and Evaluate.

Objective

To determine the effect of five step learning cycle model on sin. sec. students control group of class 11th understanding of simple harmonic motion.

Research Method

In this experimental research the research design is based on pre-test and post- test-based scheme in which pre-test used only for checking the background knowledge of the student whenever the post-test (achievement test) was used after the intervention on both the group for the data collection and after the data collection both groups' data are analyses qualitatively as well as quantitatively.

Sample

The sample of the study is 103 students of 11th class from govt schools of Dhanota and Jagatpura Jaipur. In this study govt school Dhanota is teach with a 5-E based constructive lesson plan and other school jagatpura is teach by the traditional lesson plan.

Data Collection

For the data collection a self-made achievement test is applied on both the school.

Data Analysis

Qualitatively analysis of the students' answers

Our purpose in this study is to determine the increases of student understanding. So first analysis of student's response of post-test and compare the student's response with students of other groups (conventional to 5 step learning model or vice versa).

Q.1 What is the S.H.M. ?

Conventional method response:

- Simple harmonic motion is the type of periodic or oscillation where the restoring force is directly proportional to displacement.
- To and fro motion in a circular arc by an body is known as simple harmonic. motion in one cycle attempt its mean position two time.

5 Step Learning Cycle Model Method Response:

When a body doing motion about a fixed point and direction of the motion always towards the fixed point.

When a body doing motion about the fixed point and the acceleration of the body always in the equilibrium position.

The acceleration of the object is directly proportional to its displacement from its displacement from equilibrium position and always directed towards the equilibrium position.

Q.2. What is Amplitude of Simple Harmonic Motion?

Conventional method response:

Amplitude is the maximum displacement of the object from the equilibrium position.

5. Step Learning Cycle Model Method Response:

- The amplitude of S.H.M is the total distance covered in backward and forward direction.

Q3 What is the difference between S.H.M and periodic motion?

Conventional method response:

Periodic Motion: The motion in which body refers motion after certain time interval. But in S.H.M motion do to and fro motion about a mean position.

A object change its position with time, but it moves in same path repeatedly in same time with same velocity is calls periodic motion. S.H.M is the type of periodic motion where is the restoring force which is directly proportional to the displacement.

5 Step Learning Cycle Model Method Response:

Periodic motion is the motion in which the particle repeating the path or going from a fixed point after a fix time interval. but in S.H.M the motion in backward and forward direction about a fixed point.

Periodic motion when a particle doing motion about a fixed radius circle. in S.H.M always the direction of motion from the fixed point.

Q.4 Explain the term period of Oscillation?

Conventional method response:

The period of oscillation is how long it takes for the oscillation to repeat in onetime.

Period of oscillation move the time taken to complete one oscillation.

5 Step Learning Cycle Model Method Response:

The time in which S.H.M doing one oscillation is called period of oscillation.

- Time taken by a simple pendulum in one oscillation is called period of oscillation.

Q.5 What happens to frequency and period when the speed of an object in S.H.M increases?

Conventional method response:

When the speed of object in S.H.M increase then it's frequency is decrease and the period is increase.

When speed is increases then time period decreased and frequency increase.

5 Step Learning Cycle Model Method Response:

When in simple pendulum speed is increase by external force then the period of oscillation is increase and frequency is also increase and the time period is same.

Q.6 List the characteristics of simple harmonic motion? Conventional method response:

There are characteristic of S.H.M

A restoring force work on body.

S.H.M is the type of oscillation.

S.H.M is the type of periodic motion.

It can be represented by the sin or cosine function.

5 Step Learning Cycle Model Method Response:

List of the characteristic of S.H.M motion.

No external force work on it.

Total energy is conserved.

The force direction always towards the equilibrium position.

Q.7 On what does period of Simple Pendulum Depend? Conventional method response:

The period of simple pendulum depend on the length of pendulum and the width of the pendulum's swing.

Time period of Simple pendulum depend on length of string.

5 Step Learning Cycle Model Method Response:

The period of simple pendulum depend on the wind and the angle where we leave the bob.

And the simple pendulum position and when we leave the bob(direction from the stand).

Q.8 Describe the changes in kinetic energy of a swinging pendulum body with respect to its position?

Conventional method response:

No response.

5Step Learning Cycle Model Method Response:

When the pendulum are in motion then we see at the mean position the pendulum speed is maximum and at the maximum distance the height is maximum and the speed is minimum and we know already that total energy always be conserved so maximum kinetic energy at the mean position.

The kinetic energy of the pendulum always depend on external force direction. The kinetic energy always depends on the time that is always continues at a fixed time.

Q.9 At what point is the kinetic energy potential energy maximum? Conventional method response:

At the equilibrium position kinetic energy is maximum and potential energy is zero. At maximum displacement from equilibrium point potential energy is maximum and kinetic energy is zero.

Kinetic energy in S.H.M is maximum at mean position and potential energy is maximum at maximum displacement of body from mean position.

5 Step Learning Cycle Model Method Response:

The mass has maximum K.E at an equilibrium point and maximum PE at a maximum distance from equilibrium position at backward and forward direction. And when pendulum is in rest position then the potential energy maximum at an equilibrium points and kinetic energy minimum at rest position.

Q.10 A particle doing S.H.M with a max. velocity 8 cm/s and its acceleration is 16cm/s² at 4cm from its mean position. Then calculate the time period and amplitude of S.H.M?

No one group give the correct response.

We can see the response difference between 5 step leaning cycle model group and the conventional group answer. When we are teaching with 5 step learning model then student give answer in own language and more related with their experience related answer. When we see the answer of conventional group then the answer is rote learning. They do not give the understanding type answer or experience relate learning. So, we can say that the 5-step learning cycle model develop student understanding and deep conceptual knowledge that stay in student mind for a long time. So, 5 step leaning model is best in understanding the concept of S.H.M.

Quantitative Analysis of students answers

No. of students, frequency, and percentage of Students of Control group on understanding S.H.M before and after the treatment

Table 1

Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
N=53 pre- test (before treatment)						Post test (after treatment)						
S.No.	SU*	PU**	AC***	SU	PU	AC						
1	18.86	17										
1	10	18.86	17	32.07	26	49.05	22	41.50	19	35.84	12	22.64
2	10	18.86	15	28.30	28	52.83	24	45.28	19	35.84	10	18.86

3	9	16.98	12	22.64	32	60.37	23	43.39	20	37.73	10	18.86
4	8	15.09	13	24.52	30	56.60	25	47.16	15	28.30	13	24.52
5	10	18.89	15	28.30	28	52.83	25	47.16	10	18.86	18	33.96
6	6	11.32	18	33.96	37	69.81	27	50.94	14	26.41	12	22.64
7	3	5.66	7	13.20	43	81.13	22	41.50	14	26.41	17	32.02
8	2	3.77	4	7.54	47	88.67	0	0	0	0	53	100
9	1	1.88	8	15.09	44	83.07	20	37.73	12	22.64	20	37.73
10	0	0	0	0	50	100	0	0	0	0	53	100

SU-sound understanding, PU-partial understanding, AC*** alternative conception

In above table information show that students in control group fairly shifted their level of understanding from alternative conception to sound and partial understanding of the concept.

In table 2 the information show that maximum students maintain their level of understanding from alternative conception to partial or sound understanding after the treatment.

In table 1 and 2 item no 8 and 10 students do not attempt or give the wrong answer so take all students response in alternative conception.

No. of students, frequency, and percentage of Students of EXPERIMENT group on understanding SHM before and after the treatment

Table 2

Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
S.No.	SU*	PU**	AC***	SU	PU							
N=50 pre-test (before treatment)						Post- test (after treatment)						
1	12	24	15	30	23	46	32	64	16	32	2	4
2	13	26	17	34	20	40	34	68	12	24	4	8
3	13	20	15	30	25	50	35	70	12	24	3	6
4	9	18	13	26	28	56	35	70	10	20	5	10
5	15	30	10	20	25	50	30	60	15	30	5	10
6	8	16	12	24	30	60	38	76	10	20	2	4
7	6	12	8	16	35	70	39	78	9	18	2	4
8	7	14	4	8	40	80	20	40	17	34	13	26
9	3	6	2	4	45	90	35	70	11	22	4	8
10	0	0	2	4	48	96	0	0	0	0	50	100

SU-sound understanding, PU-partial understanding, AC*** alternative conception (Table-2)

Table 3

S. No.	Group	2	1	0	DF	χ^2	Value at $P \geq 0.05$
1	Experiment	32	16	2	2	9.1722	5.991
	Control	22	19	12			
2	Experiment	28	14	8	2	5.7937	5.991
	Control	24	19	10			
3	Experiment	35	12	3	2	8.1715	5.991
	Control	23	20	10			
4	Experiment	35	10	5	2	6.1400	5.991
	Control	25	15	13			
5	Experiment	30	15	5	2	8.7223	5.991
	Control	25	10	18			
6	Experiment	38	10	2	2	9.5918	5.991
	Control	27	14	12			
7	Experiment	39	9	2	2	17.5943	5.991
	Control	22	14	17			

8	Experiment	20	17	13	2	61.2069	5.991
	Control	0	0	53			
9	Experiment	35	11	4	2	23.2200	5.991
	Control	20	12	20			
10	Experiment	0	0	53	2	--	5.991
	Control	0	0	53			

In table 3. X^2 statistics on the level of understanding of concept related to simple harmonic motion by treatment

Table 3 Indicate that there is a significant difference in the level of understanding of concepts related to SHM in item 1,3,4,5,6,7,8,9.

In the below table calculate the value of chi-square value for the first reading he table 3 other values we can find with the same method for other value.

Hypothesis Testing

In table 3 there is the value of X_2 is 9.1722 which is greater than table value of chi square at the degree of freedom $(r-1).(n-1)-2$ (where r and n are the values of row and Column) on level of .05 so our hypothesis 1(null) "Five step learning cycle model not made significant effect on learning. (NULL Hypothesis)" are rejected and the hypothesis 2nd "Five step learning cycle model made significant effect on learning" are accepted.

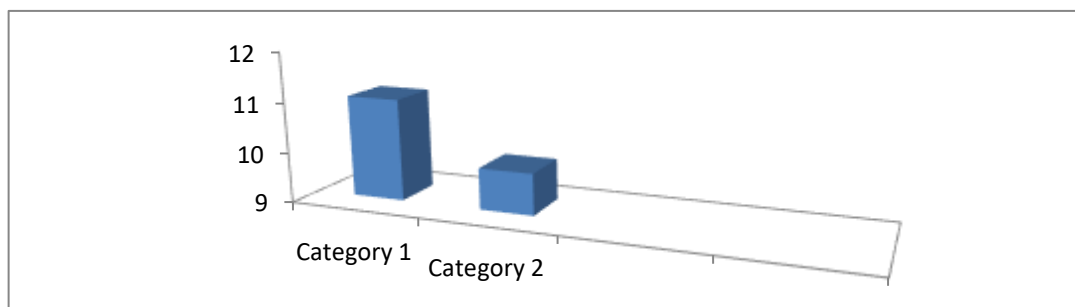
Mean Marks of Students

On the calculating of mean for both the groups' students score individually then we find that experimental group has the mean score 11.04 and the control group

have the mean score 9.83 so on the basis of hypothesis we can say that the 5-E method is more effective than the conventional method of teaching. And we can also compare the highest score in both the group then we find out that roll no. 10 in experimental get 15 marks and roll no. 12 in the control group are gets 14 marks so the experimental group gives the best performance than the control. So hypothesis 3rd are also prove true.

Students Mean Score Comparison

Conclusion



Result

So from the result it was found that students after teaching the 5-E lesson students understanding of the topic is shifted towards the sound understanding but students still have misconceptions in the topic of amplitude and frequency concept.

Conclusion

There are so many method of teaching we can use for for students misconception in physics in this study it was founds that the 5-Step learning cycle method of teaching is effective than the conventional method of teaching. Students learn critical thinking skills, observation skill, problem solving, scientific temperament, scientific attitude, creating skill. Students with the help of these skills students understand the concept and prepare world class physics and easily cracked the National and International physics level exam like MIT, NEET, Physics Olympiad, JEE exam, and other university level entrance exam for higher education studies.

