Application of 7E Learning Instructional Model Based Pedagogical Approach of Teaching on Attitude towards Science in Relation to Science Self-Efficacy

Shalini Sharma

Department of Education, Panjab University, India
shalu4948[at]gmail.com

Abstract: *The main purpose of the study was to investigate the effect of 7E learning instructional model on ninth grade students' attitude towards science in relation to science self-efficacy. Data was collected using science self-efficacy scale and attitude towards science scale. The sample comprised of 120 secondary school students studying in government schools of Shaheed Bhagat Singh Nagar district, Punjab, India. The findings revealed that significant difference was found out between the experimental group and the control group in terms of mean gain scores of attitude towards science for high, moderate and low science self-efficacy groups. Students in different levels of science self-efficacy of experimental group were positively affected by 7E learning model based teaching strategy but, it is the high science self-efficacy group students who got benefitted to the greatest extent with 7E learning model based instruction.*

Keywords: 7E learning instructional model, Attitude towards science, Science self-efficacy.

1. Introduction

The importance of education has been truly recognized in the education scenario and it has always been a key driver towards economic growth. The Asian Development Bank (2014) reviewed that the rapid paradigm shift in science education system will necessitate our community with qualified citizens capable of being a producer of knowledge, an explorer of the ways of knowing and a problem solver with different point of view to certain complex circumstances. To overcome the challenges of the 21st century in science and technology sector, students need to be equipped with the 21st century skills to ensure their active participation in education sector. The COVID 19 pandemic has also forced sudden transformation in education sector. Such challenges have now become the new realities in developing countries. Therefore in order to mitigate the challenges, there must be paradigm shift in the pedagogical approach in the education sector. The science education in today's education scenario should aim at understanding the nature of science (NOS) and the nature of science can be learned by doing science or learning through science. Understanding the nature of science is also a necessary ingredient for full realization of a human being. NCERT (2008) explicitly highlighted the importance of constructivism as a teaching approach for understanding the nature of science. By adopting such pedagogical approach, students will be able to understand or develop various processes involved in doing science since students are given spaces for their own ideas and imagination.

The National Education Policy (2019) investigated many studies which revealed that if a child is provided good quality education in school, it will enhance his/her ability to lead a more productive and meaningful life.7E learning instructional model based on constructivism has been brought in the school science curriculum that may acts as a catalyst for the students to develop positive attitude and interest towards the subject of science.7E learning instructional model is a useful recommended strategy in science curriculum and teachers should be encouraged to incorporate this strategy into their teaching. The primary aim of the 7E learning cycle is to highlight the increasing importance of provoking previous understanding of transferring the concept to new contexts (Balta & Sarac, 2016). 7E learning model can stimulate students to recall previous material, can improve their learning outcomes because this model prioritizes student experience, motivate students to be more active and increase curiosity, train students to learn concepts through experimental activities (Marfilinda, Zaturrahmi & Indrawati, 2019).

2. Research Trends

A scrutiny of the previous studies revealed that 7E model is an effective approach than direct teaching methodology in building positive attitude towards science. *Roebianto* (2020) advocated significant role of students' self-efficacy and attitudes towards increase in academic achievement. A study of Toraman & Demir (2016) advocated that constructivism approach had a positive effect on attitude towards science among the students. Cheung (2009) revealed that male's attitude towards science declines from 4th to 7th standard than females but at secondary stage both male and female students developed same attitude towards science. Another study of Adesoji & Idika (2015) stated that case based learning had a positive effect on attitude towards science as compared to 7E model. Mwamba et al., (2019) explored that PhET simulations had a positive impact on the learners' performance as well as learner's attitude towards electromagnetism. Therefore, the study recommended the use of PhET simulations rather than the traditional lecture method in teaching electromagnetism. On the contrary, a research study of Altiparmak & Eryilmaz-Mustu (2021) revealed that no significant difference was found in the attitude towards science by using SCAMPER technique.

Gonen, Kocakaya & Uyanik (2016) stated that 7E learning cycle approach had no positive correlation with attitude towards science. Babaoglan & Arikan (2017) investigated no significant relation between students' science course attitude and their genders and parental profession. Kurnia (2016) stated that 7E model is effective in improving the self-efficacy and critical thinking skills among the students. Susskind (2005) found out improvement in student's self-efficacy attitude with power point multimedia.

Rationale of the Study

Research and statistics have shown that although the achievement level of science is quite satisfactory in science subject but there are a lower percentage of students actually interested in pursuing scientific careers at secondary or upper secondary level. Thus, practical value of this study lies in the fact that it is set to explore and formulate new teaching methodology that is 7E learning instructional model that may be able to bring about improvement in the attitude towards science in order to increase the ratio of the students who actually want to pursue their career in science field which could be a contribution not only to the nation but also in the field of education. The 7E model consists of series of seven inter-linked phases namely, elicit phase, engage phase, explore phase, explain phase, elaborate phase, evaluate phase and extend phase wherein students were exposed to innovative teaching learning activities viz., Simulations using softwares such as PhET, Algodoo (virtual labs) etc., concept maps, mind maps, venn diagrams, word bank, KWL charts, problem solving methods. Scientific experimentations, generalizing the learned concept in a novel situation so as to enhance the process skills in science having dimensions such as data interpretation, drawing inferences, experimentations etc.

Research Problem

To compare the mean gain attitude towards science scores of the groups having high, moderate and low science self-efficacy.

Hypothesis

There will be no significant difference in the mean gain attitude towards science scores of the groups (experimental and control group) having high, moderate and low science self-efficacy.

3. Research Methodology

Being experimental in nature, the study employed pre-test post-test control group design for the research work because the equivalence of the groups was not assured, therefore it was necessary to establish the equivalence of the groups in order to study the causal impact of intervention. After ascertaining the equivalence of the groups, the sections were assigned as experimental group and control group. This step was followed by classifying the students in both the groups into high, moderate and low science self-efficacy sub-groups. After classifying the students, pre-test of attitude towards science was administered. The experimental group was then taught through 7E learning instructional strategy and control group was taught through the conventional chalk and talk method of teaching. Execution of the treatment was followed by the post-test of attitude towards science.

4. Results and Discussion

The scores of pre and post-test of attitude towards science were considered as near normal after subjected to descriptive analysis. Hence it was concluded that the sample was normally distributed.

Analysis of Mean Gain Scores of Attitude towards science for Different Subgroups of Science Self-Efficacy
The obtained mean gain scores of attitude towards science were subjected to descriptive analysis to measure the effect of 7E learning instructional model. The mean and standard deviation of different subgroups of science self- efficacy viz., high, moderate and low have been calculated and presented in the table 1.

Table 1: Descriptive Statistics of Mean Gain Scores of Attitude towards Science for Different Subgroups of the Experimental and Control group

Variable	Science Self Efficacy	Control Group			Experimental Group		
		Mean Gain			Mean Gain		
		N	Mean	SD	N	Mean	SD
Attitude Towards Science (Mean Gain)	High	20	3.50	5.77	20	15.15	6.57
	Moderate	20	4.15	7.83	20	9.30	5.42
	Low	20	1.85	10.12	20	6.55	4.35
	Total	60	3.17	8.02	60	10.33	6.52

The mean gain scores of attitude towards science of students with different subgroups of science self-efficacy in control group and experimental group have also been depicted through the bar diagram in figure 1.
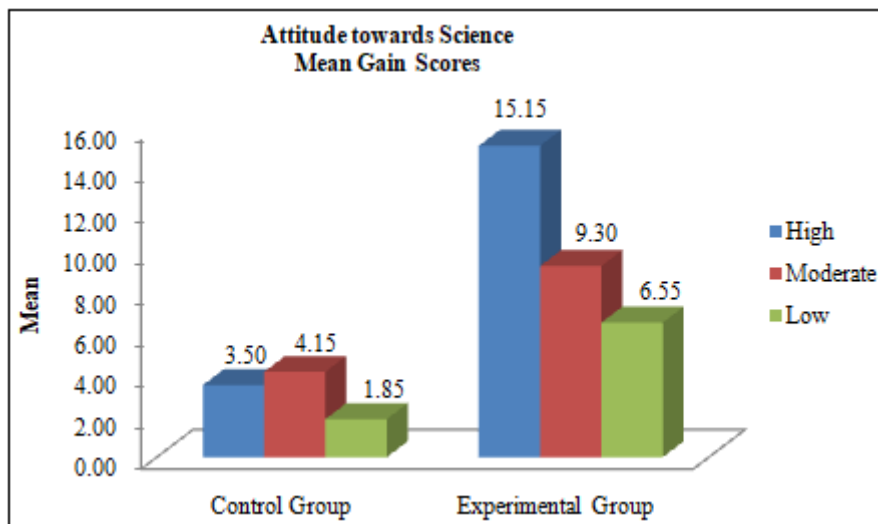
Figure 1: Bar diagram showing mean gain scores of attitude towards science for different subgroups of control group and experimental group

It is inferred from the table 1 and figure 1 that the total mean gain score of attitude towards science of the experimental group was discreetly higher than that of control group in all the three subgroups of science self-efficacy. As evident in table 1, an assessment of their respective mean gain scores revealed that students in high science-self-efficacy group (Mean gain=15.15) when instructed with 7E learning model based teaching method showed considerably superior performance in attitude towards science as compared to high science self-efficacy group students (Mean gain=3.50) who were taught via conventional mode of instruction. Similarly students in moderate science self-efficacy group (Mean gain=9.30) and low science self-efficacy group (Mean gain=6.55) achieved higher in their attitude towards science scores when exposed to 7E learning model based teaching method as compared to moderate science self-efficacy group

students (Mean gain=4.15) and low science self-efficacy group students (Mean gain=1.85) who were taught via conventional teaching method, thereby giving an impression that all the students in different levels of science self-efficacy of experimental group were positively affected by 7E learning model based teaching strategy but, it is the high science self-efficacy group students who got benefitted to the greatest extent with 7E learning model based instruction. To delve deep into the data, analysis of variance was calculated to infer the data statistically.

In order to further examine whether there were significant differences in mean gain attitude towards science scores among high, moderate and low science self-efficacy groups of the control group and experimental group, F-values were computed for both the groups which are shown in table 2.

Table 2: A Summary of F-statistics of Mean Gain Attitude towards Science Scores of Control Group and Experimental Group

ANOVA						
Attitude towards Science		Sum of Squares	df	Mean Square	F-value	p-value
Control Group	Between Groups	56.233	2	28.117	.428	.654
	Within Groups	3742.100	57	65.651		
	Total	3798.333	59			
Experimental Group	Between Groups	771.633	2	385.817	12.656	.0001**
	Within Groups	1737.700	57	30.486		
	Total	2509.333	59			

* Significant at 0.05 level of significance
** Significant at 0.01 level of significance

The *F*-ratio in the **ANOVA** table 2 tests whether there were significant differences in mean gain attitude towards science scores among high, moderate and low science self-efficacy levels of the control group and experimental group. As demonstrated in table 2, the p-value of mean gain attitude towards science scores of control group came out to be .654 which was found to be insignificant hence there exist no significant differences in the mean gain attitude towards science scores among high, moderate and low science self-efficacy levels of students in the control group. This suggests that in control group, students in high, moderate

and low science self-efficacy groups performed almost similar in their attitude towards science. In case of experimental group, the p-value came out to be .0001 which was significant at 0.01 level of significance, hence it can be concluded that there exist significant differences in the mean gain attitude towards science scores among high, moderate and low science self-efficacy groups.

In order to probe deeper, Post-hoc test (Scheffe's test) was run to find out multiple comparisons of different sub-groups of science self-efficacy in experimental group.

Table 3: Scheffe's Test for Multiple Comparisons of Mean Gain Scores of Attitude towards Science for Different Subgroups of Experimental Group

Multiple Comparisons (Experimental Group)						
Scheffe						
Dependent Variable			Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
						Lower Bound	Upper Bound
Attitude Towards Science (Mean Gain)	High	Moderate	5.85	1.75	.006**	1.46	10.24
		Low	8.60	1.75	.0001**	4.21	12.99
	Moderate	High	-5.85	1.75	.006**	-10.24	-1.46
		Low	2.75	1.75	.297	-1.64	7.14
	Low	High	-8.60	1.75	.0001**	-12.99	-4.21
		Moderate	-2.75	1.75	.297	-7.14	1.64

* Significant at 0.05 level of significance
** Significant at 0.01 level of significance

Looking at the table 3, the following comparisons of different subgroups of science self-efficacy were made from the results obtained from gain attitude towards science scores of experimental group:

- It is evident from table 3 that high science self-efficacy group showed statistically significant difference with both moderate and low science self-efficacy groups with respect to mean gain attitude towards science scores with p-values of .006 and .0001 which were found to be significant at 0.01 level of significance. An assessment of their respective mean gain attitude towards science scores as shown in table 4.25 also depicted the same findings which reveals that mean gain attitude towards science score of high science self-efficacy group (Mean gain=15.15) was higher than the mean gain attitude towards science scores of moderate science self-efficacy group (Mean gain=9.30) and low science self-efficacy group (Mean gain=6.55).
- Table 3 shows that moderate science self-efficacy group showed statistically significant difference with high science self-efficacy group with respect to mean gain attitude towards science scores due to significant p-value of .006, however moderate science self-efficacy group showed statistically no significant difference with low science self-efficacy group due to insignificant p-value of .297.The results were further validated by examining their respective mean gain attitude towards science scores from table which clearly depicts that mean gain attitude towards science score of high science-self efficacy group (Mean gain=15.15) came out to be highest whereas the mean gain attitude towards science scores of moderate science self-efficacy group (Mean gain=9.30) and low science-self efficacy group (Mean gain=6.55) did not differ much in terms of attitude towards science.
- It is revealed from table 3 that low science self-efficacy group showed statistically significant difference with high science self-efficacy groups with respect to mean gain attitude towards science scores due to highly significant p-value of .0001,however low science self-efficacy group showed no significant difference with moderate science self-efficacy group in terms of attitude towards science due to non-significant p-value of .297.

The statistical analysis computed above explicitly reveals that *the null hypothesis (H_{01}) stating that, "There will be no significant difference in the mean gain attitude towards science scores of the groups (experimental and control group) having high, moderate and low science self-efficacy." was rejected at 0.05 level of significance."*

5. Conclusion

In experimental group (treated with 7E learning instructional model),students with high science self-efficacy achieved maximum gain on attitude towards science as compared to students in moderate science self-efficacy group, the students in moderate and low science self-efficacy group showed almost equal gain in attitude towards science. On the contrary, control group (treated with conventional teaching method) students with different levels of science self-efficacy showed very little improvement in their attitude towards science and all the groups performed almost similar in attitude towards science. The probable reason for above results is that in experimental group, students in high science self-efficacy group when treated with 7E learning instructional model of teaching gained better understanding and fondness towards science learning which resulted into notably higher performance in attitude towards science as compared to the students in moderate and low science self-efficacy groups whereas students in control group despite having different science self-efficacy levels when treated with conventional mode of teaching showed almost equal performance in attitude towards science which advocates that conventional mode of teaching did not contribute radically in improving the attitude towards science.

In the words of *Roebianto* (2020) both students' attitude and self-efficacy had a significant direct role in determining student achievement in science. Many studies reveal a significant relationship between science self-efficacy, attitude towards science and science related choices across grade level (Andrew, 1998).The above conclusions made by the researchers are in consistent with the findings of the present study which showed that students with high science self-efficacy levels when treated with 7E learning model intended to perform better in science tasks or activities, hence showed maximum improvement in their attitude towards science as compared to students of control group with different levels of science self-efficacy.

6. Educational Implications

- The present study has established that 7E learning based instruction is a more effective teaching strategy than conventional teaching in terms of improving the

attitude towards science. Therefore, 7E learning instructional model can be used by teachers in their courses to attain an effective student-centered learning environment in the classrooms.

- Because of the positive effect of 7E learning model based instruction on students' attitude towards science, this technology can make learning science easy and motivates more and more students to opt science for higher studies which would further offer better future prospects for them.

- 7E learning demands students to resolve a particular problem by doing in-depth research or it may ask students to learn a topic or a subject in detail. So, in this way 7E learning instructional model based instruction can serve as an exceptional way for instilling creativity instudents.

- 7E learning model based instruction is a student-centeredteaching technique where teacher plays a role of facilitator and guide students in completing their task. This kind of atmosphere stimulates students to think sensibly and logically augmenting their high order thinking skills which is a crucial aspect to enhance learning achievement of students.

- The 7E learning instructional approach was found helpfulin developing the questioning ability, creativity in framing questions, inductive reasoning, problem solving ability and creative thinking skills among the students.

- The 7E learning instructional model is effective for the students in terms of arising curiosity, generating interest in science, better retention of the concepts.

- This study revealed that students become more enthusiastic and encouraged to use this in other subjects also. Therefore, this study thus has implications for all concerning authorities i.e. for school administrators, curriculum developers, teachers, parents and students.

- The 7E learning instructional strategy brought changes among learners as various strategies like collaborative learning, simulations, think pair share, group discussion, mind maps, experiments etc were used. Such strategies created opportunities for the students to work together and developed a sense of mutual respect and care foreach other.

- There must also be in-service and pre-service teacher training programmes to make teacher and perspective teachers aware about the 7E learning instructional model that broadens their horizon of understanding the subject.

- The teachers must include such activities during the teaching learning process that involves various senses and movement as it caters to multiple intelligence.

- The studies can be conducted to assess the awareness about 7E learning instructional model among in-service teachers and pre-service teacher trainees.

- Studies can be conducted to understand the attitude/perception of teachers towards 7E learning instructional model.

- The studies can be done to study the perception of science teachers and teacher trainees about teaching methods in relation to awareness about 7E learning instructional model.

- The study included students selected randomly having different cognitive levels. The same can be implemented on the sample of bright learners as well as slow bloomersto further explore its effectiveness on acquisition of concepts among learners at upper and lower extreme end.

7. Suggestions for Further Researches

Based on the findings and respective conclusions drawn from the present study, few suggestions have been proposed for related future studies discussed as below:

- The present study was confined to Shaheed Bhagat Singh(S. B. S) Nagar district of Punjab state, however the study may be extended to other states of India and other countries.

- The present study was demarcated to the students of class IXth only, however to further corroborate this finding, the same experiment may be carried out on the students at elementary, higher secondary, college and university level. Thus offering a broader scope in variability inacademic performance.

- The present study dealt with students of government schools only, however same type of study may be conducted in a sample selected from private and government-aided schools.

- In this study, only one classifying variable (science self- efficacy) was selected. There can be more classificatory variables such as socio economic status, cognitive styles, motivational achievement etc.

- The present study was confined to only one dependent variables i.e. attitude towards science, however academic achievement, problem solving ability, interest, critical thinking, motivation, reflective thinking, self concept etc may be used as dependent variables.

- Gender can also be considered as one of the major variable during teaching through 7E learning instructional model. The studies may be conducted to see the effect of this approach on stream or on locale also.

- As the study was conducted in the subject of science only, other school subjects could also be explored to see the impact of 7E learning instructional model in order to enhance the achievement among the students in these subjects.

- The comparative studies may be conducted in which 7E Learning instructional approach can be compared with other instructional approaches.

- The study can be replicated on the students of same classto validate and generalize the results.

- The studies can be conducted to assess the awareness about 7E learning instructional model among in-service teachers and pre-service teacher trainees.

- Studies can be conducted to understand the attitude/perception of teachers towards 7E learning instructional model.

- The studies can be done to study the perception of science teachers and teacher trainees about teaching methods in relation to awareness about 7E learning instructional model.

- The study included students selected randomly having different cognitive levels. The same can be implemented on the sample of bright learners as well as slow bloomersto further explore its effectiveness on acquisition of concepts among learners at upper and lower extreme end.

References

[1] Adesoji, F. A., & Idika, M. I. (2015). Effects of 7E learning cycle model and case-based learning strategy on secondary school students learning outcomes in chemistry. *Journal of the International Society for Teacher Education*, *19*(1), 7-19.

[2] Altiparmak, T., & Eryilmaz-Mustu, O. (2021). The effects of SCAMPER technique activities in the 8th grade simple machines unit on students' academic achievement, motivation and attitude towards science lessons. *International Journal of Educational Methodology*, *7*(1), 155-170.

[3] Andrew, S. (1998). Self-efficacy as a predictor of academic performance in science. *Journal of Advanced Nursing*, *27*, 596–603.

[4] Asian Development Bank (ADB). (2014). ASEAN 2030 toward a borderless economic community. Retrieved from https://www. adb.org/sites/default/ files/publication/159312/adbi-asean-2030-borderless-economic-community. Pdf

[5] Babaoglan, B., & Arikan, T. (2017). Sixth grade students' attitude toward science course. *Turkish Journal of Education, 6*(2). Retrieved from https://dergipark.org.tr/tr/download/article-file/320489

[6] Balta, N., & Sarac, H. (2016). The effect of 7E learning cycle on learning in science teaching: A meta-analysis study. *European Journal of Educational Research*, *5*(2), 61-72.

[7] Cheung, D. (2009). Student's attitude towards chemistry lessons:The interaction effect between grade level and gender. *Research in Science Education*, *39*(1), 75-91.

[8] Kurnia,S. N. (2016). *The study of mathematics by using a 7E model of learning cycle in relation to achievement-oriented learning, critical thinking skills and self-efficacy of students*. [Doctoral dissertation, Negeri Yogyakarta University: Indonesia]. Retrieved from https://etd. lib. metu. edu. tr/upload/12605747 /index. pdf

[9] Marfilinda, R., Zaturrahmi, & Indrawati, E. (2019). Development and application of learning cycle model on science teaching and learning : A literature review. *Journal of Physics*, *1317*(1). Retrieved from https://doi. org/10. 1088/1742-6596/1317/1/012207

[10] Mwamba, R., Jumbe, J. G., Moonga, M., & Pondo, J. K. (2019). Impact of using physics education technology (PhET) simulations in teaching electromagnetism on learner performance and attitude. *Journal of Basic and Applied Research International*, 218-226. Retrieved from https://www.ikprress.org/index.php/JOBARI/article/view/4735

[11] National Council of Educational Research and Training. (2008). *National curriculum framework for school education*. New Delhi: Aravali Books. Retrieved from http://www. ncert. nic. in/rightside/links/pdf/framework/english/nf2005. pdf

[12] National Education Policy. (2019). Draft National educational policy. Retrieved from https://www. education. gov. in/sites/upload_files/mhrd/files/Draft_NEP_ 2019_EN_Revised. pdf

[13] Roebianto, A. (2020). The effects of student's attitudes and self-efficacy on science achievement. *Journal of Indonesian Psychology and Education Measurement*, *9*(1), 1-10.

[14] Susskind, J. E. (2005). PowerPoint's power in the classroom: Enhancing student's self-efficacy and attitudes. *Computers & Education*, *45*(2), 203-215.

[15] Toraman, C., & Demir, E. (2016). The effect of constructivism on attitude towards science lessons: A meta–analysis study. *Eurasian Journal of Educational Research*, *16*(62). Retrieved from http://dergipark. ulakbim. gov. tr/ejer/article/view/5000198632

Author Profile

Dr. Shalini Sharma, Ph.D (Education), Research Area- Educational Technology, Alma Mater-Panjab University, India