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LEARNING STRATEGIES IN TEACHING OF PHYSICS

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Abstract:

The purpose of this study was to determine physics teachers' opinions about student-centered activities applicable in physics teaching and learning in context. A case study approach was used in this research. First, semi-structured interviews were carried out with 6 physics teachers. Then, a questionnaire was developed based on the data obtained from the interviews. This questionnaire was implemented to 40 physics teachers in Fatehabad, a small provincial city in Haryana, India. Finally, a semi-structured observation chart was used in physics lessons to determine how these activities were demonstrated. In this way, the relation between teachers' views about active learning techniques and their actual implementation were compared. The findings indicated that although teachers were aware of student-centered physics instruction, they were still using traditional techniques widely.

Keywords: Physics education; Active learning; Physics teachers; Active physics teaching

1.0 Introduction

Active learning, through which students become active participants in the learning process, is an important means for development of student skills. In the process of active learning, students move from being passive recipients of knowledge to being participants in activities that encompass analysis, synthesis and evaluation besides developing skills, values and attitudes. Active learning not only emphasizes the development of students' skills but also their exploration of their own attitudes and values [1]. When active learning is carried out, simulations, discussions, student presentations, games, role-plays, flip charts and handouts are basic elements of physics lessons.

Meyers & Jones have maintained that the active learning consists of three factors, which are interrelated [2]. These are: basic elements; learning strategies; and teaching resources. The basic elements of active learning are speaking, listening, reading, writing and reflecting. These five elements involve cognitive activities that allow students to clarify the question, consolidate and appropriate the new knowledge. The second factor of active learning is the learning strategies that in corporate the above five elements. These are small groups, co-operative work, case studies, simulation, discussion, problem solving and journal writing. Third factor of active learning is teaching resources that the teacher uses to encourage students to interact and participate actively in the activities.

1.1 The literature on active learning

It is not possible to a generally accepted definition for the entire vocabulary of active learning, since different authors in this field have some different notions interpreted. However, it is possible to give some generally accepted definitions and to highlight distinctions in the way common terms are used.

Active learning is generally defined as any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing [3]. While this definition could include traditional activities such as homework, in practice active learning refers to activities (demonstration, group working ect.) that are introduced into the classroom [4]. In other words, all learning is in some sense active, but active learning refers to the level of engagement by the student in the instructional process. An active learning environment requires students and teachers to undertake to a dynamic partnership in which they share the responsibility for instruction.

More recently many researchers in our country and abroad have carried out studies on the effects of active learning approaches or strategies on student progress [5-14]. In a study carried out by Sivan et al., students received an education through active learning and student-centered learning [5]. Students' perceptions of the effectiveness of these techniques were evaluated by means of a questionnaire and interviews. Results showed an overall contribution of the active learning approach used in tutorials to the development of students' communication and problem-solving skills as well as to their critical-thinking ability. The importance of incorporating aspects of field work into classroom learning was also highlighted. The efficiency and implementing of active learning techniques on university students were examined in another study by Sivan and et al. [1]. In classrooms where active learning techniques are used, it is observed that the lessons become more interesting to the students and they take part in the lessons attentively. In addition, it is determined that the success and the interest of the students are highly improved in active learning group better than the traditional group.

The Livingstone & Lynch's study found supportive data that the interest and learning of the students are effectively increased by the use of active learning techniques [7]. Kalem & Fer searched the effects of a model designed for active-learning on the students' view of learning, teaching, communication and learning environment [10]. According to the study realized on the university students, it was seen that the teaching carried out through active learning had positive effects in view of learning, teaching and communication.

In the light of the results of the studies presented above, it is determined that attitudes and successes of the students are effectively increased by using active learning techniques. Through this point of view, it can be clearly claimed that active learning is an effective way of teaching. Examining some studies, it indicates that the concepts and subjects about physics or science are not understood by students and lead some confusion [15-24]. It is possible to make them clear by teaching these concepts more concretely and through research, observation and experiments. Students should be encouraged with giving responsibilities and helping them to develop their creativeness. It is accomplished through active learning methods. However, examining the related literature, it is obviously observed that there is not any knowledge how much the active learning approached is used for the physics teaching. For these reasons it is necessary to examine the reasons why the active-learning is not used to yield permanent learning.

In our country the number of researches carried out on active learning is not sufficient to determine that whether it is as successful as in other countries. Therefore, we need to find answers to the following questions.

i. How often do the teachers use student-centered active learning techniques in physics teaching?
ii. Do they have sufficient knowledge about active learning techniques?
iii. Do they have enough opportunities to realize them in their classes?

Moreover, teachers do not perceive the differences between traditional teaching and active learning fully enough. They are not willing to change their point of view when they think of transforming traditional teaching to active learning. As they encounter new obstacles for new forms of material presentation, these obstacles would influence the hostile attitude towards a change in a teaching manner. In addition, teachers often are afraid to gain new skills, as they do not want to show themselves incompetent. Considering teacher's knowledge, skills and opinions about active learning methods would play an important role when trying to enhance the quality of physics teaching. Since teachers always have to use active learning techniques in the curricula to ensure their teaching quality.

The purpose of this study was to answer the questions above and to determine physics teachers' opinions about student-centered activities carried out in physics teaching and learning.

2.0 Methodology

A case study research methodology is used in this study. This methodology provides opportunities to employ a wide variety of techniques for in-depth investigation [25-26]. In this methodology, the instruments and the participants for each instrument are analyzed and the data are indicated below together.

2.1. Participants

The participants of the study consisted of forty physics teachers. Twenty-four (60%) of the physics teachers were male whereas sixteen (40%) female. Thirty-one teachers (77.5%) had teaching experience over 15 years, eight (20%) 8-14 years, and one (2.5%) under 8 years. These teachers randomly selected from the secondary schools located in Fatehabad, a small provincial city in Haryana, India. Its socio-economic statue is considered to be as medium. All types of secondary schools exist in this city, while student success rates is under the average, in comparison with the other cities in Haryana, India. In order to enroll in an undergraduate program in Haryana, India it is necessary to hold a senior secondary/high school certificate and attain a sufficient score from any Board of school Education under the ministry of Human resources.

2.2. Data collection and analysis

Six open-ended questions were developed to find out the teachers' opinions about active learning techniques, the necessary conditions to use them, how student-centered learning was implemented in the learning environment.

Teachers were interviewed individually using a semi-structured interview that lasted approximately 30 minutes and took place at the teachers' lounge in the school. The interview consisted of a fixed protocol but, according to the custom in semi-structured interviewing, the interviewer felt free to modify these questions and to add clarification and probing questions whenever needed. The fixed protocol consisted of the following questions:

1. What are the teaching approaches in developing science curriculum materials in Haryana, India? Do you have necessary information about them?
2. Do you know student-centered learning? How to apply this approach in education?
3. Should active learning be applied in implementing student-centered approach? How to use student-centered activities in active learning?
4. What type of methods and techniques do you use in performing active learning? How to use them?
5. Do you have necessary equipments to provide active learning in your school?
6. Do you believe that your experiences are adequate in order to provide active learning? What are your suggestions for further applications of active learning?

Interviews were transcribed. Transcripts were then read several times in search for recurrent categories and ideas [27]. Initial categories were clarified and clear criteria for each category were defined. Then two independent coders analyzed selected transcripts. Categories and criteria were refined until the interrater agreement was at least 80% for all categories.

Based on the interview results, a questionnaire consisting of three parts was developed. In the first part of the questionnaire, the teachers were asked questions related to personal characteristics, such as teaching experience, number of students in their classes, textbooks and other materials they used in teaching physics. In the second part; the following issues were written down in charts. These are: learning techniques (learning techniques related to both active and traditional learning), whether or not they are able to use these techniques, and the usefulness of these techniques. Teachers marked their answers in related columns on the charts. The last part also consists of the following questions:

- What is the meaning of active learning?
- How are these techniques implemented in the classes?
- What is the rate of their usage of this technique in teaching?
- What are the conditions for implementations of this technique?

The questionnaire validity and reliability were secured by the following steps. Firstly, we wrote items and then invited a group of physics educator to check and revise the questionnaire content in order to establish the content validity of the questionnaire. All items were scored on a 4-point scale, with a score of 1 indicating an unfavorable response toward the teachers' using activities in teaching and a score of 4 indicating a favorable response. The teachers were requested to choose one of the following verbal descriptors for each item: Never, Rarely, Mostly, or Always. Afterwards, the questionnaire was piloted. A reliability coefficient of 0.76 using the Cronbach α was supported. The process helped to increase validity and reliability of the questionnaire. Finally, a semi-structured observation chart was used in order to determine relations between teachers' views about active learning techniques

(based on the data from the interview and questionnaire) and their actual implementation. Semi-structured observation charts or protocols developed by Karamustafaoğlu et al. were used with some minor changes and filled in the classes [28]. In the light of aim, six physics classes taught by three teachers in different schools were observed. The protocol focused on the active learning activities in physics classes.

The collected data from the interviews was categorized in accordance with similarities and differences of the teachers' opinions. The questionnaire consisted of three parts and each part analyzed in different ways. The first and second parts were analyzed by calculating percentages of frequency. The third part was analyzed by evaluating teachers' explanations. The collected data from the semi-structured observations were analyzed by giving tables of frequency of teaching techniques used by the three teachers in their classes depending of their teaching experiences.

Moreover, this study was bounded into a limitation which was acknowledged by the author. This limitation was the representation of the physics teachers, who were selected from schools in Fatehabad. Therefore, these findings can not be generalized to the whole teacher population in Haryana, India. However, the results of this study will be of interest to educators and scientific community because the results can provide useful information to conventional practitioners about active learning strategies and examine the active learning techniques usage degree of physics teachers in a developing country.

3. Results

The data were divided into three subtitles: i) teacher interview findings, ii) questionnaire findings, and iii) teacher observation findings.

3.1. Teacher interview findings

The collected data from the interviews were categorized in accordance with similarities and differences of the teachers' explanations. Their opinions and responses are given below in detail.

Question 1: What are the teaching approaches in developing science curriculum materials in Haryana, India? Do you have necessary information about them?

They said that recently, a student-centered curriculum was developed in the field of primary science. However, secondary science curriculum hasn't been renewed yet. The secondary science curriculum was developed in 1992 and according to this curriculum textbooks were published. They teach science with these textbooks. The secondary science curriculum does not have student-centered activities. Although it does not have necessary activities, they develop their own activities based on their experiences and improve them. Nevertheless, they do not have necessary knowledge and skills in using student-centered activities. As a conclusion, primary science curriculum is student-centered whereas secondary science curriculum is not. Moreover, most teachers (5 teachers, 83.3%) do not have adequate knowledge about these activities. Some recent modifications were done in education system. They are unable to keep up with these changes and they usually encounter with some difficulties. One of them is lesson planning. This year, the format of lesson planning is changed but the related in-service training is not given. One-thirds of the teachers (2 teachers, 33.3%) also stated that science curriculum had often changed in recent years. It is difficult for them to follow-up these changes. They have to follow a textbook published by National Council of educational research and training. Because, most of the teachers' and their students' aims are being successful in OSS, they do not want to take sufficient information about activities. They have occasionally informed new approaches of teaching in education seminars, but still do not know how to apply it.

Question 2: Do you know student-centered learning? How to apply this approach in education?

Four physics teachers (66.7%) stated that they knew this approach, whereas two teachers did not. Three teachers knowing this approach explained that "According to this approach, the most important element is the fact that students are located in the centre and teacher guides them. That is, students actively participate in their learning. For example, students could have full responsibility to teach the topic. This approach is especially effective in social science lessons such as history, geography and so forth. However, students could not teach physics topics, since they did not know. Students only would be active in laboratories because they perform laboratory activities under

the guidance of the teachers." The other teachers also stated that they did not know how to implement these approaches.

Question 3: Should active learning be applied in implementing student-centered approach? How to use student-centered activities in active learning?

Most teachers (5 teachers, 83.3%) stated that active learning should be applied in implementing student-centered approach. They also stated that the following issues for either students or teachers should be provided in order to perform student-centered activities. These are willingness for learning, desire of studying, sufficient materials for performing laboratory activities and their usage by the teachers and other new techniques. Moreover, they stated that this approach could be more effective if teachers use other new techniques in science lessons.

Question 4: What type of methods and techniques do you use in performing active learning? How to use them?

Most of the teachers (5 teachers, 83.3%) claimed that providing active learning in secondary schools was very difficult. They put forward the following reasons.

1. Students are generally prepared for Board Exam
2. Because of the Board Exam, teachers do not perform laboratory activities. In labs, they solve some problems related to the exam, rather than going into the details of the topic
3. Classrooms are over crowded

The teachers in their explanations implied that active learning was provided with learning methods such as brainstorming, role playing, demonstration, laboratory works and so on. They stated that it was impossible to use active learning techniques, especially in 2 and 3 levels of high school, because of Board Exam and class population. One of the surprising explanations of the teachers was that school authorities did not encourage them to use such types of techniques. Instead, they encouraged teachers to solve problems and make other practices related to Board Exam.

Question 5: Do you have necessary equipments to provide active learning in your school?

Most of the teachers (5 teachers, 83.3%) stated that facilities of the schools were insufficient in many cases and it was mostly very hard to provide or purchase necessary equipments and chemical substances for performing the experiments. They also stated that because of these deficiencies, laboratory activities were not performed in many cases and therefore active learning for students could not be provided. One of the teachers explained that computer aided instruction was one of the way in providing active learning; however, it was not used. The reasons were teacher's lack of necessary information about using computers and having insufficient number of computers in schools. In addition teachers complained that classes are very crowded and this problem was ignored by authorities.

Question 6: Do you believe that your experiences are adequate in order to provide active learning? What are your suggestions for further applications of active learning?

Teachers gave similar explanations for this question. Most of them (5 teachers, 83.3%) believed that their experiences were adequate in order to provide active learning. Teachers made some similar suggestions about active learning and they stated: "To provide effective teaching is one of the requirements in in-service education for teachers. In addition the number of students in classes should be reduced. Laboratories should be prepared for active learning. In Board Exam items contain generally numerical problems; so that these should be reorganized by increasing the items including conceptual ones. Students should be encouraged to carry out researches. Sometimes, teachers should use computers in their class. Thus, computer needs in schools should be met by school managements and both students and teachers must be given necessary in-service training about using computers effectively. Apparatus for visual demonstration e.g. concrete models, animations, overhead and so on, should be used to enrich learning environment in laboratories". The last one stated that "I have no idea about active learning applications so I have no suggestions".

3.2. Questionnaire findings

3.2.1. The first section:

The data obtained from the analysis of the questions such as the demographic characteristics, class population, which books they use in physics lessons and which materials they use while teaching were presented in Table 1.

Table 1. Social demographic characteristics of participants

sex		teaching experience			what books		class population	
Male	Female	0-7	8-14	15 +	NCERT	O	0-30	31 +
24	16	1	8	31	40	21	24	16

NCERT: approved by National council of educational research and training, Of the others

As illustrated in Table 1, 40 teachers, 24 male and 16 female participated in this research. 9 teachers have less than 15 year experience, the rest has over 15 years. All of them declared that they used the textbook approved by National council of educational research and training whereas 21 of them stated that they also used other reference textbooks to enrich their lessons. Twenty four teachers indicated that their classroom populations were 0-30 and the others over 31 students.

3.2.2. The second section:

In this section, the answers given by the teachers about how often they used the teaching methods and activities offered to them in their classrooms what they think on the effects of their students' learning were presented in Table 2.

Table 2. The percentage of the teachers' using activities in teaching and their thoughts on the effects on their students (N=40)

Teaching methods and activities	level of importance			frequency of usage			
	1	2	3	Always(4)	Mostly(3)	Rarely(2)	Never(1)
	%	%	%	%	%	%	%
Brain storming	-	20	80	-	-	10	90
Role playing	30	50	20	-	5	15	80
Case study	-	-	-	-	-	-	-
Demonstration	40	40	20	10	5	15	70
Experiment in the lab.	5	35	60	10	15	25	50
Organizing a classroom	45	30	25	25	35	25	15

debate							
Using Computer Programming	-	90	10	-	-	5	95
Learning through research	-	45	55	10	5	45	40
Individual study	5	55	40	-	-	45	55
Group working	5	45	50	5	5	30	60
Watching film, video, etc.	40	15	45	10	5	20	65
Using Concept Mapping	10	45	45	-	-	10	90
Using Concept Framework	-	-	-	-	-	-	-
Learning through exploration	10	25	65	5	-	40	55
Using students games	-	55	45	-	-	-	100
Work sheet	-	-	-	-	-	-	-
Using models and analogies	-	60	40	-	-	10	90
Expressing	-	80	20	45	55	-	-
Question-answer method	10	55	35	60	20	20	-
Taking notes	-	70	30	45	35	20	-

Always: active learning techniques are used in every class. Mostly: active learning techniques are used three times a week. Rarely: active learning techniques are used once. Never: active learning techniques are never used.

Examining the Table 2, the ideas of teachers about using teaching activities according to the level of importance is usually parallel to the frequency of their usage during their teaching.

It is seen that nearly half of the teachers claimed that demonstration, organizing a classroom debate and watching film, video and Vcd are useful effectively teaching methods for students' understanding. Besides these, more than half of the teachers admitted that the methods such as role playing, computer programming, individual study, student games, models and analogies, expressing, question-answer and taking notes are useful at a second degree. They commented nothing about case study, using concept framework and work sheet. Furthermore, most of the teachers declared that they have never used brain storming, computer programming, concept mapping, student games, models and analogies during their teaching.

It is determined that question-answer method, expressing, organizing a classroom debate and taking notes are the methods they often use in their classrooms. Besides, nearly half of them declared that they sometimes use the methods such as learning through research, individual study, and group working and learning through exploration during teaching.

3.2.3. The third section:

The data obtained analyzing the three open-ended questions which demand the thoughts of the teachers related with the active learning were presented below by categorizing their common expressions.

Q1. Describe how student-centered teaching carried out?

Most of the teachers (30 teachers, 75%) whose teaching experiences are over 15 year's expressed that the students' knowledge level was adequate, the class population was not over-crowded, the teachers and administrators had sufficient information about the application of active learning and the physical capacity of the school was suitable (labs, library…). The other 10 teachers (25%) whose teaching experiences under 15 years claimed that the active learning could be performed through solving problems, brain storming, drama, role-playing and individual study. They, moreover, expressed that if the active learning wanted to be successful through the methods mentioned above, they should be supported by using audio-visual materials such as computers, over-head projectors, CDs.

Q2. Regarding to the opportunities of the school do you believe active learning methods can be used? Give reasons.

Nearly all of them (36 teachers, 90%) declared that they could use the active learning methods if the students level and the physical capacity of the school were adequate and they had the necessary information how they used these methods. They also expressed that the active learning could not be realized because of the lack of school opportunities, students' level, school materials, chemical materials in labs and university entrance exam. Furthermore, half of the teachers (20 teachers, 50%) said that student-centered teaching could not be exactly carried out. The reason of their claim was that physics is a numerical science-subject and it could be more effective if it was taught by a teacher.

Q3. What are your suggestions to perform the student-centered teaching?

The 24 teachers (60%) participating the survey have expressed that active learning could not be realized but the students could be encouraged to be active. To make the students active could be succeeded through asking questions and debating with them. The other 16 teachers (40%) claimed that the students should be motivated to do research, school managers should be illuminated about the benefits of using internet, library and labs, the classrooms should not be over-crowded, the teachers who are not aware of active learning methods and their application should be supported by giving pre-service courses by experts, providing experiment sets per student and the university entrance exam should be revised such as providing questions depending on permanent learning.

3.3. Teacher observation findings

The researcher chose three physics teachers of the participants and made a six-hour-visit to their classes. In order to understand the teachers' way of teaching and their choice of teaching activities, one of the classes was observed. The three teachers came from three schools of different levels of students' academic standard. Their characteristics are shown in Table 3. The schools were selected to reflect the different academic levels of schools in the city. Lesson observations were conducted in 18 classrooms from 3 schools over a two month period of time.

During the observation, notes were taken with the teaching activities. Based on the observation notes, the activities were counted according to observation protocol. The observation findings of three physics teachers working in different schools and teaching experiences after observed for six hours are presented in Tables 3-4, respectively.

Table 3. The characteristics of the teachers studied

Teacher	School	Academic standard of the school[†]	School facilities	Teacher's Academic qualification	Teaching Experience
A	I	Average	Average	Bachelor	Less than 5

					years	
B	II	Above average	Good	Bachelor	Over years	10
C	III	Below average	Average	Bachelor	Over years	15

†This is based on the classification by the government. In Haryana, India, secondary schools are divided into 5 different types based on the quality of student intake.

Table 4. Frequency of methods, techniques and activities used in observed lessons.

ACTIVITIES	A_f	B_f	C_f
The repetition of the previous lesson	6	6	6
Expression	6	6	6
Problem solving	6	6	6
Taking Note	5	6	6
Giving samples from their everyday life	4	3	3
Question-answer method	4	6	6
Experiment in the lab.	3	-	1
Classroom discussion	3	1	2
Demonstration	2	2	1
Debate	2	1	1
Making experiments using simple tools	2	-	-
Using models and analogies	2	-	-
Using techniques where students are active	1	-	-
Using concept maps	-	-	-
Group working	-	-	-
Solving problems the students face in their everyday life	-	-	-
Watching film, video, etc.	-	-	-

A: teacher with 4 years of experience, B: teacher with 11 years of experience, C: teacher with 18 years of experience

As shown in Table 4, three teachers have used the activities such as the repetition of the previous lesson; expressing, taking notes, solving and making them solve the problem in their teaching sessions. On the other hand they never use the active learning techniques (group working, using concept maps, problem solving etc.). Besides this, they seldom benefit from the techniques such as giving samples from their everyday life, making experiments, classroom discussions and debates. One of the important point is that inexperienced teacher with A code is trying to teach using active teaching techniques more often. The reason of this case is that such a teacher is trained in a teaching program where active teaching techniques are placed in the curriculum in the last decade.

4. Discussion, conclusion and recommendations

In this study the thoughts of the physics teachers on active learning techniques are found out how often these techniques are used in the schools and what can be done to use the techniques effectively through interviews, questionnaire and observation methods. According to interview data it is clear that teachers do not use the student-centered methods. The most important reason for this is caused by the board examination system. Teachers think that the more questions they solve the more successful their students will be in the exam. This idea is also supported by the school administrators. In our country the quality of school is evaluated by the number of students who pass the university entrance exam. Then if it is so, this case is inevitable. The data obtained from the third section of the questionnaire supports the interview findings about university entrance exam. On the other hand, depending on the interview and questionnaire findings, teachers believe that active learning techniques are useful for permanent learning. In the related literature it is found out that there are teachers who believe that the teaching consisting active learning techniques is more effective. It is however determined there are teachers who believe student-centered learning can not be realized as the physics is a numerical subject. This belief shows that active learning techniques are necessary in teaching. From the interviews they confessed that they didn't have any idea about active learning techniques. This case is proved during our observations at schools. According to the observation data, teachers prefer traditional teaching techniques such as solving problems, expressing and question-answer. This finding is in agreement with the findings of other national studies [16, 28]. It can be claimed that the physics teachers do not know active learning techniques and applications.

Based on the collected data, the level of physics teachers' use of active teaching methods in their lessons was determined. It is also determined what the necessary procedures to use these methods effectively are. According to interview results, teachers do not use teaching techniques which requires students' active participation. This possibly stems from the current way of applications of the Board exams. Since this exam comprise of the multiple choices test items, teachers commonly think that the more test items they solve, the better learning occurs. Students also make great effort solving lots of multiple-choices questions in order to pass the exam in the school context. Moreover, teachers' views are supported by the school administrators and they urge the teachers to solve many multiple-choices questions in school lessons. Thus, school administrators think that success of their students could rise in this way. Similar results are appeared in the third section of the questionnaire. In general, it can be said that Board exams have a great impact on using active learning techniques in classrooms.

It has been determined that the current physics teaching program in the secondary schools is not student-centered. So the teachers do not feel themselves need to use active learning approaches in their classes. However, some studies indicate that using student-centered applications is necessary for the permanent learning as physics contains abstract concepts. It is believed that the teachers should benefit from the active learning approaches. For the reason to use these approaches effectively, the curriculum should be revised and improved which makes the student active. It has been observed the teachers have idea about active learning theoretically but not have any practice in their classes. This case is supported by a lot of studies in Haryana, India. In parallel to the related literature, the teachers have thought that using active learning techniques in science lessons are necessary for students' permanent learning [1, 5-10, 29].

Nevertheless, they mostly have the idea that these techniques are not used because science (physics) course is a numerical subject. This result indicates that the teachers having this idea do not believe active learning techniques. In addition, most of the teachers are also stated that they do not fully understand active learning. The evidence from the classroom observations shows the same results. According to observations, the teachers commonly make use of traditional methods e.g.: Lecturing, question-answer method, solving sample problems and so forth. These confirm the result of the study undertaken in our country [30].

The suggestions depending on the results of study are presented below.

1. Schools should be altered proving labs for using these techniques easily and also the number of teaching materials should be increased.
2. Pre-services courses should be organized for the teachers who have lack of active learning knowledge, techniques and application.
3. University lectures should motivate both the students and the teachers to research on the subject through seminars, conferences. They should also persuade the teachers that their teaching is more effective by using active learning techniques.
4. Board exam should provide questions to encourage the students to make interpretation and to use their

perception.

5. School administrator should allow teachers and students to use the labs, libraries widely.
6. School administrator and teachers should be illuminated these techniques provide permanent learning for the students for their future life.
7. The secondary school curriculum should be revised including the topics using active learning techniques.

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