



IN-SERVICE TEACHERS' PERCEPTION ABOUT THEIR COMPETENCIES IN DELIVERY OF BIOLOGY LESSONS

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ABSTRACT

This paper explores in-service teacher perception of their competencies in delivery of biology lessons at secondary level. The objectives of the study were to examine the perception of biology teachers about their competencies in lesson delivery, to make analysis of their competencies at four formal steps as mentioned by Herbart (1776-1841), and to suggest remedial steps for improvement of present teaching competencies of biology teachers. The study is significant for biology teachers, curriculum developers, school administrators and teacher trainers, finding can be incorporated

The study was conducted on in-service biology teachers in Federal Government Secondary School in Punjab. One hundred and sixty biology teachers participated in the study. Main data collection tool was questionnaire. The items of questionnaire were developed on five point scale. A structured interview was also conducted for senior biology teachers, working as principals of secondary schools. The study result showed that in-service teachers found themselves partially competent in making multiple choice question and exemplification skills and lesson closure skill. $X^- = 3.43$; $X^- = 3.36$; $X^- = 3.74$. They felt incompetent in effective use of technical devices such as computer and interactive white board. $X^- = 3.13$; $X^- = 2.80$;

Teachers may be trained in activity based teaching. They may be provided latest knowledge of the subject biology during in-service training. Teachers may be trained in exemplification skills too apart from proper usage of computer, multimedia and interactive white board. Strength of lab staff may be enhanced. This may solve the problem of shortage of time.

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ISSN(e): 2224-4441/ISSN(p): 2226-5139

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Keywords: In-service biology teacher, Teacher competencies, Class and laboratory activities.

Contribution/ Originality

The present study contributed that in-service teachers found themselves partially competent in using internet and structuring a problem. The analysis of open-ended question revealed that teachers felt incompetent in using problem solving method due to absence of training in problem solving teaching methodology in their pre-service and in-service training. It was concluded that most of the teachers did not use problem solving methods in their routine teaching. However, senior teachers pointed out that teachers were not in a position to guide students in collecting information through internet due to the absence of computer and internet facility in school laboratory. These were main deficiencies of biology teaching in secondary schools. Senior teachers suggested in the interviews that teachers needed to desire from the students to search relevant information through internet by pin-pointing them relevant websites

1. INTRODUCTION

Teaching of science is acquiring an important position in the development of nations. Science teachers occupy an important position in the entire spectrum of education, we can equip our future generation to play their role in various branches of national life in a manner which provides honour and respect to Pakistan through effective and competent teachers. The vision to prepare Pakistani students to meet the challenges of future can be fulfilled by investigating the competencies of science teachers. According to [Lamauskas and Vilkoniene \(2006\)](#), 'acquiring appropriate competencies in high school science teachers is a guarantee for successful lesson delivery, but achieving competencies is not a final process as it lasts long.' In this regard, teachers have to develop not only their teaching skills related to lesson delivery but also skills related to organize different activities inside and outside of class. Competency means specific teaching skills of biology teachers required for effective teaching of the subject biology in order to produce problem solving abilities in students.

It is a fact that our science teachers are unable to meet international standards of biology teaching. In order to ensure national and international standards of biology teaching in secondary schools, science teachers specially biology teachers have an ability to individualize text book content according to students' needs, ability to apply teaching skills and ability to organize different activities inside and outside the classroom for producing problem solving ability in students. The main objective of biology teaching at secondary level is to produce understanding among students, and ability to apply their knowledge to solve problems by using scientific method.

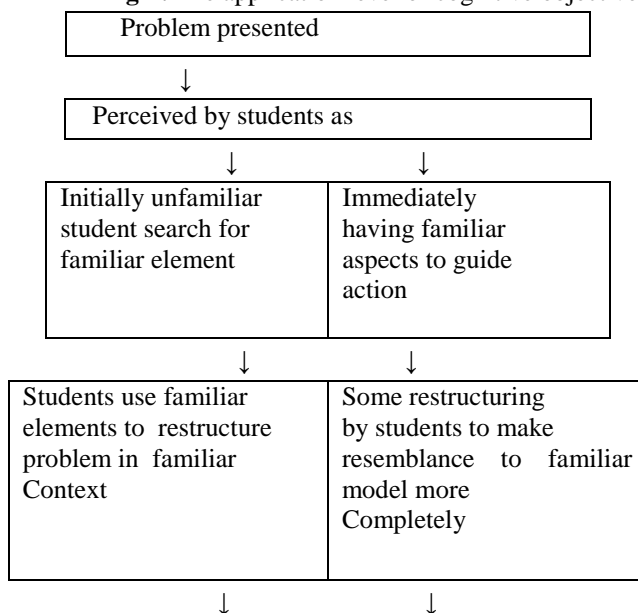
There were a few limitations of the study, one was that the respondents were hesitant to respond the questionnaire but the researcher made an extra effort for ensuring them that it will not affect their job security or performance. Furthermore they were assured to be provided material to overcome their deficiencies and in this way they will become competent. Additionally, there was difficulty in collecting data from principals and heads.

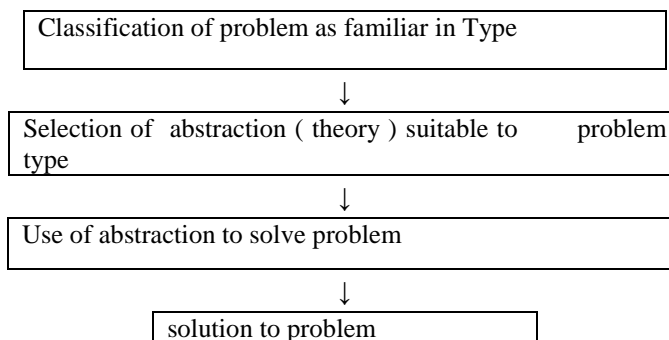
1.1. Literature Review

This study finds out existing level of teaching competencies of biology teachers in lesson delivery in the light of Herbartian formal steps. Herbartian formal steps are preparation, presentation, comparison and abstraction, generalization and application. In preparation phase teachers arouse curiosity in the mind of students. He must be competent to connect present lesson with past and daily life experiences to give meaning to problem. In presentation step, teacher presents new material for students' learning. Teachers must present questions, examples, technical and laboratory devices and equipments for the solution of problem. In comparison and abstraction phase, teacher analyzes and organizes data into significant relationship, by organizing class discussion and activities. Generalization step involve summary of the careful evaluation of preceding step into general conclusion. Application step involve competency of the teachers, to produce ability in students to apply their understanding in new situation and solve a problem.

Shahid (2000) suggested two different approaches for problem-solving procedure, i.e. inductive and deductive. Inductive means that thinking moves from the particular to the general, while deductive moves from general to particular. Inductive procedure is most commonly used in problem-solving school work.' Teachers may have knowledge about these two approaches. Shahid (2000) recommended Morrison' teaching cycle plan for science type learning closely akin to the Herbarian formal steps. Biology teachers prepare students' minds to receive new knowledge by linking new lesson with previous knowledge and develop skillful discussion during teaching. In second step, teacher arrange materials and introduce important principles to students by encouraging students to observe, compare, contrast and ask questions about topic. Teachers lead the students to certain conclusion and generate law or principle and then apply this generalization to the solution of problem. In the end of lesson, teacher ascertains whether the students understand the lesson by asking questions about topic taught.

Fig-1. The application level of cognitive objectives





Biology teachers guide their students during different steps of problem-solving procedure for cultivating creative thinking. [Shahid \(2000\)](#) quotes Parker discussion in this regard as get them define the problem at issue and keep it clear in minds and recall as many related ideas as possible by encouraging, to analyze the situation, formulate hypothesis, get them to evaluate carefully each suggestion, verify conclusion, help them in organizing their materials in tabulation and express conclusion. [Shahid \(2000\)](#) explains application level of cognitive domain of Blooms' taxonomy through Fig-1 above.

Studies on teacher's competency especially teacher's competency in successful lesson delivery has shown the required competencies for producing problem solving ability in students. [Bibi \(2005\)](#) study mentioned that exemplification, questioning, relate lesson to daily life and proper use of teaching aids were essential skills for successful delivery of lesson. In another study by [Halim et al. \(2006\)](#), biology teachers must have skills of planning and developing science instruction. [Hamza and Griffith \(2006\)](#) recommended safe class environment for producing problem solving ability in the students.

[Eze and Onyegebu \(2006\)](#) found that effective use of new technical devices had engaged students in practical activities enhanced students' problem solving ability. [Atav and Altunoglu \(2010\)](#) biology teachers felt themselves incompetent in using teaching technologies and problem solving teaching skill. [Suryawati et al. \(2010\)](#) pointed out that problem solving, arranging group discussion, and provision of opportunities of learning from environment and daily life were essential teaching competencies for producing problem solving abilities in students.

[Vaselinovska et al. \(2011\)](#) concluded that creating active classrooms and laboratories, daily life experiences and safe class environment prepare students for future challenges. All of these studies indicated the teachers' in-competencies for teaching biology in regards to successful delivery of lesson. These studies also pointed out essential competencies of teachers for producing problem solving ability in students.

Teaching skills employed by science teachers in the past were well suited to small sized institutions. However, the world today is rapidly changing. With new socio-economic demands and technological changes, teaching today is much more difficult than it was some years ago. The 21st century has brought innovative teaching skills in science teaching, new goals are being set and new teaching techniques are being devised in order to meet new challenges and demands of modern era. Therefore, it may be contended that rapid expansion in population and technological advancement is responsible for the increasing role of the science teachers. Hence there is need to explore the

traditional role of the biology teachers and attempt to reconsider and reexamine teaching competencies of biology teachers in the context of national and international standards of biology teaching.

2. METHODOLOGY

This study was conducted on In-service biology teachers who have been teaching biology in FG secondary schools in province Punjab. In total, 160 biology teachers participated in the study. The study was based on “teacher competencies” for successful delivery of lesson in the light of Herbartian formal steps mentioned by (Shahid, 2000). Accordingly, by using the 40-item scale, teachers were asked how competent they found themselves as in-service biology teachers in planning and preparing lesson, lesson presentation, comparison and abstraction, generalization and application. The answers were grouped in a five point Likert type scale ranging from quite competent (five point) to incompetent (point one). Apart from the scale, the in-service teachers were asked two open ended questions, namely, what are reasons for feeling in-competent in lesson delivery and what are your suggestions for the improvement of existing level of biology teaching at secondary school level?. In addition to questionnaire, an interview schedule was also developed for senior most biology teachers, working as principals of secondary schools. Principals of secondary schools asked two questions, namely, if you think your biology teachers are in-competent in lesson delivery, what are the reasons behind this in-competency? What are main deficiencies in your schools for teaching biology?

The responses of biology teachers were analyzed with the help of mean and chi-square.

3. DATA ANALYSIS AND INTERPRETATION

The data collected through questionnaire presented below in the form of tables.

Table-1. Competence perception of in-service teachers about “lesson preparation and lesson planning”

Teaching skills	Teachers' perception			
	n	Mean Score	SD	Calculated χ^2 Value
Skill in arousing curiosity in students	160	4.15	.946	145.438
Accept incorrect answer of students for class discussion	160	2.80	1.098	43.938
Link lesson with past experience	160	4.24	.955	158.750
Define problem (topic) in simple language	160	4.49	.785	225.561
Use daily life examples	160	4.26	.754	194.563
Use multiple choice questions	160	3.43	1.237	22.813

df=4, $p < .001$, Table value at $.001=18.467$

Table-2. Competence perception of in-service teachers about “lesson presentation”

Teachers' perception				
Teaching skills	n	Mean Score	SD	Calculated Value χ^2
Make hypothesis for presentation of problem	160	3.15	1.150	27.813
Use of computer	160	3.79	.877	160.813
Prepare stained slides	160	2.80	1.098	43.938
Prepare research article for class discussion	160	3.36	1.146	29.188
Use interactive white board for labeling diagrams	160	2.80	1.098	43.938
Use daily life examples	160	3.96	.886	156.000
Use examples from other science subjects	160	3.43	1.237	22.813
Prepare cross sectional slides	160	3.92	1.034	103.188
Take pauses during presentation	160	2.97	1.329	5.438
Arrange field trips for finding answers to students' queries	160	2.23	1.466	91.188

df=4, p< .001, Table value at .001=18.467

Table-3. Competence perception of in-service teachers about “lesson comparison and abstraction”

Teachers' perception				
Teaching skills	n	Mean Score	SD	Calculated Value χ^2
Make students' group for structure the problem	160	3.20	1.033	53.813
Collect information from library	160	4.05	1.039	93.500
Use internet to gather information for students	160	3.66	1.364	40.250
Link concrete and abstract experiences of students	160	4.03	9.90	110.125
Help students in organizing materials in tables	160	3.96	.886	156.000
Speculate on ways to clear up the difficulty in an investigation	160	2.83	1.230	16.188

df=4, p< .001, Table value at .001=18.467

Table-4. Competence perception of in-service teachers about “Generalization of lesson”

Teachers' perception				
Teaching skills	n	Mean Score	SD	Calculated Value χ^2
Give task to conclude main points about topic	160	3.74	1.000	71.500
Help students to write report of experiment	160	2.93	1.406	9.563
Arouse interest of students	160	4.31	.912	158.313
Collect animals and plants	160	2.83	1.296	8.500
Use daily life examples	160	3.96	.886	156.000
Ask questions about topic	160	3.43	1.237	22.813

df=4, p< .001, Table value at .001=18.467

Table-5. Competence perception of in-service teachers about “application of lesson”

Teachers' perception				
Teaching skills	n	Mean Score	SD	Calculated χ^2 Value
Help students in making science models	160	2.63	1.232	18.875
Make a green house effect in school	160	2.44	1.395	31.563
Create new thing on charts	160	2.38	1.350	33.688
Make ecosystem in school ground	160	3.17	1.117	40.063
Make botanical garden in school	160	2.67	1.541	25.313
Help students to apply their knowledge to solve problem	160	3.99	1.049	80.813

df=4, $p < .001$, Table value at $.001=18.467$ **Table-6.** The reasons reported by in-service biology teachers' for their in-competency

Reasons	Yes	No	%age
Weak knowledge base of students in primary and middle classes in science	147	13	92
Teachers mainly focused on course coverage	77	83	48
Teachers have heavy teaching load	147	13	92
Science students were not well trained in their lower classes for participation in class activities	160	-	100
Students use help books, guess papers and key books for the solution of their study problems	147	13	92
Absence of multimedia in school	160	-	100
Absence of computer in school lab	77	83	48
Absence of internet in schools	160	-	100
Absence of interactive white board for labeling diagrams	160	-	100
Absence of latest study material in school library	126	34	78
Teachers are not competent in using problem solving method	128	32	80

Table-7. The suggestions of teachers to overcome their in-competency. (n=160)

Suggestions	Frequency	%age
Teachers need training in preparing models	72	45
Teachers may have easy access to computer lab of school	147	92
Teachers need training in multimedia usage	35	22
Teachers need training in slide preparation	127	79
Teachers need training in research report writing	59	37
Teachers need training in power point lesson presentation	67	42
Teachers need training in internet usage	75	47
Teachers need training in using Lab equipment	147	92
Teachers should be competent in exemplification skill	28	17

Continue

Teachers should be competent in using interactive white board	34	21
Teachers should be competent in arranging problem solving activities	49	31
Teachers should be competent in naming plants & animals botanically and zoologically	23	14
Teachers should be competent in question making technique	48	30
Teachers should be competent in lesson preparation skill	77	48
Teachers should be competent in lesson closure	65	41

4. ANALYSIS OF THE DATA COLLECTED THROUGH INTERVIEW

Table-8. The reasons reported by heads of schools for biology teachers' incompetence (n=20)

Reasons	Yes	No	%age
Weak knowledge base of students in previous classes	18	2	90
Teachers mainly focused on course coverage due lengthy syllabus	13	7	65
Teachers have heavy teaching load	3	17	15
Science students were not well trained in their lower classes for participation in class activities	20	-	100
Students use guess papers and key books for the solution of their study problems	12	8	60
Absence of multimedia in school	20	-	100
Absence of computer in school lab	16	4	80
Absence of internet in schools	20	-	100
Absence of latest study material in school library	16	4	80
Teachers are not competent in using problem solving method			

Table-9. Main deficiencies in teaching biology (n=20)

Main deficiencies in teaching biology	Yes	No	%age
Teachers were partially competent in lesson preparation.	16	4	80
Inadequacy of teachers in giving appropriate examples and showing living organism about topics	12	8	60
Teachers were not well equipped in question making skill.	12	8	60
Teachers were not competent in stimulus variation skill for producing safe class environment.	16	4	80
Acute shortage of lab staff and equipment	20	-	100
Lack of awareness in teachers for using computer and multimedia	16	4	80
Teachers did not ask students to explore main point of lesson	12	8	100
Teachers' in competency in making science models in working order.	16	4	80
Teachers are not competent in using problem solving method	20	-	100
Absence of computer and internet facility in school Laboratory.	16	4	80
Teachers are not competent in naming animals zoologically and plants botanically.	12	8	60
Absence of interactive white board in schools	15	5	75
Teachers are not competent in interactive teaching method	16	4	80

5. FINDINGS

The findings of the study have been presented under following headings.

5.1. Findings Based upon Responses of Biology Teachers

5.1.1. Lesson Preparation

It is noted in table 1 of questionnaire for in-service biology teachers that in-service teachers were very competent in performing class activities, linking textbook topic to previous knowledge of students and defining topic in simple language whereas teachers found themselves barely competent in accepting incorrect answers of the students.

5.1.2. Lesson Presentation

It is indicated in table 2 of questionnaire that teachers found themselves quite competent in preparing microscopic slides for lesson demonstration. Also they found themselves partially competent in using computer and multimedia for showing ambiguous diagrams of the book as well as in presenting articles of newspaper. In-service teachers found themselves barely competent in making hypothesis and arranging fieldtrips and using interactive white board. They found themselves incompetent in taking pauses at right phases during presentation for enhancing students' thinking for the solution of problem.

5.1.3. Lesson Comparison and Abstraction

Table 3 reveals that in-service teachers regarded themselves competent in collecting information from library, organizing materials in tables and linking concrete and abstract experiences of students. In-service teachers found themselves partially competent in using internet and structuring the problems in group discussion. They found themselves barely competent in helping their students to speculate on ways to clear up difficulties in an investigation.

5.1.4. Generalization of Lesson

As can be seen in Table 4 teachers were competent in giving task to explore the main points of lesson to their students and arousing interest of students. They found themselves very competent in questioning and exemplification skills. However, they were incompetent in naming animals and plants scientifically and in report writing of experiment.

5.1.5. Application of Lesson

Table 5 shows that teachers regarded themselves very competent in helping their students to apply their knowledge to solve a problem. They found themselves partially competent in helping their students to prepare green house effect and to create new things in biology class. They found incompetent in preparing science models in working order and in making botanical garden in school ground.

5.2. Findings on the Basis of Interviews with Senior Biology Teachers Working as Heads of Secondary Schools

Mostly senior biology teachers pointed out that their biology teachers are partially competent in teaching skills such as lesson preparation, exemplification skill, questioning skill, create safe

class environment for active participation of students, use of computer and multimedia, give pauses during lecture to motivate students to think and make concept map for concept clearance.

Majority of the senior teachers held the opinion that biology teachers did not involve students in activities such as to prepare models, to collect animals and plants, to make botanical garden, to formulate hypothesis and to collect information from internet due to shortage of time, absence of computer and internet in schools, due to their in-competency in making science models, naming plants and animals botanically and zoologically and usage of computer, multimedia, interactive white board and internet. Majority of senior biology teachers pointed out that biology teachers were not in position to help their students in selecting and structuring the problems due to their in-competency in organizing problem solving activities and shortage of time. Teachers did not provide help to their students in formulating hypothesis and applying their knowledge to solve a problem.

5.3. The Reasons Reported by Heads of Schools for Biology Teachers' In-Competence

4. Majority of the senior teachers reported the main reasons for teachers' in competence were as follows

- Weak knowledge base of students for science
- Teachers mainly focused on course coverage
- Teachers are in-competent in using problem solving method of teaching
- Overcrowded classes
- Busy timetable in school
- Lack of incentives for efficient and well-committed teachers
- No participation of students in creative activities due to use of key-books.

According to senior teachers, computer, multimedia, internet facilities, interactive white board and latest reference books were not available in schools.

6. CONCLUSIONS AND DISCUSSION

Following are the conclusions of the study

Results of the research showed that teachers utilized lesson preparation teaching skill effectively in their routine teaching. Majority of teachers agreed that they started lesson by performing some activities and linked textbook topic with the previous knowledge of students. Senior teachers expressed in interview that the teaching of biology was mainly focused on course coverage rather than performing class activities for the enhancement of students' learning. Hence it was concluded that teachers were partially competent in lesson preparation skill. According to findings obtained from the study, the participants found themselves barely competent in accepting incorrect answers of the students. Therefore, teachers needed latest knowledge of the subject biology.

It was concluded that the teachers developed a link between concrete and abstract learning experiences of students by giving examples from daily life or showing living things about lesson. The analyses of the responses to the open-ended question showed that teachers felt inadequate in giving appropriate examples and showing living things about topics. Hence it is concluded that

teachers were partially competent in exemplification skills. Majority of teachers found themselves partially competent in using multiple choice question and in changing their questions on the basis of the understanding of the students. Senior biology teachers opined that biology teachers needed to improve their multiple choice question making technique. Hence it was concluded that the teachers were not well equipped in questioning technique.

The use of computer and interactive white board for showing multidimensional images of ambiguous diagrams in class was not encouraging because most of the teachers were in competent in using computer and interactive board in the class. Teachers were competent in preparing slides on microscope for lesson presentation. The analysis of responses to the open-ended question revealed that main reason of teachers' in-competency was that they had no access to computer lab in the schools. Teachers also expressed that computer and multimedia facilities were not available in science laboratory of school. They expressed that strength of laboratory equipment and lab staff was not according to the requirement of overcrowded classes of students. They suggested that strength of laboratory staff and equipment may be enhanced. Heads of the institutions expressed in an interview that schools had very busy schedule for computer classes. Hence biology teachers could not have access to computer lab of the institutions. Some senior teachers expressed that biology teachers and science students had an easy access to computer lab of schools. They expressed that lack of awareness for the use of electronic equipments specially computer and multimedia was main deficiency in biology teaching. They expressed that computer and multimedia is a vital and basic need in the current situation of schools. They suggested that teachers need specific training in using computer and multimedia.

Some teachers favoured pauses during lecture but majority of teachers did not use this technique during their teaching due to their incompetence as well as shortage of time. Hence it was concluded that the teachers were not competent in giving pauses to motivate students to think, but practically, teachers do not provide such pauses for giving time to students for thinking to solve a problem. As expert teachers emphasized in interview that biology teachers should improve this teaching technique for producing problem solving ability in students. Students did not get any opportunity of clarifying their misconceptions during field trips. Majority of experts held the opinions that teachers did not arrange field trips. The absence of this practice in our school is also created deficiency in biology teaching. Majority of teachers were competent in using different teaching skills for arousing interest of students in the end of lesson. But they were not competent in making hypothesis for solving a problem as analyzed through interview. This produced a deficiency in teaching of biology.

The present study showed that in-service teachers found themselves partially competent in using internet and structuring a problem. The analysis of open-ended question revealed that teachers felt incompetent in using problem solving method due to absence of training in problem solving teaching methodology in their pre-service and in-service training. It was concluded that most of the teachers did not use problem solving methods in their routine teaching. However, senior teachers pointed out that teachers were not in a position to guide students in collecting information through internet due to the absence of computer and internet facility in school laboratory. These were main deficiencies of biology teaching in secondary schools. Senior

teachers suggested in the interviews that teachers needed to desire from the students to search relevant information through internet by pin-pointing them relevant websites.

Teachers felt incompetent in helping students to speculate on ways to clear up the difficulty in an investigation. It is evident from the findings that students were not involved in the preparation of models, green house and botanical garden. Moreover, they were not involved in the collection of animals, insects and plants. However, teachers were competent in helping students to prepare charts and slides. The suggestions of the teachers were analyzed and it was found that majority of teachers had no time to carry out creative activities in biology class due to lengthy syllabus of biology text book and shortage of school time. Teachers also pointed out that students used help books, guess papers and key books for the solution of their study problems. Thus they did not take interest in problem solving activities. As revealed in interviews, the main reason for teachers' in competency in making science models was their inability to prepare models in working order. Some of the senior teachers were of the view that teachers were incompetent in naming the collected animals and plants zoologically and botanically. It was concluded that most of the teachers did not take interest in arranging creative activities due to their in-competency in making models and naming animals and plants zoologically and botanically. These in-competencies of teachers indicate a deficiency in biology teaching.

7. RECOMMENDATIONS

On the basis of conclusion, following recommendations are made:

Teachers may be trained in activity based teaching. This is likely to enable teachers to draw attention of students and to ensure their active participation of students. They may be provided latest knowledge of the subject biology during in-service training. This may enable teachers for accepting incorrect answers of students with comments. Teachers may be trained in exemplification skills. Exemplification skills of the biology teachers may help teachers to enhance students learning. Teachers need to ensure active participation of weak students by using multiple choices questioning technique. Teachers may be trained in the skill of question development. Computer, multimedia and interactive white board may be provided in schools. Teachers may be trained in proper usage of computer, multimedia and interactive white board. This may help biology teachers to explain ambiguous diagrams of textbook and to prepare lesson presentation.

Strength of lab staff may be enhanced. This may solve the problem of shortage of time. This may also ensure active participation of the students. Teachers may be trained in preparing and staining microscopic slides. This may enhance practical exposure of students as well as ensure deep learning of biology. Teachers may provide pauses during lecture in order to motivate students to think for the solution of problem. Teachers may be trained in lesson closure technique. This may help them to involve students in classroom activities till the end of lesson. Teachers may involve their students in problem solving activities by assigning marks for such activities. Training may be given to teachers in preparing science models in working order by using waste and in-expensive materials. This may also help in enhancing thinking of the students for solving a problem.

Biology teachers may be trained in teaching by naming plants and animals botanically and zoologically. Plants in textbook and practical notebook may be present in school garden. This

may also help in enhancing students' knowledge about kinds of plants and animals. Field trips to school ground and nearby areas of school may be arranged by the school management and teachers. This enables teachers to help students in finding answer to their queries. Teachers may also be trained in problem solving teaching methodology as well as in guiding students through problem solving activities in biology class. This may help teachers in producing problem solving abilities in students for solving problems related to textbook topics as well as daily life. Internet facility may be provided in school libraries. Teachers may give home work to collect information from internet by telling them relevant websites.

8. RECOMMENDATION FOR FUTURE RESEARCH

In future research may be conducted to investigate teaching competencies of science teachers at primary and middle school levels by using observation as data collection technique. A research study may be conducted for investigating teaching competencies of physics and chemistry teachers at secondary and higher secondary school levels.

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