Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
an open access publisher
http://ansinet.com

Journal of Applied Sciences 7 (20): 3031-3037, 2007
ISSN 1812-5654

Pre-Service Science Teachers' Views About Characteristics of Effective Science Teaching and Effective Science Teacher

[1]Kutret Gezer and [2]Kadir Bilen
[1]Department of Secondary Science and Mathematics Education,
Faculty of Education, Division of Biology Education,
[2]Department of Elementary Education, Faculty of Education, Division of Science Education,
Incilipinar Campuses, Pamukkale University, P.O. Box 20020, Denizli, Turkey

Abstract: In this study an attempt was made to understand the perceptions of pre-service science teachers regarding effective science teaching strategies and teachers who are successful at implementing these strategies in their educational practice culminating towards being considered an effective science teacher. Firstly, for the purposes of this research a consideration of the following questions was necessary: What are the characteristics of effective science teaching? What are the characteristics of an effective science teacher? In order to gain insight into the research in question, related literature was reviewed and questionnaire research, including open-ended questions had been administered to pre-service teachers. Some remarkable findings have been discovered which are briefly discussed. The main feature revealed through the study is that pre-service science teachers believe the pedagogical skills of professional teachers should take precedence at first over the improvement of their theoretical knowledge on their subject matter.

Key words: Effective science teaching, effective science teacher, pre-service science teachers

INTRODUCTION

In this age, which experiences rapid changes, science and technology are important components. Science is to examine and explain the living creatures and events, to generalize and find principles about them and the attempts to determine the future events with the help of these principles. In science lessons the living creatures and events in nature are examined with the same aims (Tytler, 2001; Harlen, 1999). For making science a favorite lesson for students and for increasing the academic success, the field knowledge of science teachers and in addition to this their ability of effective teaching are important. Today, in our country the science instruction is conducted through teacher-centered traditional methods. Whereas, by taking the individual differences into consideration, the science lessons must provide active students.

The science instruction is the instruction of an attractive and amazing wealth in child's environment. It is the instruction of the food a child eats, the water he drinks, the weather he breathes, the animals he feeds, the car he drives, the electricity, the light and the sun. Then, the science instruction must be made by taking the interests and needs of the child, his level of development, his desires and the facilities of environment into consideration. It is an easy and concrete instruction which must be made with appropriate methods and techniques. In other words it is necessary to make it in such a way (Walter *et al*., 1998; Tytler, 2003).

For an effective science instruction, beginning with search, examination, observation and experiment, when such methods and techniques like presentation and invention are applied, there can be provided a permanent and effective education. When many techniques are applied in the phase of application the instruction gets easier. During lesson activities while the children are learning they can at the same time use the things they learnt in another subject or field (Tytler *et al*., 2001).

An interesting study has also been conducted by Moreira (2002). The researcher realized that high school students' (n = 369) perceptions do not change largely when it is comprised with other research findings. In order to collect data, the researcher firstly asked students to complete an essay and found that students highlighted some characteristics of an effective teacher as follows: explains assignments, gives example and materials; does not take personal problems out on students; grades fairly;

Corresponding Author: Kutret Gezer, Department of Secondary Science and Mathematics Education, Faculty of Education, Division of Biology Education, Incilipinar Campuses, Pamukkale University, P.O. Box 20020, Denizli, Turkey

is honest and friendly; maintains control of the classroom; listens to students; helps students, does not ridicule students. In Moreira's study the following points might also be considered as interesting:

- Instructionally, students want classes to be more interesting and fun. This suggestion should come as no surprise to educators. What student doesn't want to have more fun in the classroom? Granted, it's not always easy to make learning fun, but according to students, the good teachers do.

Recently, Korthagen (2004) investigated what the essential qualities of a good teacher are and concluded that this question can not be answered in a simple way. On the other hand, the researcher also indicated that a good teacher will not always show good teaching which is interesting and a considerable point in this study.

The literature has been reviewed so far and shows that there has been numerous research findings on what makes teaching strategies effective teaching and an effective teacher. This extensive literature review implies that:

- There is a variety of terminology in order to identify the characteristics of an effective teacher. The concept of good teacher was also often used in the research studied on effective teaching and teacher.
- There are many studies on effective teaching, in particular; on what it means to be an effective teacher in the literature. It should be noted that it is not so easy to put forward a definition of an effective teacher since there are different views presented by researchers.
- Different types of research methods were used to define who an effective teacher is. Different methodologies such as surveys, essays and literature-based methods were used in the studies of understanding effective teaching and a teacher being successful which suggest that both qualitative and quantitative research methods are available to study this subject.

An effective teacher should gain his students' participation in the course. It is impossible to think to reach achievement, when participation of the students are provided in the class environment. Anderson (1991) gives some suggestions about students' participation and teacher effectiveness in achievement:

- Teachers should put some criterion for achievement, operate them for students and meet students with every kind of living.
- Those students who endevour and pay attention required to learn should be öğrenmenin gerektirdiği çabayı harcayan ve dikkat eden öğrenciler pekiştirilmelidir.
- Teachers should help students to develop their learning strategies.
- Teachers should create necessary circumstances to have the power of having influencing students.
- During the presentation of the course, teachers should use techniques to obtain students' notice and participation.
- While students are doing their homework, teachers should walk around and help them.
- Teachers should make students feel their interest by verbal and non verbal means like gestures, smiling eyes, being careful every time.

The aim of this study is made to determine science teacher candidates' views about the properties of effective science teaching and effective science teachers.

New technologies are produced based on data accumulation in a speedy way. In order to adapt this rapid improvement, people should be educated according to conditions of the time. In order to make science education at school functional and productive, from the beginning of their first years of education, students must be acquired the property of investigating and obsolete education which is based on memorizing should be avoided.

Science teachers should give direction to education and teaching process with taking into account the effects of the role of science on our social life. Replying interest of children to the events around them and their duty is to foster this interest in order to develop.

Science has a very important role in developing concepts, scientific thinking, problem solving and creativeness. There are concrete concepts like acid, base, salt, solid and liquid and also abstract concepts like atom, ion and gene in science concepts. If the situation is like that, it comes to the fore to make abstract concepts concrete. For this, techniques such as analogy, modelling, drama, experiment and show should be utilized. So, teacher with the knowledge of technique and method should be put into use. Teacher should choose appropriate methods and techniques to use in the course carefully. Techniques and methods to be used in the course should be student centered, make students active, not cause misconceptions and mistaken understanding.

MATERIALS AND METHODS

Sample: The sample of this study is 90 fourth grade students in Science Education Teaching

Department of Education Faculty of Pamukkale University in 2003-2004 academic year.

Mean of collecting data: Open ended questions provide researchers an important flexibility to make research questions more detailed. Open ended questions provide chance of finding out and constituting theory by taking into account the gathered data. It would be appropriate to start research period with open ended questions for unresearched or uninvestigated subjects (Yıldırım and ve Şimşek, 1991). For this reason, the views of candidate teachers were taken with open ended questions in the questionnaire.

In choosing open ended questions, parallel to research problem, it is wanted to be written properties of effective science teacher and science teaching according to order of importance.

Method: Prepared criterions were applied to 94th grade students chosen in 2003-2004 academic year 2nd term.

Theme of qualitative research was to try to understand human behavior in environment in it and in many sides. Traditional methods are insufficient to investigate human behavior, but with a flexible and complete approach, views and experience of the people who participate in the research will be more proper. Therefore, in this research qualitative methods were also used.

In qualitative researches, generally three types of data are gathered: environmental data, data related to period and perceptions. Environmental data is the basis of data related to period and provides chance of compare with the other situations. Data related to period is related to what has happened and how this happening has effected the research group. Data related to perception is related to the thought of research group about the period (Yıldırım ve Şimşek, 1999).

In this research, preservice science teachers were asked to write the properties of effective science teaching and effective science teachers in order of importance for qualitative data. These questionnaire forms and documents which have these written properties are investigated.

ANALYSIS OF DATA AND FINDINGS

In this research, the answers to the open ended questions were analyzed by using document's and content analysis techniques. In the analysis of data related to answers to the open ended questions of preservice science teachers, frequency (f) and percentage (%) were used. Main themes were constructed according to aims of research and problems in order to evaluate the data collected from the answers of the open ended questions of preservice science teachers. In addition, these main themes were categorized according to answers from preservice teachers (Table 1).

Answers of preservice teachers about the three important properties of effective science teaching and effective science teachers were seen as accumulated in five headlines such as the structure of science, methods of teaching, occupational properties, personal properties and classroom atmosphere.

The item make a connection between current events and science topics is seen as the most important item with 16 teachers' view and 6.1% over all among the preservice teachers' answers related to effective science teacher.

Among other answers, there are explaining science topics from easy to difficult (f = 6), the usage of science in daily life (f = 5), to make science lessons be loved (f = 5), preventing student from tendency to memorization (f = 4), cause and aims of science (f = 3), teaching science topics in an order (f = 2), field knowledge about the course (f = 2) for effective science teaching according to order of importance.

Field knowledge of the course (f = 23) is explained as the most important property of effective science teacher by preservice teachers. It has 8.8% view over all.

Among the other answers, there are to make science lessons be loved (f = 6), make a connection between current events and science topics (f = 5), preventing student from tendency to memorization (f = 4), cause and aims of science (f = 3), explaining science topics from easy to difficult (f = 2), the usage of science in daily life (f = 1), teaching science topics in an order (f = 1) for effective science teacher according to order of importance.

Table 1: Distribution of frequency and percentage of the view of preservice science teachers about the structure of science in total

	Effective science teaching		Effective science teacher	
The structure of science	f	(%)	f	(%)
The usage of science in daily life	5	1.9	1	0.3
Make a connection between current events and science topics	16	6.1	5	1.9
Field knowledge about the course	2	0.7	23	8.8
Preventing student from tendency to memorization	4	1.5	4	1.5
Cause and aims of science	3	1.1	3	1.1
Teaching science topics in an order	2	0.7	1	0.3
To make science lessons be loved	5	1.9	6	2.2
Explaining science topics from easy to difficult	6	2.2	2	0.7

Table 2: Distribution of frequency and percentage of the view of preservice science teachers about the methods of teaching in total

	Effective science teaching		Effective science teacher	
Methods of teaching	f	(%)	f	(%)
Laboratory method	83	31.8	32	12.2
Active learning	7	2.6	2	0.7
Usage of technology	5	1.9	3	1.1
Knowledge of teaching methods and techniques	2	0.7	3	1.1
Exploratory teaching	23	8.8	8	3.0
Group work	5	1.9	2	0.7
Usage of homework and worksheet	2	0.7	1	0.3
Question answer	3	1.1	0	0.0
Discussion	3	1.1	0	0.0
Scientific project making as homework	11	4.2	3	1.1
Usage of activities	1	0.3	1	0.3

Table 3: Distribution of frequency and percentage of the view of preservice science teachers about the occupational properties in total

	Effective science teaching		Effective science teacher	
Occupational properties	f	(%)	f	(%)
Clear and understandable expression	11	4.2	5	1.9
Student centered education	5	1.9	8	3.0
Reaching the student's level	8	3.0	19	7.2
Guidance activity	0	0.0	2	0.7
Experience	2	0.7	5	1.9
Occupational characteristic and quality	0	0.0	2	0.7
Planning	1	0.3	3	1.1
Evaluation activity	0	0.0	1	0.3
Loving his/her occupation. Explaining the course fondly	0	0.0	5	1.9
Being a good observer	0	0.0	5	1.9
Being willing and idealist	1	0.3	2	0.7
Being successful	0	0.0	1	0.3

Laboratory method is seen as the most important teaching method (f = 83) for preservice science teachers. Its is 31.8% (Table 2).

For other answers, there are exploratory teaching (f = 23), scientific project making as homework (f = 11), active learning (f = 7), usage of technology (f = 5), group work (f = 5), question answer (f = 3), discussion (f = 3), knowledge of teaching methods and techniques (f = 2), usage of homework and worksheet (f = 2), usage of activities (f = 3) for effective science teaching in the order of importance.

In teaching methods, Laboratory method (f = 32) is the most important property of the effective science teachers with the percentage of 12.2%.

For the other answers, exploratory teaching (f = 8), scientific project making as homework (f = 3), usage of technology (f = 3) knowledge of teaching methods and techniques (f = 3), active learning (f = 2), group work (f = 2), usage of homework and worksheet (f = 1), usage of activities (f = 1) for effective science teacher in the order of importance.

One of the most important occupational property of effective science teaching includes clear and understandable expression (f = 11) for preservice teachers with the percentage of 4.2%. For other answers, reaching the student's level (f = 8), student centered education (f = 5), experience (f = 2), planning (f = 1), being willing and idealist (f = 1) for effective science teaching in the order of importance (Table 3).

One of the most important occupational property of effective science teacher is reaching the student's level (f = 19) with the percentage of 7.2%. For other answers, There are student centered education (f = 8), clear and understandable expression (f = 5), experience (f = 5), loving his/her occupation, explaining the course fondly (f = 5), being a good observer (f = 5), planning (f = 3), guidance activity (f = 2), occupational characteristic and quality (f = 2), being willing and idealist (f = 2), evaluation activity (f = 1), being successful (f = 1).

The most significant item among personal characteristics in effective science teaching properties was being patient (f = 5) with 1.9%, followed by consecutively being determined (f = 3), being resolute (f = 1) and being careful (f = 1).

According to analysis of data, the most important item among properties of effective science teacher, as stated by 17 teacher candidates which constitutes 6.5%, was being patient. In order of importance it was followed by being resolute (f = 10), being active in every field (f = 7), having pleasant disposition, being witty (f = 5),

Table 4: Distribution of frequency and percentage of the view of preservice science teachers about the personal properties in total

	Effective science teaching		Effective science teacher	
Personal properties	f	(%)	f	(%)
Being resolute	1	0.3	10	3.8
Being patient	5	1.9	17	6.5
Being good natured	0	0.0	3	1.1
Being determined	3	1.1	4	1.5
Being understanding	0	0.0	2	0.7
Having pleasant disposition, being witty	0	0.0	5	1.9
Having pragmatic mind	0	0.0	3	1.1
Being sincere	0	0.0	2	0.7
Having oral explanation ability	0	0.0	1	0.3
Showing respect and love	0	0.0	5	1.9
Being active in every field	0	0.0	7	2.6
Being careful	1	0.3	2	0.7
Having labour ethics and being hardworking	0	0.0	1	0.3

Table 5: Distribution of frequency and percentage of the view of preservice science teachers about the classroom atmosphere

	Effective science teaching		Effective science teacher	
Classroom atmosphere	f	(%)	f	(%)
Teaching suitable for personal differences	2	0.7	2	0.7
To make lesson enjoyable	2	0.7	5	1.9
Having good dialogue with students	0	0.0	2	0.7
Being interested in lesson for students	0	0.0	1	0.3
Being effective in communication in lesson in the classroom	0	0.0	1	0.3
Classroom existing	0	0.0	1	0.3
To encourage students to ask questions	6	2.2	9	3.4
To deal with the lesson with students	5	1.9	2	0.7
To motivate students	1	0.3	2	0.7
To make students participate in the lesson	2	0.7	2	0.7
Not to explain directly to give students an opportunity to think	0	0.0	5	1.9
To be effective on the mental development of the students	0	0.0	2	0.7
Time management	2	0.7	2	0.7
Classroom management	0	0.0	3	1.1

showing respect and love (f = 5), being determined (f = 4), having pragmatic mind (f = 3), having good natured (f = 3), being understanding (f = 2), being sincere (f = 2), being careful (f = 2), having oral explanation ability (f = 1), having labour ethics and being hardworking (f = 1).

The teacher candidates stated that (Table 5) the most significant item for effective science teaching in class atmosphere was encouraging students to ask question (f = 6) with percentage of 2.2%. The other items were to deal with the lesson with students (f = 5), to make lesson enjoyable (f = 2), to make students participate in the lesson (f = 2), time management (f = 2), teaching suitable for personal differences (f = 2), to motivate students (f = 1), in order of importance (Table 4 and 5).

In light of views of teacher candidates concerning class atmosphere among properties of efficient science teachers, the highest score was for encourage students to ask question (f = 9) with percentage of 3.4%, which was followed by to make lesson enjoyable (f = 5), not to explain directly, to give students an opportunity to think (f = 5), classroom management (f = 3), teaching suitable for personal differences (f = 2), having good dialogue with students (f = 2), to deal with the lesson with students (f = 2), to motivate students (f = 2), to make students participate in the lesson (f = 2), to be effective on the mental development of the students (f = 2), time management (f = 2), being interested in lesson for students (f = 1), being effective in communication in lesson in the classroom (f = 1), classroom existing (f = 1) in order of importance.

RESULT AND DISCUSSION

It can be concluded from present research that the most important items among properties of effective science teaching were Laboratory method, To form connection between science topics and current topics, learning by exploration, giving students scientific project homework.

The results such this study stressed that among the science teaching methods the importance of supporting the lessons with experiments, learning by means of finding and exploring, actively participation of student in

lesson were necessary was in good harmony with previous studies by Lucas (1991), Walter *et al.* (1998), Harlen (1999) and Tytler (2003).

Of the most importance properties of effective science teachers, being patient, getting students' level, field knowledge about the lesson and to utilize Laboratory method in the lesson were the most preferred by teacher candidates.

The results of finding of this study are to some extend in consistent with previous studies in this field. Kyriacou (1997), Moreira (2002), Minor ve Onwuegbuzie (2002), McEwin and Thomason (1989), Buckner ve Bickel (1991) and Gelinas (2000) also concluded that of the outstanding professional properties of an efficient teacher, giving clear and understandable explanations, filed knowledge about the lesson were leading items.

The importance of listening to considerations of students among properties of an effective teacher was stressed by Moreira (2002) and Tytler *et al.* (2002). According to research carried out by Gürdal (2002) and Dindar and Yaman (2002) in Turkey, carrying out experiments in effective science education was also determined. Kılıç (2002), in his research stated that science education was carried out in developed countries substantially through experiments.

Suggestions: By determining the features of effective science teaching and effective science teacher, general strategies for abilities in science teaching and different types of instruction have been determined.

For the educators: In order to grow effective science teacher it is important to teach professional field knowledge and effective science teaching methods. The experiments about the subjects in science lesson programme must be designed by taking all the primary schools in our country into consideration. The exams which are applied in order to save our education system from learning-by-heart must be revised.

For science educators: The special instruction methods used in science teaching must be studied and which methods are the most effective ones at present must be determined.

The subjects in science instruction must be taught from concrete to abstract and they must be appropriate for the level of students.

In science instruction the laboratory technique must be used and students must be enabled to learn by finding and discovering.

The subjects in science lessons must be taught with cause-effect relationship and they must be related with daily life.

REFERENCES

Anderson, L.W., 1991. Increasing teacher effectiveness. UNESCO, Paris.

Buckner, J.H. and F. ve Bickel, 1991. If you want to know about effective teaching why not ask your middle school kids? Middle School J., 22: 26-38.

Dindar, H. and S. Yaman, 2002. Öğretmenlerin İlköğretim 4. ve 5. Sınıflarda Fen Bilgisi Dersinde Öğretim Yöntemlerini Kullanma Durumları, Kastamonu Eğitim Dergisi, sayı, 7: 31-40.

Gelinas, R.A., 2000. Effective Teachers at the Middle Level. Doctor of Education University of Massachusetts.

Gürdal, A., 2002. Fen Öğretiminde Metot ve Teknikler. İlköğretimde Fen/Fizik Eğitimi Sempozyumu ve İşlik Çalışması, 3-4 Haziran, Tekirdağ.

Harlen, W., 1999. Effective teaching of science, a review of research. Using Research Series. 21. Edinburg. Scottish Council for Research in Education ERIC Reproductive Service ED.

Kılıç, B.G., 2002. Science Education in Turkey and World. V. Fen ve Matematik Egitimi Sempozyumu, 16-18 Eylül, Ankara.

Korthagen, F.A.J., 2004. In search of the essence of a good teacher: Towards a more holistic approach in teacher education. Teaching and Teacher Education, 20: 77-97.

Kyriacou, C., 1997. Effective Teaching in Schools: Theory and Practice. Cheltenham: Stanley Thornes.

Lucas, A., 1991. Info-tainment and informal sources for learning science. Int. J. Sci. Edu., 13: 495-504.

McEwin, C.K. and J.T. Thomason, 1989. Who they are, how we teach: Early adolescents and their teachers. Columbus, OH: National Middle School Association.

Minor, C.L. and J.A. Onwuegbuzie, 2002. Preservice Teachers' Educational Beliefs and Their Perceptions of Characteristics of Effective Teachers. J. Edu. Res. November-December, 96: 116-126.

Moreira, S.J., 2002. Student perceptions of good teaching practices. Ph.D Thesis, University of Pacific Stockton, California (Un Published).

Tytler, R., 2001. Describing and supporting effective science teaching and learning in Australian schoolvalidation issues. Asia-Pasific Forum on Science Learning and Teaching, Vol. 2.

Tytler, R., B. Sharpley and S. Tsiatsias, 2001. Effective science teaching and a strategy for its implementation. Proceeding of the annual Conference of the Australian Science Teachers Association.

Tytler, R., B. Waldrip and M. Griffiths, 2002. Talking to Effective Teachers of Primary Science. Investigating. Vol. 18, Issue 4, December.

Tytler, R., 2003. A window for a purpose: Developing a framework for describing effective science teaching and learning. Res. Sci. Edu., 33: 273-298.

Walter, S.S., M. Eileen and D.T. Sue, 1998. Effect on primary level student of inservice teacher education in an informal science setting. J. Sci. Teacher Edu., 9: 123-142.

Yıldırım, A. and H. ve Şimşek, 1991. Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Seçkin Yayınevi, Ankara.