

# วรรณะของครูผู้สอนวิทยาศาสตร์ในกรุงเทพมหานคร เกี่ยวกับการใช้สวนสัตว์เป็นแหล่งเรียนรู้

## Bangkok Elementary Science Teachers' Views on Zoos as a Learning Resource for Schools

ศศิเทพ ปิติพorphin (Sasithep Pitiporntapin)<sup>1\*</sup>

นฤมล ยุตากม (Naruemon Yutakom)<sup>2</sup>

กันทิมาภี พันธุ์วิเชียร (Kantimanee Phanwichien)<sup>3</sup>

เกเลน อีริกสัน (Gaalen Erickson)<sup>4</sup>

แดเเดวิด แอนเดอร์สัน (David Anderson)<sup>5</sup>

### บทคัดย่อ

การวิจัยนี้มีจุดประสงค์เพื่อศึกษาวรรณะของครูผู้สอนวิทยาศาสตร์ชั้วชั้นที่ 2 ในโรงเรียนสังกัดกรุงเทพมหานคร จำนวน 65 คน เกี่ยวกับการใช้สวนสัตว์เป็นแหล่งเรียนรู้ โดยใช้แบบสอบถามที่มีคำถามชนิดปลายเปิด ผลการวิเคราะห์ข้อมูลพบว่า แม้ว่าครูผู้สอนเชื่อว่าการใช้สวนสัตว์เป็นแหล่งเรียนรู้สามารถเชื่อมโยงกับเนื้อหาหลักสูตรวิทยาศาสตร์ แต่ครูผู้สอนส่วนใหญ่ไม่ได้เน้นการเชื่อมโยงความรู้ที่ได้รับจากสวนสัตว์เข้ากับการจัดการเรียนรู้วิทยาศาสตร์ ด้านการประเมินผลการเรียนรู้ของนักเรียน ครูผู้สอนส่วนใหญ่เน้นประเมินจากการรายงานที่มอบหมายให้นักเรียนทำซึ่งเกี่ยวข้องกับการศึกษานอกสถานที่ที่สวนสัตว์ ส่วนปัจจัยที่ส่งผลต่อการใช้สวนสัตว์เป็นแหล่งเรียนรู้ของครูผู้สอน ได้แก่ งบประมาณ การเดินทาง ครูผู้สอน สวนสัตว์ ผู้บริหาร โรงเรียน การวางแผนงาน และผู้ปกครอง

### ABSTRACT

This research study investigated the views on using zoos as a learning resource of 65 upper elementary science teachers in schools under the Bangkok Metropolitan Administration. The study employed an open-ended questionnaire, voluntarily completed by teachers. The data analysis demonstrated that although the teachers believed that using a zoo as a learning resource could be linked to the science curriculum, in doing

<sup>1</sup>Doctoral Candidate in Program to Prepare Research and Development Personnel for Science Education, Faculty of Education, Kasetsart University

<sup>2</sup>Assistant Professor of Department of Education, Faculty of Education, Kasetsart University

<sup>3</sup>Assistant Professor of Department of Zoology, Faculty of Science, Kasetsart University

<sup>4</sup>Professor of Department of Curriculum and Pedagogy, Faculty of Education, University of British Columbia, Canada

<sup>5</sup>Associate Professor of Department of Curriculum and Pedagogy, Faculty of Education, University of British Columbia, Canada

\*Corresponding author, e-mail: sasithep@hotmail.com

so most teachers did not emphasize linking the information gathered with science teaching. For evaluation of students' learning Outcomes, most teachers focused on student tasks related to the zoo visit. Key factors that affected teachers' use of the zoo as a learning resource included: funds, transportation, teachers, zoos, school administrators, planning, and parents.

**คำสำคัญ:** สวนสัตว์ ครุพัสดุสอนระดับประถมศึกษา โรงเรียนสังกัดกรุงเทพมหานคร

**Keywords:** zoo, elementary science teachers, schools under the Bangkok Metropolitan Administration

## Introduction

The rapid scientific and technological changes in Thailand in response to accelerating economic development promotes and supports the harvesting of natural resources which leads to a high rate of wildlife extinction. The continuous loss of many species is accompanied by a public lack of awareness and the fact that the Thai school system does not provide enough information on the extinction of wildlife to Thailand's youth (Office of Natural Resources and Environmental Policy and Planning (ONEP), 2004). Therefore, basic knowledge about animals should be provided from the elementary to the highest grade level in Thai Schools to facilitate conservation and management awareness, and to better understand how to use biological resources in a sustainable manner (Baimai and Brockelman, 1998).

To cope with this problem, the National Education Act 1999 and Amendments (Second National Education Act B.E. 2545 (2002)) in section 25 indicates that the state shall promote the running and establishment of all types of life-long learning resources (Office of the National Education Commission (ONEC), 2003). It implies that learning can take place anywhere, at any time, and at all levels within learners themselves, both inside and outside the classroom (ONEC, 2000). In addition, the Thai National Science Standards addresses the topic about animals both in Substance 1 (Living

things and living processes) and 2 (Life and Environment) at all grade levels (IPST, 2002). Within this topic, the zoo is one of many informal resources it is suggested that teachers can use to promote a formal education and awareness of conservation by providing information about animals and their natural habitats (Office of the National Education Commission (ONEC), 2003; Office of the Education Council (OEC), 2005). Several studies have demonstrated that students also enjoy studying animals in the zoo because they have the opportunity to observe animal behavior in a real context, not just learning by studying their textbooks (Melber, 2001; Crider et al., 2009). Moreover, other studies suggest that students' field trip experiences to zoos are in fact powerful mediators of learning about animals connected with the school curriculum (Crider, et al., 2009; Lawson, 2007). However, many schools are failing to make effective use of the educational potential of zoos (Tunnicliffe, 1997; ONEC, 2005). Therefore, the quality of an excursion to the zoo undoubtedly depends on the inclinations and capabilities of teachers (Crider et al., 2009). However, in the current situation, the teachers in Thailand and other educational systems around the world make little effort to link topics studied in the classroom with informal learning environments (Griffin and Symington, 1997; Anderson et al., 2006). In schools within the Bangkok Metropolitan Administration, there also exists the compounding problem that many

teachers lack knowledge and experience of science teaching. Moreover, as is the case with many teachers in formal educational contexts around the world, they have many other teaching and personal responsibilities and too little time to attend to current issues and educational news (Chaihongkum, 2005).

There is a large literature on why teachers' beliefs are important and how they affect teaching practices and behavior (Pajares, 1992; Tobin, et al., 1994; Loucks-Horsley, et al., 2003). Pajares (1992) indicated that the beliefs that the teachers held can guide their decisions and actions which have an impact on their students. In addition, Tobin et al. (1994) argued that the beliefs can predict how and why they act. Therefore, the teachers' views on the use of zoos as a learning resource and the factors that they face in the development of an excursion are important factors that profoundly influence their use of the zoo as a learning resource (Anderson et al., 2006). This study is significant because it provides preliminary data for institutes, schools, and universities that are involved in professional development, and will yield practical guidelines which will enhance elementary science teachers' using the zoo as a learning resource. For this study, elementary teachers' views on using the zoo as a learning resource included the teachers' knowledge, beliefs, and opinions about planning, implementing, and evaluating an excursion to the zoo as part of teaching and learning science in the classroom.

## Objective

The purpose of the study was to understand these views and determine the factors that affected their use of the zoo as a learning resource. Two questions guide this investigation: 1) What are the elementary teachers' current views on using the zoo

as a learning resource? 2) What are the factors that affected their use of zoos as a learning resource to support the school curriculum?

## Methodology

This investigation focused on a survey. The survey is used as methodology to explore various phenomena and conclude about the relationship between them in patterns of cause and effect (Henn et al., 2006). Therefore, the *View on Using the Zoo as a Learning Resource* (VUZLR) questionnaire was developed to include closed and open-ended questions to explore elementary science teachers' current views on science teaching and learning about animal content in the first semester of the 2008 academic year. The researchers developed a framework for the questionnaire by reviewing the national science curriculum, documents, text books, and related research about using the zoo as a learning resource. The framework for the questionnaire included demographics, the elementary science teachers' views on their objectives for using the zoo as a learning resource, how to link the zoo with science content, the strategies of using the zoo as a learning resource, students' learning from using the zoo as a learning resource, and factors that affect using the zoo as a learning resource. The early draft was reviewed by three experts. Two experts were teachers who have much experience in teaching animal content and one expert was a science educator in the Science Education Department of a university. The VUZLR was sent to them for their approval of the format, content, and wording. Feedback involved clarifying jargon and ambiguous items, eradicating redundancy, and adding items to ensure a broad sampling of questions. The VUZLR was piloted with three elementary science teachers from one school within the public schools

educational district under the Bangkok Metropolitan Administration, which was not the school of the participants. The researchers revised the VUZLR and checked for internal validity by the three experts just mentioned

For the implementation of the questionnaire, the researchers distributed the VUZLR by mailing. A 25% random sampling of 433 schools under the Bangkok Metropolitan Administration determined the 108 schools on which the study was based. To maximize response rates, participants were informed that the results would be kept strictly confidential and a letter commending their views would be sent to their administrators. There were 66 from 108 upper elementary science teachers who sent the questionnaires back to the researchers. However, there was one questionnaire that was answered from an elementary science teacher who taught at other grade levels. The result in the response rate was approximately 60%. Therefore, the samples in this study were 65 upper elementary science teachers (Grade 4-6) who taught topics about animals. Most respondents were female. The most predominant range of age was 31-40 years old. Most teachers had graduated with a bachelor's degree in Science or Science Teaching. For teaching and learning, most teachers had 5-10 years of teaching experience. The number of students per classroom was between 31-40 students. Most schools took students to Safari world. The greatest frequency of excursions to zoo was once a year.

For data analysis, the data from each respondent in the VUZLR used descriptive statistics to identify which categories were most commonly answered in the questionnaires.

## Results

This section presents the findings from examining elementary science teachers' views on using the zoo as a learning resource. There are five topics in this section: views on their objectives for using the zoo as a learning resource, science content that could be linked to the zoo experience as a learning resource, the strategies of using the zoo as a learning resource, students' learning from using the zoo as a learning resource, and factors that affect using the zoo as a learning resource.

### 1. Views on objectives for using the zoo as a learning resource

Typically, the teachers' objectives for using the zoo as a learning resource were to connect to the curriculum and to provide students' opportunities to see real animals and get direct experience. A few teachers were concerned with promoting students' awareness about animal conservation, in motivating students' interest about animals, in promoting lifelong learning, and in enhancing students' enjoyment and relaxation about learning. These views are presented below in Table 1.

**Table 1.** Views on the objectives for using the zoo as learning resource

Students' learning	Example of the teachers' answers	Frequency (Percentage)
Connection to the curriculum	To promote students' learning related to animals' living and behaviour, animal classification, and animal propagation.	31 (62)
Promotion of students' direct experience	To provide students with opportunities to see real animals and get direct experience	10 (20)
Promotion of students' awareness about animal conservation	To promote students with awareness about endangered species and conservation	3 (6)
Motivation of students' interest about animals	To motivate students' interests about animals because the zoo had a lot of animals that were more interesting than studying by animal pictures in textbook	3 (6)
Promotion of lifelong learning	To promote students' awareness so that they can learn from everything around them	2 (4)
Enhancement of students' enjoyment and relaxation	To help students enjoy learning about animals outside the classroom experience	1 (2)

## 2. Views on science content that can be linked to the use of the zoo as a learning resource

Teachers identified a wide diversity of connections that could be made between the zoo experience and the school curriculum. Data analysis showed that most teachers viewed that what was

learned at zoo could be linked to content about the *living things and living processes*. Other content that teachers could link to were *animal diversity, life and the environment*. A few teachers felt that parks in zoos could be linked to the topic about plants, soil, and rocks in local areas and all content could be linked to using the zoo as a learning resource. These views are presented below in Table 2.

**Table 2.** Views on science content that can be linked to the use of the zoo as a learning resource

Topics	Example of the teachers' answers	Frequency (Percentage)
Living things and living processes	Animal bodies and systems, life cycle, reproduction and propagation, behaviour, food, habitat, growth	58 (45)
Animal diversity	Animal classification, genetics and genetics transferring, and animal kingdom.	34 (26)
Life and environment	Ecology, the relationship between groups of living things in different habitats, food chains, the relationship between the environment and living things, local natural resources, the care and preservation of natural resources and the environment	30 (23)
Plants, soil, and rocks in local areas	The park in the zoo could be linked to the topic about plants, soil, and rocks in local areas.	6 (5)
All content	The zoo as learning resource could be linked to all content which depends on teachers.	2 (2)

### 3. Views on the strategies of using the zoo as a learning resource

Most teachers felt that they did not have specific plan to link knowledge in the zoo with teaching and learning in the classroom but some teachers did have a plan. The researcher divided teachers' strategies of using the zoo as a learning

resource into three groups: *unfocused strategies*, *moderately-focused strategies*, and *focused strategies*. The strategy that most teachers used was moderately-focused strategy. The next strategy that teachers used was focused strategy which focused on linking science content to using the zoo as a learning resource. A few teachers felt that they used unfocused strategies. These views are presented below in Table 3.

**Table 3.** Views on the strategies of using the zoo as a learning resource

Strategies	Example of the teachers' answers	Frequency (Percentage)
Moderately-focused strategies	There could be individual or group activities to help explore something in the zoo. Students had to complete worksheets. When the students went back to school, teachers might ask students to summarize their knowledge and report on what they learned in front of the class.	23(64)
Focused strategies	The teachers might set up activities at particular sites specifically related to science concepts. When the students went back to school, teachers used students' answers in worksheets to set up student learning activities to accomplish science concepts according to the objective(s).	10(28)
Unfocused strategies	Students did activities according to the zoo or the private company that set up the trip. When the students went back to school, if the science content that teachers taught could link to students' learning in the zoo, the teachers would tell their students.	3(8)

### 4. Views on students' learning from using the zoo as a learning resource

Most teachers viewed that they could know students' learning outcomes from checking the students' tasks such as the answers in worksheets, exercises, tests, essays, and reports. In addition, some teachers thought that they could understand students' learning outcomes from students' performances such

as enthusiasm or interest in studying animals in the zoo, showing their happiness, communicating about their learning, answering oral questions, discussing their opinions, and making suggestions. Moreover, some teachers viewed that they could know students' learning outcomes based on students' opinions from questionnaires, conversation, or evaluation forms. These views are presented below in Table 4.

**Table 4.** Views on students' learning outcomes from using the zoo as a learning resource

Evidences of students' learning outcomes	Examples of the teachers' answers	Frequency (Percentage)
Students' tasks	The answers in worksheets, exercises, tests, essays, and reports.	34 (62)
Students' Performances	Students' enthusiasm or interest in studying animals in the zoo, students' behaviour that showed their happiness, students' willingness to communicate what they learned, how they answered question, discussed their opinions, and made suggestions.	14 (25)
Students' opinions	The answers in questionnaires, conversation, or evaluation forms.	7 (13)

### 5. Views on factors that affected using the zoo as a learning resource

Most teachers viewed that the factor which most affected their use of zoos as a learning resource

was funds. In addition, some teachers viewed that the factors that affected teachers' use of zoos as a learning resource also were transportation, teachers, zoos, school administrator, planning, and parents. These are outlined in Table 5.

**Table 5.** Views on factors that affected using the zoo as a learning resource

Factors	Example of the teachers' answers	Frequency (Percentage)
Funds	1: Supporting funds from schools, communities, and private companies make it convenient to use the zoo as a learning resource. 2: The schools did not have enough funds.	26 (12) 39 (18)
Transportation	1: The zoo was not far from school, so the teachers could provide vehicles at a reasonable fee and safely. 2: The distance between the school and zoo was far, and the school lacked vehicles to take students to the zoo.	5 (2) 34 (16)
Teachers	1: The teachers prepared worksheets, time for each activity, and follow up activities in the classroom. 2: Each teacher had many responsibilities and tasks so they did not have enough time to plan activities for using the zoo as a learning resource.	34 (16) 1 (1)
Zoos	1: There is animal and plant diversity, media, zoo curators, and activities at the zoo to promote student learning. 2: The activities the zoo set up were not new and attractive and there were not enough zoo curators to explain about the animals.	27 (12) 7 (3)
School administrations	1: The awareness of using the zoo as a learning resource. 2: The school administrators had the power to make all decisions about learning outside the classroom.	20 (9) 4 (2)
Planning	1: Having appropriate schedules and enough time for each activity supported using the zoo as a learning resource. 2: The time was quite limited for each activity and the weather was not appropriate.	1 (1) 16 (7)
Parents	1: Parents participated in excursions and helped teachers to look after the students. 2: The parents did not permit students to go to the zoo.	3 (1) 2 (1)

1= positive view 2= negative view

## Summary and discussion

This study showed that a lot of teachers wanted to link the use of zoos with school curricula and to promote student direct experience. This finding is similar to that of Falk et al. (1998) and Kisiel (2005), who found that many teachers think that field trips provide students with the types of experiences that are important to spark their interest and to link their knowledge in meaningful ways to science curriculum content. However, there were some teachers in the current study who thought that using the zoo as a learning resource could promote life long learning and could be integrated to all content.

Concerning views on science content that could be linked to the zoo experience as a learning resource, five topics were identified by the teachers: the living things and living processes, animal diversity, life and the environment, plant, soil, and rock in local area, and all contents which could link to using the zoo as a learning resource. To support these ideas, Orion (1993) suggested that field trips should be an integral part of the curriculum in order to promote students' learning and enjoyment while observing, exploring, and investigating several kinds of animals.

The teachers' strategies of using the zoo as a learning resource in this study were divided into three groups Moussouri (1997) argued that. He argued that visitors use three types of strategies when using the zoo as a learning resource: unfocused strategies, moderately focused strategies, and focused strategies. Visitors with an unfocused strategy did not have a specific plan for visiting. They can see whatever is offered or interesting. For visitors using moderately focused strategies, they may plan to see one or more particular exhibitions, but the specific exhibition or

aspect of these areas does not represent their sole objective. Finally, visitors with focused strategies have a plan and a goal before they visit the zoo. Moussouri claimed that visitors who use focused strategies will receive more knowledge than those who visit using the other two strategies. The strategy that most teachers in this study used was a moderately-focused strategy rather than a focused strategy. Therefore their activities in the zoo did not emphasize much on the making of links to science content in the classroom. This finding is similar to Anderson and Zhang (2003) who found that although teachers had positive views about the importance of using learning resources outside school, these teachers did not link students' experience with these informal learning resources to learning in the classroom to the curriculum. Therefore, there were not many teachers making connections between curriculum objectives and the field trip experience (Kisiel, 2005).

For examining the students' learning, the teachers thought that they could gauge students' learning outcomes by checking the students' tasks, students' performance, and students' opinions. These views showed that most teachers focus on students' tasks related to the zoo. They did not consider the students' learning process, which is the key to construct knowledge through activities such as doing hands-on activities or exchanging ideas with their friends. These views are similar to Griffin (2007), who found that many teachers did not emphasize students' learning processes in the zoo.

The factors that affected teachers' use of zoos as a learning resource in this study were funds, transportation, teachers, zoos, school administrators, planning, and parents. There is a lot of research which supports this finding suggesting that before taking students to the zoo, teachers should consider the following: the funding of the trip (Anderson and

Zhang, 2003; Coll et al., 2003 Noymai, 2004 Kisiel, 2005), and transportation (Orion, 1993; Anderson and Zhang, 2003; ). The teacher also should have prepared how the knowledge learned on field trip might be linked to the curriculum (Orion, 1993). In addition, teachers also take into consideration the students' safety (Orion, 1993; Noymai, 2004), as well as how they will prepare for different weather conditions during the excursion (Orion, 1993).

From the results of this study, there are a lot of recommendations for school administrators, teachers, and researchers. School administrators should give opportunities to teachers to decide the area of excursion. Moreover, an expert could work with teachers both prior and during trips to zoos to point out where and how to link curriculum and zoo knowledge. For future study, the researcher could do an in-depth study about how the upper elementary science teachers typically use the zoo as a learning resource to link with science content. Moreover, the researcher could study the students' views about the zoo as a learning resource in order to find the appropriate ways of connecting curriculum knowledge with knowledge gained by visiting the zoo.

## References

Anderson, D., Kisiel, J. and Storksdieck, M. 2006. Understanding Teachers' Perspectives on Field Trips: Discovering Common Ground in Three Countries. *Curator* 49(3): 365-386.

\_\_\_\_\_, and Zhang, Z. 2003. Teacher Perceptions of Field-Trip Planning and Implementation. *Visitor Studies Today* 6(3): 6-11.

Baimai, V. and Brockelman, W. Y. 1998. Biodiversity Research and Training Program in Thailand. *Pure and Applied Chemistry* 70(11): 2073-2078.

Chaihongkum, P. 2005. **Current Situation and Problems in Teachers Development of Primary Schools in Accordance with the 6<sup>th</sup> Educational Development Plan of Bangkok Metropolitan Administration.** Master Thesis, Kasetsart University Bangkok.

Coll, R. K., Tofield, S., Vyle, B., and Bolstad, R. 2003. Free-Choice Learning at Metropolitan Zoo. *Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching* (Philadelphia), PA, March 23-26.

Crider, S., Passmore, C. and Anderson, D. 2009. Learning on Zoo Field Trips: The Interaction of Students', Teachers', and Zoo Educators' Agendas and Practices. *Science Education* 94 (1) : 122-141.

Falk, J. H., Moussouri, T. and Coulson1, D. 1998. The Effect of Visitors' Agendas on Museum Learning. *Curator* 41(2): 107-120.

Griffin, J. 2007. Students, Teachers, and Museums: Toward an Intertwined Learning Circle. **In Falk, J.H., Dierking, L.D., Foutz, S.(Eds.) 2007. In Principle, In Practice: Museums as Learning Institutions.** s(pp.31-42), Lanham, MD: AltaMira Press.

\_\_\_\_\_, and Symington, D. 1997. Moving from Task-Oriented to Learning-Oriented Strategies on School Excursions to Museums. *Science Education* 81(6): 763-779.

Henn, M., Weinstein, M., Forard, N. 2006. **A Short Introduction to Social Research.** London: SAGE Publications Ltd,

Institute for Promotion of Teaching Science and Technology (IPST). 2002. **The Manual of Science Learning Management under the Basic Education Curriculum B.E. 2544.** Bangkok: Karusapa Press.

Kisiel, J. F. 2005. Understanding Elementary Teacher Motivations for Science Fieldtrips. **Science Education** 89: 936-955.

Lawson, B. 2007. **Understanding Young Children's Agendas, Experiences, and Learning from a Field Trip to a Zoo.** Unpublished Masters of Education Thesis. University of British Columbia, Vancouver, Canada.

Loucks-Horsley, S., Love, N., Stiles, K. E., Mundry, S. and Hewson, P.W. 2003. Designing Professional **Development for Teachers of Science and Mathematics.** The National Institute for Science Education. California: Corwin Press, Inc.

Melber, L. M. 2001. Why Are They Doing That? Animal Investigations at the Local Zoo. **Science Activities** 37(4): 10-14.

Moussouri, T. 1997. Family Agendas and Family Learning in Hands-on Museums. In Falk, J. H., Moussouri, T., and Coulson1, D. 1998. The Effect of Visitors' Agendas on Museum Learning. **Curator** 41(2): 107-120.

Noymai, I. 2004. Organizing Field Trips for Integrated Learning. **Journal of Education** 16(1): 1-14.

Office of Natural Resources and Environmental Policy and Planning (ONEP). 2004. "Thailand's Biodiversity" [Online] [Cite 6 January 2008.] Available from : [http://www.chm-thai.onep.go.th/Publication/ThaiBiodiv/ThailandBiodiversity\\_eng.pdf](http://www.chm-thai.onep.go.th/Publication/ThaiBiodiv/ThailandBiodiversity_eng.pdf).

Office of the National Education Commission (ONEC). 2000. **Learning Reform: Learner-centered approach.** Bangkok: ONEC.

Office of the Education Council (OEC). 2005. **Research Report about Teaching and Learning with life - Long Learning Resources : Zoo.** Bangkok : OEC.

\_\_\_\_\_. 2003. **National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002)).** Bangkok: Pimdeekanpim Co., Ltd.

Orion, N. 1993. A Model for the Development and Implementation of Field Trips as an Integral Part of the **Science Curriculum. School, Sciences and Mathematics** 93(6): 325-330.

Pajares, M. F. 1992. Teachers' Beliefs and Educational Research: Cleaning up a Messy Construct. **Review of Educational Research** 62(3): 307-332.

Tobin, K., Tippins D. J., and Gallard, A.J., 1994. "Research on Instructional Strategies for Teaching Science". In Gabel, D.L. (Ed.). **Handbook of Research on Science Teaching and Learning.** New York: Macmillan.

Tunnicliffe, S. D. 1997. School Visits to Zoos and Museums: A Missed Educational Opportunity? **International Journal of Science Education** 19(9): 1039-1056.