

# Application of Inquiry- Based Teaching Learning Model to Improve Learning Outcomes

M. Chotibuddin<sup>1</sup>

<sup>1</sup>STIT Muhammadiyah Paciran, Islamic Religious Education, Lamongan, East Java, Indonesia

Ahmad Iwan Zunaih<sup>2</sup>

<sup>2</sup>STIT Muhammadiyah Paciran, Islamic Religious Education, Lamongan, East Java, Indonesia

Subhan Adi Santoso<sup>3</sup>

<sup>3</sup>STIT Muhammadiyah Paciran, Islamic Religious Education, Lamongan, East Java, Indonesia

**Abstract:- English is an important thing to learn. However, many students have difficulty in learning English. The difficulty of students in learning English subjects for students is due to the conventional methods applied by teachers making students less proactive in learning. Teachers as educators must innovate in learning methods so that students can be more proactive in English learning activities. One method that can be used is the inquiry learning method. The Use of Inquiry Method in Improving English Learning Outcomes of Grade VII MTs Muhammadiyah 17 Lamongan. The purpose of this study is to describe the steps of inquiry method in improving English learning outcomes in fifth grade elementary school and identify the obstacles and solutions of using inquiry method in improving English learning outcomes in seventh grade of Islamic Junior High School Muhammadiyah 17 Lamongan. The inquiry learning strategy is a useful learning model used in modern learning (3) Inquiry learning is a process that provides opportunities for students to be actively involved in learning activities (4), Increased student activity in inquiry learning occurs in conducting investigations, answering, responding, expressing ideas, and drawing conclusions based on solutions obtained from problem solving (5). This research is a classroom action research (PTK) carried out in three cycles, each cycle includes planning, implementation, observation and reflection. Data were analysed using the Miles and Huberman interactive model which consists of three components, namely: data reduction, data display, and conclusion drawing/verification. The results showed that (1) the steps of the inquiry method can be carried out in accordance with the scenario, (2) the use of the inquiry method can improve the English learning outcomes of seventh grade students of SMP Islam Muhammadiyah 17 Lamongan. The increase in English learning outcomes from the pre-test was 40%, in the first cycle was 60%, in the second cycle was 73% and the third cycle increased to 80%.**

**Keywords:- Inquiry, Management, Education Management, Language, Education.**

## I. INTRODUCTION

English language learning equips students with critical and creative thinking skills, as well as collaboration (Agbi & Yuangsoi, 2022). These competencies are given so that students can have the ability to obtain, manage, and utilise information to solve the problems they face (Ibrahim & Kusuma, 2020). The success of English language learning depends on students in the teaching and learning process, while the success of students does not only depend on educational facilities and infrastructure, as well as the curriculum. However, teachers in the learning process can also affect the improvement of language learning outcomes in accordance with the learning carried out by the teacher (Iakovos, 2011; Rahman & Manaf, 2017; Bedir, 2019; Choudhary, S. 2011; Li, N. 2013; Wang, 2014).

Based on the results of observations in the learning process in the classroom, school conditions, and through academic and non-academic reviews, it was found that SMP Islam Negeri Muhammadiyah 17 Lamongan, especially class VII students in 2016/2017 in English language lessons, had not shown learning outcomes in accordance with the specified KKM (Minimum Completeness Criteria). Judging from the physical condition of the school, classroom VII is good and suitable as a place for the teaching and learning process. Observations of the learning process conducted by researchers can be concluded that the implementation of the teaching and learning process has not made students active in learning, so that students' abilities have not been maximally explored. The use of learning methods in learning English is not appropriate and makes students look not eager to learn. Teachers still focus on explaining the material and students only carry out orders to do the questions without instilling a strong learning concept (Kivunja, 2015; Pifarré & Kleine Staarman, 2011; Raikhanova & Kassymova, 2019; Morgoun, Kozharskaya & Kozhevnikova, 2021).

To obtain optimal learning outcomes not only requires continuous practice, but first students must know the essence of the material being studied. Based on this concept, they are enthusiastic, actively learning and trying to find solutions to problems given by the teacher using their own abilities. With students' enthusiasm or motivation in learning and well- embedded concepts, it is expected that students are able to complete each task given with the

correct procedure, so that the learning outcomes obtained are better than before (Şendağ & Odabaşı, 2009; Kruger, 2012; Gallavan & Kottler, 2012; Chu, Tse & Chow, 2011).

Therefore, a solution is needed to overcome the obstacles that occur. One of them is by using the inquiry method in learning English. The inquiry method is a way of presenting lessons that provides opportunities for students to seek and find information with or without the help of the teacher. student-centred learning, so that students are expected to be more active, enthusiastic, and brave in finding solutions to the problems they face, and allow students to find the information they need themselves.

Duran and Dokme [6] conveyed that the inquiry approach makes students more active in the learning process because the inquiry approach is student-centred. Inquiry allows students to make decisions about the problems they investigate, helping to move them towards meaningful engagement and deeper learning [3]. Inquiry learning is a process that provides opportunities for students to be actively involved in learning activities [4].

Based on the description above, the problem formulations that arise are 1) how is the use of the inquiry method in improving the English learning outcomes of seventh grade students at SMP Islam Muhammadiyah 17 Lamongan in the 2021/2022 academic year? 2) can the use of the inquiry method improve the English learning outcomes of seventh grade students at SMP Islam Muhammadiyah 17 Lamongan in the 2021/2022 academic year? 3) what are the obstacles and solutions to the use of the inquiry method in improving the English learning outcomes of seventh grade students at SMP Islam Muhammadiyah 17 Lamongan in the 2021/2022 academic year?

The objectives of this study are 1) to describe the steps of using the inquiry method, 2) to find out the improvement in English learning outcomes, and 3) to find out the obstacles, as well as solutions in using the inquiry method in improving students' English learning outcomes. class VII SMP Muhammadiyah 17 Lamongan in the 2021/2022 academic year.

## II. LITERATURE REVIEW

Education management is a process of planning, organising, directing, supervising, and assessing educational efforts in order to achieve educational goals that have been set before. Or another definition of education management is a form of cooperation between educational parties in order to achieve an educational target that has been set before. The general goal in education management is to carry out a formation of the student's personality based on the objectives of national education and the level of development or improvement for the age of education.

Independent learning means students can solve complex problems not only from existing definitions [7] Students are also guided to investigate a concept in the process of learning by doing [8]. One model that suits this

purpose is the guided inquiry model. In the guided inquiry model, students are required to be more active in learning, not just passive in learning, and relying on what is taught by the teacher. The guided inquiry model is a learning model that is constructivism, meaning that students are required to find the meaning of what is being learned [10], in other words students direct to explore and hypothesise the problems given in a learning process [11]. In more detail, it is explained that the guided inquiry model is learning that will make students more active, creative, critical and able to develop their ideas freely and deeply, so that they can express their imagination and thoughts [12]. Furthermore, in the guided inquiry model, students are guided to find concepts in the learning process from various sources of information so that they can find new understanding. The guided inquiry model has advantages, including: (1) Students will understand basic concepts and ideas better; (2) Helps in using memory or cognitive abilities and connecting in the lesson being studied; (3) Encourages students to take the initiative and formulate their hypotheses; (4) provides deep satisfaction with what has been discovered; (5) The learning process becomes more meaningful [12]. The steps taken in the guided inquiry model are: (1) Planning phase; (2) Retrieval phase; (3) Processing phase; (4) Creation phase; (5) Sharing phase; (6) Evaluation phase [13].

In the application of the guided inquiry model, the learning media used by the teacher can also assist students in finding solutions to the problems presented [14] From the results of previous studies, it can be concluded that the guided inquiry model can influence and improve several student learning abilities. [15] Furthermore, students' activities in Open-Inquiry Approach learning experienced a proper development cycle. Students' positive response to the Open-Inquiry Approach can be seen from the active and interesting attitude of students directly involved in the learning process [16].

## III. METHOD

The research was conducted in class VII MTs Muhammadiyah 17 Lamongan. The number of research subjects was 15 students consisting of 8 male students and 7 female students. The research was conducted from March to March June 2017 even semester of the 2021/2022 school year. Data collection tools in this study are divided into two, namely tests and non-tests. Tests were in the form of question sheets to evaluate English learning outcomes, and non-tests consisted of observations and interviews. In the implementation of the action, the researcher was observed by three observers whose job was to observe and provide input for the course of the research. The data obtained in this study are divided into two, namely pre-action data and action data in the form of research results. The research data is in the form of observation of the steps of using the inquiry method in learning English, students' responses to ongoing learning, and written test results.

Data analysis was carried out through qualitative analysis referring to the opinion of Miles and Hiberman (1984), including three lines of activity, namely data

reduction, data presentation, and conclusion drawing, which was carried out during and after data collection was completed (Sugiyono, 2008: 246-253). To test and maintain the validity of the data, a data triangulation method was used involving researchers, grade VII teachers, peers, and grade VIII teachers.

This research procedure uses the class action research method. The steps or procedures of classaction research are action planning, action implementation, observation, and reflection. In the planning stage, researchers make action plans or learning scenarios, collect materials and make learning media, make assessment sheets, and make observations. The implementation stage used the Kemmis and Taggart model which includes four stages, namely planning, action, observation, and reflection (Wiriaatmadja, 2008). In its implementation, these stages are always related and continuous in the process, and experience improvements until they achieve the expected results or goals.

**IV. RESULTS**

The improvement of English learning outcomes by using the inquiry method in the learning of seventh grade students of MTs Muhammadiyah 17 MTs Muhammadiyah 17 Lamongan was carried out with three cycles. Each cycle consists of three meetings, with a time allocation of 2x35 minutes for each meeting. The results of the action during the three cycles can be seen from the steps of using the inquiry method according to the scenario and the learning outcomes obtained by students during the implementation of the action. Based on the research results from cycle I to cycle III, it can be said that the steps of using inquiry methods in learning English are in accordance with the scenario or planning. The results of observations of the steps of using inquiry methods in learning by teachers in cycle I to cycle III can be seen in the following table:

Table 1 Teacher's Observation Results in Cycle I, II and III

Steps of inquiry learning		
Cycle I	Cycle II	Cycle III
3.21	3.47	3.75

Based on table 1, it can be concluded that the average score on the steps of using the inquiry method by the teacher in cycle I reached 3.21, in cycle II reached 3.47, and in cycle III reached

3.75. The average score of the steps of using the inquiry method by the teacher is 3.47 and is included in the good category. The results of observations of the steps of using inquiry methods in learning English by students in cycle I to cycle III can be seen in the following table:

Table 2 Student Observation Results on Cycle I, II, III

Inquiry learning steps				
Cycle I	Cycle II	Cycle III	Average Value	Category
3.35	3.57	3.69	3, 54	Good

Based on table 2, it can be concluded that the average value of the steps of using the inquiry method by students in

cycle I reached 3.35, while in cycle II it reached 3.57, and in cycle III it reached 3.69. The average value of the steps of using the inquiry method by the teacher reached

3.54 and was included in the good category. Based on the two tables above, it can be concluded that teachers and students performed the steps of using the inquiry method in learning English well and in accordance with the scenario or plan. During the implementation of the action, improvements were made to the steps of using the inquiry method. The improvements or changes that researchers make in terms of realisation in learning, so that the main steps do not change and are in accordance with the underlying theory using the inquiry method.

English with Inquiry method includes teacher and student activities. The focus of student observation is on the responses given by students during the learning process. Teachers' activities in using the steps of inquiry method in English learning include: creating cooperation with students in formulating problems, providing opportunities for students to make learning hypotheses (problems), guiding students in finding or collecting relevant information, forming and guiding students in working groups or discussions to process data (information), providing opportunities and stimuli so that students can prove initial answers based on the results of their discussions, and jointly concluding the results of discussions and learning. Furthermore, students' activities or responses in learning English with the inquiry method include: focusing students' attention on the material presented, students' activeness in learning, students' enthusiasm in learning, students' activeness in discussion activities, students' cooperation in learning, completing assignments or worksheets. This is in accordance with Supriyadi's opinion that the use of inquiry methods in learning begins with providing stimulation or stimulation to students, providing opportunities for students to formulate hypotheses. Based on the formulation of the problem, data collection, data processing in learning discussions, proving the truth of the hypothesis, and drawing learning conclusions (2009).

Therefore, with the learning process there are certainly learning outcomes achieved by students.

Learning outcomes are in the form of the results of answering questions given by the teacher in English questions from pre-action, cycle I to cycle III with the hope that the results will improve. The acquisition of students' English learning outcomes in the pre-test of cycles I to III, as follows:

Table 3 English Language Learning Outcomes

Treatment	English learning out comes			
	Passed		Not passed	
	Freq	%	Freq	%
Pretests	6	40	9	60
Cycle I	9	60	6	40
Cycle II	11	73,3	4	26,6
Cycle III	12	80	3	20

Based on table 3, it can be seen that the English learning outcomes of seventh grade students are increasing. This is shown in the pre-test or initial test activities, students who achieved learning outcomes were 6 students. In cycle I, the percentage of students' achievement of English learning outcomes increased by 20% to 60% or 9 students. Furthermore, in cycle II the percentage of students who achieved KKM (minimum completeness criteria) 73.3% or 11 students. Meanwhile, in cycle III, the percentage of students who achieved mastery of English learning outcomes was 80% or 12 students. Students who have not completed or the value of learning outcomes < KKM is 20% or as many as 3 students.

The application of the inquiry method in learning English according to the scenario in class VII MTs Muhammadiyah 17 Lamongan in the 2021/2022 academic year is one of the ways or steps to improve student learning outcomes. The use of inquiry methods in English language learning provides opportunities and facilities for students to seek and find concepts or core material, and solve problems. Students become more active in developing their abilities because students build their own knowledge and skills through learning activities to search, find, and conclude agreed learning.

With good mastery of concepts or materials and the ability of students to use their skills in practising problem solving well, their learning outcomes will improve. Before using the steps of using the inquiry method in English learning, students were directly directed to practice solving problems. However, with the steps of the inquiry method in English learning, students are equipped with concepts and learning experiences so that it will be easier to solve or solve learning evaluation questions. This is in line with the opinion of Buchari Alma who states that the advantage of the inquiry method is that it can encourage students to act actively in finding answers to the problems they face by drawing their own conclusions by thinking scientifically, logically, and systematically. Thus the use of the inquiry method can improve student learning outcomes because students acquire problem-solving skills or problems based on steps they make themselves (2010).

The obstacles or constraints that arise in using the inquiry method in improving the learning outcomes of English language students in class VII MTs Muhammadiyah 17 Paciran in the 2021/2022 academic year include: the learning habits of some students who are still teacher-centred (conventional), the time used in English language learning is often ineffective, most students' learning resources are still centred on the books provided, and there are still students who have the ability to learn English.

This is in line with the opinion of Sumantri and Permana who stated that the weaknesses of the inquiry method include: requiring adequate facilities, the difficulty of changing student learning from conventional to active, the freedom given by the teacher is sometimes not maximally utilised by students. This is in line with the opinion of Sumantri and Permana who state that the weaknesses of the

inquiry method include: requiring adequate facilities, the difficulty of changing student learning from conventional to active, the freedom given by the teacher is sometimes not maximally utilised by students, so that the time required increases. much or ineffective (2001: 143-144). The problem solving carried out by researchers included: giving quizzes or focused questions, so that students have motivation and limitations to find answers, the division of study groups by researchers was carried out before the lesson began and tried to be different in each lesson. meeting with the aim of creating good cooperation between students. students, as well as optimal use of learning media and libraries as learning resources other than books. For students who experience learning delays, the handling will be handed over to the class teacher with the consideration that they know the characteristics of their students better. Furthermore, the researcher concluded that the success of this study was also determined by the strategy in practising the steps of using the inquiry method in English language learning during the implementation of the action. In addition, classroom management needs attention so that all students are well controlled during learning. Provision of educational facilities, books and learning media that are relevant to the material and in accordance with the number of grade V students. Students are more controlled in learning. Then, students' activeness in question and answer activities, assignments, and discussions during the implementation of actions, especially in cycles II and III, can improve English learning from teachers and students. This ultimately had a positive influence on improving the English learning outcomes of grade V students. This is in line with the opinion expressed by Akhmad Sudrajat that in the steps of using the inquiry method, the teacher should provide space for students to learn actively according to their learning style, and the role of the teacher, facilitator and supervisor (control). learning to students (2011: 135-136).

## V. DISCUSSION

The practical inquiry method can make students more active in learning activities because it does not only rely on the teacher. The inquiry method is easy to use in the learning process and can be used as an alternative learning method to the lecture method,

Based on the results of research on the use of the inquiry method in improving the learning outcomes of seventh grade students of MTs Muhammadiyah 17 Paciran in the 2021/2022 academic year, it can be concluded that the use of the inquiry method in learning English is in accordance with the scenario and can improve the English learning outcomes of seventh grade students of MTs Muhammadiyah 17 Paciran in the 2021/2022 academic year.

Furthermore, from the results of the above research, the researcher provides suggestions to schools, especially fifth grade teachers. In learning English, the subject of fractions can use the inquiry learning method because it can stimulate students to be active and enthusiastic in learning, so that student learning outcomes increase.

➤ *Managerial Implications*  
For School Management

To improve innovation performance, schools must be more proactive in responding to various issues related to changes in the school environment both internally and externally. These changes must be responded wisely through *research and development* activities so that schools can maintain their existence in the future.

It is expected that the school can maintain some core subjects that have been carried out well even though it is not optimal, it must still be carried out in accordance with making a vision and mission, culture and values, core competencies, SOPs, Jobdisc, KPIs and standardisation in all parts of the HR line.

### REFERENCES

- [1]. Agbi, A., & Yuangsoi, P. (2022). Enhancement of critical thinking skills in students using mobile-blended learning with a collaborative inquiry-based approach. *Humanities, Arts and Social Sciences Studies (FORMER NAME SILPAKORN UNIVERSITY JOURNAL OF SOCIAL SCIENCES, HUMANITIES, AND ARTS)*, 9-20.
- [2]. Alma, B. 2010. Professional Teachers Mastering Teaching Methods and Skilled. Bandung:Alfabet.
- [3]. Bedir, H. (2019). Pre-service ELT teachers' beliefs and perceptions on 21st century learning and innovation skills (4Cs). *Journal of Language and Linguistic Studies*, 15(1), 231-246.
- [4]. Buchanan, et al., "Inquiry-Based Learning Models, Information Literacy, and Student Engagement", *School Libraries Worldwide*, 22(2), pp. 23-39. 2016.
- [5]. C. Kuhlthau, "Guided inquiry: School libraries in the 21st century," *School libraries worldwide*, vol. 16, no. 1, pp. 17-28, 2010.
- [6]. Nwagbo, "Effects of two teaching methods on the achievement in and attitude to biology of students of different levels of scientific literacy," *International Journal of Educational Research*, vol. 45, no. 3, pp. 216-229, 2006.
- [7]. Chu, S. K. W., Tse, S. K., & Chow, K. (2011). Using collaborative teaching and inquiry project-based learning to help primary school students develop information literacy and information skills. *Library & Information Science Research*, 33(2), 132-143.
- [8]. Choudhary, S. (2011). A literary approach to teaching English language in a multi-cultural class-room. *Higher Learning Research Communications*, 6(4), 8.
- [9]. M. Hanson, *Instructor's guide to process-oriented guided-inquiry learning*, Lisle, IL: PacificCrest, 2006.
- [10]. T. Chin, Y. T. Lin, C. T. Chien and H. L. Tuan, "Collaborative action research on implementing inquirybased instruction in an eighth grade mathematics class: an alternative mode for mathematics teacher professional development," *International group for the psychology of mathematics education*, p. 305, 2006.
- [11]. Gallavan, N. P., & Kottler, E. (2012). Advancing social studies learning for the 21st century with divergent thinking. *The Social Studies*, 103(4), 165-170.
- [12]. Iakovos, T. (2011). Critical and creative thinking in the English language classroom.
- [13]. *International Journal of Humanities and Social Science*, 1(8), 82-86.
- [14]. Ibrahim, M., & Kusuma, A. E. (2020). The effect of collaborative based science learning model on enhancing students' critical thinking skills and responsibility. In *Journal of Physics: Conference Series* (Vol. 1422, No. 1, p. 012026). IOP Publishing.
- [15]. J. Radisic and S. Josic, "Challenges, obstacles and outcomes of applying inquiry method in primary school mathematics: an example of an experienced teacher," *Inovacije u nastavi- časopis za savremenu nastavu*, vol. 28, no. 3, pp. 99-115, 2015.
- [16]. Kadir and Lucyana and G. Satriawati, "The Implementation of Open-Inquiry Approach to Improve Students' Learning Activities, Responses, and Mathematical Creative Thinking Skills", *JME Journal on Mathematics Education*, volume 8, no. 1, pp. 103-114, January. 2017.
- [17]. K. Kadir, L. Lucyana and G. Satriawati, "The Implementation Of Open-Inquiry Approach To Improve Students' learning Activities, Responses, And Mathematical Creative Thinking SKILLS," *Journal on Mathematics Education*, vol. 8, no. 1, pp. 103-114, 2017.
- [18]. Kivunja, C. (2015). Exploring the pedagogical meaning and implications of the 4Cs "super skills" for the 21st century through Bruner's 5E lenses of knowledge construction to improve pedagogies of the new learning paradigm. *Creative Education*.
- [19]. Kruger, F. (2012). The role of TESOL in educating for peace. *Journal of Peace Education*, 9(1), 17-30.
- [20]. Li, N. (2013). Seeking best practices and meeting the needs of the English language learners: Using second language theories and integrating technology in teaching. *Journal of International Education Research (JIER)*, 9(3), 217-222.
- [21]. M. Ardiany, W. Wahyu and A. Supriatna, "Enhancement of Self Efficacy of Vocational School Students in Buffer Solution Topics through Guided Inquiry Learning," In *Journal of Physics: Conference Series*, vol. 895, no. 1, 2017
- [22]. M. Duran and I. Dökme, "The Effect Of The Inquiry-Based Learning Approach On Student's Critical-Thinking Skills", *Eurasia Journal of Mathematics, Science & Technology Education*, 12(12), 2887-2908, 2016.
- [23]. Morgoun, N., Kozharskaya, E., & Kozhevnikova, M. (2021, June). Teaching Critical Thinking in ESP Distant Learning Format. In *2021 IEEE International Conference on Educational Technology (ICET)* (pp. 208-214). IEEE.

- [24]. Pifarré, M., & Kleine Staarman, J. (2011). Wiki-supported collaborative learning in primary education: How a dialogic space is created for thinking together. *International Journal of Computer-Supported Collaborative Learning*, 6, 187-205.
- [25]. Rahman, S. A., & Manaf, N. F. A. (2017). A Critical Analysis of Bloom's Taxonomy in Teaching Creative and Critical Thinking Skills in Malaysia through English Literature. *English Language Teaching*, 10(9), 245-256.
- [26]. Raikhanova, D., & Kassymova, G. (2019, April). Implementing Project-Based Learning in Teaching English for Specific Purposes for Science Students. In *6th Eurasian Conference on Language and Social Sciences Samarkand State University* (Vol. 65).
- [27]. S. Maarif, "Improving junior high school students' mathematical analogical ability using discovery learning method," *International Journal of Research in Education and Science*, vol. 2, no. 1, pp. 114-124, 2016.
- [28]. Şendağ, S., & Odabaşı, H. F. (2009). Effects of an online problem-based learning course on content knowledge acquisition and critical thinking skills. *Computers & education*, 53(1),132-141.
- [29]. Sumantri, M and Permana, J. Teaching and Learning Strategies, Surabaya: Cakrawala Ilmu.
- [30]. Wiriaatmadja, R. 2008. Classroom Action Research Methods. Bandung: Rosdakarya. Sudrajat, A. 2011. Curriculum and Learning in the New Paradigm. Yogyakarta: Paramitra Sugiyono. 2009. Qualitative Quantitative and R&D Research Methods. Bandung: Alfabeta. Supriyadi. 2011. Teaching and Learning Strategies. Surabaya: CV. Cakrawala Ilmu
- [31]. Teo, P. (2019). Teaching for the 21st century: A case for dialogic pedagogy. *Learning, Culture and Social Interaction*, 21, 170-178.
- [32]. T. L. Friedman, "The world is flat: A brief history of the twenty-first century," Macmillan, 2005.
- [33]. Wang, Y. C. (2014). Using wikis to facilitate interaction and collaboration among EFL learners: A social constructivist approach to language teaching. *System*, 42, 383-390.
- [34]. Yumiati and M. Noviyanti, "Analysis Of Mathematics Representation Ability Of Junior High School Students In The Implementation Of Guided Inquiry Learning", *Infinity Journal on Mathematics Education*, volume 6, no. 2, pp. 137-148, September. 2017.
- [35]. Z. Ordilek and N. Bulunuz, "The Effect of a Guided Inquiry Method on Pre-service Teachers' Science Teaching SelfEfficacy Beliefs," *Journal of Turkish Science Education (TUSED)*, vol. 6, no. 2, 2009.