INCORPORATING STUDENTS' FUNDS OF KNOWLEDGE TO DEVELOP A SUSTAINED INTEREST IN SCIENCE

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UNIVERSITI SAINS MALAYSIA

2010

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By

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Thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy

June 2010

Acknowledgments

I would like to thank my main supervisor, Associate Professor Dr. Ahmad Nurulazam Md. Zain, for his scholarly guidance and many hours of support throughout this research. I also appreciate the help and encouragement from my co-supervisor, Associate Professor Dr. Sharifah Norhaidah Syed Idros.

I would like to thank all the participating teachers, students, and other faculty and staff of St. George and St. Paul Junior High School. I express my sheer gratitude for their willingness to participate in this study and assist in the fulfillment of my degree requirement.

I would like to acknowledge that my wife Fr. Irma Yudianti and my beloved daughters, Ig. Handipta Mahardika and A. Hancitta Mahardika have instilled in me a love for learning. I am confident all of them would be very proud of my accomplishment and it is to them that I owe my perseverance and tenacity.

I received the encouragement to pursue this doctorate from Father Dr. Paul Suparno, S.J. and Drs. A. Atmadi, M.Si. I thank them both for encouraging me towards this degree. Many thanks to all my colleagues at Physics Education Department, Sanata Dharma University for their constant support and encouragement to enable me to complete my dissertation. I would like to acknowledge Sanata Dharma Foundation especially Father Y. Ageng Marwata, S.J., and Indonesia Higher Education Directorate who provided me with the financial support.

Finally, I wish to express my sincere thanks to all my friends for an unconditional love and hospitality.

Table of Contents

Pages

List of Tables

Pages

List of Figures

Pages

MENGGABUNGKAN PENGALAMAN BUDAYA PELAJAR UNTUK MENGEKALKAN MINAT DALAM SAINS

ABSTRAK

Tujuan kajian ini adalah untuk mengenal pasti pengalaman budaya pelajar dan kesulitan pelajar dalam memahami konsep sains, merangka pengajaran sains dengan menggabungkan pengalaman budaya pelajar yang telah dikenalpasti, dan mengkaji perubahan sikap dan minat pelajar dalam sains. Perkaitan antara pengalaman budaya pelajar, pengalaman dari rumah atau persekitaran, dan pengetahuan daripada pengalaman pelajar yang dikenalpasti sebagai pengalaman budaya pelajar telah digabungkan dalam pengajaran dan pembelajaran sains yang memberi penekanan kepada padanan instruksi. Kajian ini telah dijalankan di dua buah sekolah menengah di Indonesia. Dua orang guru dan seramai 173 murid (94 laki-laki dan 79 perempuan) terlibat dalam kajian. Data diperoleh melalui temubual, rakaman pengajaran dan pembelajaran, jurnal, soalselidik sikap dan minat, dan ujian konsep sains. Dua orang guru tersebut serta dua puluh orang murid yang dipilih daripada sampel turut ditemubual secara mendalam. Dapatan kajian menunjukkan bahwa pengajaran yang melibatkan pengalaman budaya pelajar meningkatkan penglibatan murid dalam mempelajari sains dan mengembangkan minat dan sikap yang berterusan terhadap sains. Pelajar berasa bahawa pendekatan konsep sains melalui konteks pengalaman budaya membuat kandungan pengetahuan sains lebih mudah difahami dan lebih menarik. Kebanyakan pelajar mengharapkan bahawa pengajaran semestinya dijalankan dalam bentuk eksperimen sains atau aktiviti. Dapatan kajian ini menunjukkan salah satu masalah kritikal yang dihadapi dalam pembelajaran sains ialah tiadanya akses untuk penglibatan dalam aktiviti yang bermakna berkaitan sains.

INCORPORATING STUDENTS' FUNDS OF KNOWLEDGE TO DEVELOP A SUSTAINED INTEREST IN SCIENCE

ABSTRACT

The objectives of this study were to identify students' funds of knowledge and learning difficulties they faced in understanding science concepts, to design identified science lessons incorporating students' funds of knowledge, and to investigate the change in students' attitudes and interests engaging in science. The connection among students' culture, home experiences and experiential knowledge of students which is identified as funds of knowledge have been incorporated into the teaching and learning of science that put emphasis on instructional congruence. The study involved two sub-urban Junior High Schools in Indonesia. Two teachers and 173 students (94 males and 79 females) participated in this study. Multiple data sources included semi-structured interviews, student's artifacts, videotaped process of participants in learning, journal writing, attitudes and interest questionnaires, and concept test. The two teachers and a total of twenty students selected from the sample also participated in in-depth interviews. The findings revealed that the incorporation of students' funds of knowledge in teaching had improved students' engagement in learning science and developed a sustained interests and attitudes towards learning science. The students felt that approaching science concepts through the context of everyday life made the content of science more understandable and interesting. Most students expected that the teaching process should be in the form of science experiments or other hands-on activities. This finding shows that one of the critical problems faced during the learning process is the absence of access to participation in meaningful science related activities.

Chapter 1
INTRODUCTION

1.1 Introduction

The development of science and technology is vital for the progress of any country as it is also a major vehicle for enhancing the quality of human life (Garg & Gupta, 2003). This leads to the important role of science education in developing science and technology. Bybee (1993) states that the aims of science education are to provide students with the range of accumulated observations and systematic information about the universe and to develop the required skills of inquiry to produce knowledge, and to develop personal attitudes important for scientific inquiry. Science education encompass a total body of activities such as science education policy development, science curriculum development, science textbook development, science teacher education, and science teaching in classrooms where many stakeholders are involved in and committed to (Ogawa, 2001a). Bybee (1993) argues that science education should prepare students to make responsible decisions concerning science-related social issues.

Science curriculum across a number of countries has been developed by using contexts and applications of science as a means of developing scientific understanding (Bennett *et al.*, 2007). Students are expected to develop an understanding of the epistemology of scientific knowledge as well as the processes/methods used to develop such knowledge (Zeidler *et al.*, 2005). It is believed that students' understanding of science as a "way of knowing" is absolutely necessary if informed decisions are to be made regarding the scientifically based personal and societal issues that increasingly confront students (Zeidler *et al.*, 2005).

However, school science has traditionally attempted to prepare students for the next level of science courses by focusing on intellectual knowledge acquisition (Aikenhead, 2006). Whereas, for some time, science educators in many countries have expressed concerns that current provision in schools (especially at age 14–16 years) is all too often boring, irrelevant, and outdated; designed only to educate a minority of future scientists, rather than equipping the majority with the scientific understanding, reasoning, and literacy they require to engage as citizens in the twenty-first century (Braund & Reiss, 2006).

Dissatisfaction with the outcome of science education efforts in schools is widespread. Science educators in developing countries and in non-Western settings have been interested in the nature of interaction between the traditional practices and beliefs existing in the communities in which students live and the science taught in school. George (1999) has identified from some research findings that the links between science as taught in schools and Western culture; and the likely consequences for science education programs in other cultural settings need to be recognized and explored. There is also some research evidence which indicates that the conceptions held by students in non-Western settings prior to formal instruction may, in part, be a result of traditional practices and beliefs that exist in their communities and to which the students are committed. The evidence further suggests that the ideas that students bring to their classes are part of what influences learning in science. It would seem important, then, that science educators/teachers and science curriculum developers consider these factors if the provision of adequate science education is to make science accessible, meaningful, and relevant for all students.

In making science accessible for all students, the National Science Foundation, or NSF, for example, emphasizes “culturally and gender relevant curriculum materials” that recognize “cultural perspectives and contributions so that, through example and instruction, the contributions of all groups to science will be understood and valued” (Fradd *et al.*, 2001). This science education is seen as context-dependency. The idea of the context-dependency of science and science education can guide learners to a new cultural perspective in the enterprise of science education (Ogawa, 1998). This notion is further recognized as a multicultural perspective in science education. Multiculturalism in science education has become an increasingly rich area of study as educators struggle to find answers to the question of how to teach science in a multicultural world (Stanley & Brickhouse, 2001).

It is recognized that students come to class with their own perceptions because of their interaction with the environment in a complex social setting. This situation may influence the way in which students learn science. Science in a multicultural world assumes that the diversity of students’ background, experiences, and learning styles should be accepted and appreciated instead of being perceived as a hindering force (González-Espada, 2004). This approach puts emphasis on the importance of students’ experiences and the experiential knowledge of students. The connection between students’ experiences and how experiential knowledge of students which can be valued as part of the epistemological tradition of the classroom, is identified as ‘‘funds of knowledge’’ (González & Moll, 2002). The cultural artifacts and bodies of knowledge that underlie household activities are examples of funds of knowledge. Knowledge and skills gained through historical and

cultural interactions that are essential for individuals to function appropriately in his/her community are also identified as funds of knowledge (Basu & Barton, 2007).

In developing the learning science which incorporates funds of knowledge, science education need to promote ‘‘social relations between schools and homes’’. The establishment of connections between school and home through a ‘‘funds of knowledge lens’’ are strategic for incorporating not only whatever kinds of knowledge which are used at home but also how that knowledge is intentionally used toward a set of greater goals or purposes (González & Moll, 2002). When implemented appropriately, this approach has the potential to have a positive and significant impact on students, especially students from diverse backgrounds in terms of their engagement and interests towards science.

When teaching science puts emphasis on incorporating funds of knowledge, students move from their culture to another (science culture). This process which is called “cultural border crossing” (Aikenhead, 2006), negotiates the transition from a student's home culture to the culture of school science. Thus, teaching science can be identified as a cultural approach. With this approach, learning science for most non-Western students is a cultural event. Students will move from their everyday cultures associated with their home to the culture of Western science (Aikenhead, 2001a). In this regard, students require an effective use of cognitive explanation with a heavy reliance on successful cultural border crossings into school science when they move from their home culture into school science culture (Jegede & Aikenhead, 1999).

The process of enculturation through a smooth border crossing is indicated by harmonization between students’ life-world and the culture of science (Jegede &

Aikenhead, 1999). Jegede and Aikenhead (1999) further describe border crossing as being problematic and at odds with school science if students lack motivation and interest, possess ineffective instructional strategies, and suffers an inability to relate what is learned to the world of work.

In order for students to descend smoothly into science culture, facilitating and mediating students' everyday experience, and scientific understanding in teaching science are crucial. To this end, Lee and Fradd (1998) propose the notion of instructional congruence that focus on "incompatibility" between habits of mind as well as language and other interactive practices. Through implementing instructional congruence, students will get opportunities to explicitly consider and master new ways of thinking.

In improving teaching and learning science in a rapidly changing society, teachers actually have a great challenge to improve their teaching competencies and adopt a relevant current model of teaching and learning science. As teachers are expected to adopt new models, they also need to reconsider their approach towards educational processes. It seems that introducing a new model of teaching and learning demands new attitudes from teachers. In some cases teachers need to adopt a new teaching paradigm in line with the changing society and increasing information and technology. However, in the teaching profession this is a paradox since in a rapidly changing society, teachers are often reluctant to change their practices (Hoban, 2002). In fact, memorizing facts still exists during the science learning processes. King and Frick (2000) state that as the amount of information increases exponentially, our educational practices can no longer focus primarily on memorizing a core body of knowledge. It is impossible for students to memorize and

master all the available information. The teaching and learning processes must, besides helping students become skillful manipulators, synthesizers and creators of knowledge (King & Frick, 2000), should also prepare students to make responsible decisions concerning science-related social issues (Bybee, 1993), and are eventually expected to become better citizens in a society enriched by cultural differences (Aikenhead, 2001a).

1.2 Background of Study: Current Picture of Science Education in Indonesia

The aim of the national education in Indonesia is to enhance the intellectual life of the people and develop complete Indonesian people who believe in God the Almighty and have supreme conducts, have knowledge and skills, are physically and mentally healthy, have strong personality and are independent and have the sense of responsibility to the society and the nation as well. In Indonesia, basic education is compulsory which consists of nine years of general education, six years of primary school and three years of junior secondary school. The aim of basic education is to develop students as individuals, members of society, citizens, and members of humankind, as well as to prepare them to pursue their studies in secondary education.

Recently Indonesia is riding a decentralization wave. The culmination of its efforts to reconfigure authority frameworks was the passage of two laws in 1999 (Law No. 22/1999 on Regional Government and Law No. 25/1999 on the Fiscal Balance Between the Central Government and the Regions). This policy granted sweeping powers to Indonesia's districts/cities, beginning in 2001 (Usman, 2001). This legislation indicated that the education system, like all sectors of government, would be managed by local authorities and educators, and the Ministry of National

Education (MONE) primary responsibility would shift from direction to coordination. In the decentralized education system envisioned by government officials, parents, community leaders, teachers, and administrators will work in partnership to improve the quality of teaching and learning delivered in the schools (Bjork, 2006).

How decentralization applies to the education system has been defined in Education Law 20/2003, which transfers the principal responsibilities, authority, and resources for the delivery of education to lower levels of government, while some decision making power is transferred to schools themselves (Indonesia, 2004a). There are four key conditions for decentralization to overcome barriers and stimulate educational development: (a) clear division of responsibilities and power among the different levels of government, (b) greater decision making power and autonomy to local governments, (c) greater voice of teachers and parents on how schools operate, and (d) effective accountability mechanisms and financial structures that are consistent with educational goals (Indonesia, 2004a).

Science education in Indonesia is expected to serve students in understanding themselves and the environment, and the application of science in everyday life. Science education in Indonesia emphasizes on the inquiry activities that guide students to obtain a deep understanding of their environment (Depdiknas, 2006). A new curriculum (Curriculum 2004) which is competencies based consists of a number of basic competences inherent to the students. Based on these basic competences, the districts/cities, and even schools can develop and formulate syllabi. So the districts/cities or school aspirations have main roles in the daily implementation of the curriculum.

A new science curriculum promotes minimizing the number of facts taught in the curriculum in favor of treating fewer concepts with greater depth. Inquiry based teaching is expected as a primary method of teaching science. In inquiry-based teaching, students participate in investigations that require them to develop questions and hypotheses, collect data, analyze data, and draw and test conclusions. Inquiry learning typically seeks to excite curiosity in students, encouraging them to investigate questions on their own initiative and grounding this activity in a context. In science, as with any other curriculum, the quality of learning depends largely on the quality of teaching. The kind of learning processes which teachers choose affects the outcomes. The learning process should not only present information suitably packaged, but also provide opportunities for the gradual development of ideas and skills. With regard to the curriculum which emphasizes the basic competences, the role of teacher is on the accountability, which is how far the students achieve and have the established basic competences.

The current science curriculum provides national standards for basic competencies in science, leaving each district responsible for adapting them to its own cultural characteristics. Diversified approaches appear particularly relevant in multi-ethnic countries, such as Indonesia. However, the definition of effective teaching in the diverse environments of Indonesian schools is still far from clear in the context of the new decentralized education system (Indonesia, 2004a). This means that understanding of and respect for differences in culture, family experience, forms of intelligence, and approaches to learning and the ability to teach in a way that connects with students have not been a major concern in improving the teaching profession. Individuals working at all levels of the system stressed the value of creating tighter links between curricula and local conditions. Educators may have

differed in their interpretations of how curriculum can best match the local context (Bjork, 2004). Nevertheless, teachers, in particular, have not adopted the role of the autonomous educator that government officials have designed for them (Bjork, 2004).

The current science curriculum in Indonesian schools allows teachers to design learning activities more freely. In implementing the curriculum, teachers should consider the integration of natural resources around schools and students, social, culture and the rich resources related to science (Depdiknas, 2006). Moreover, this curriculum also put forward a great emphasis on the students' outcome of competencies. That is, of the students' competence in showing the ability to improve a self-regulated learning, to analyze and solve problem in their everyday life, and to describe the natural and social context and phenomenon in developing their science understanding (Depdiknas, 2006). But in reality, content transmission in the learning process is still dominant (Raka Joni, 2005), and it is due to the assessment that is remain focused on content. This results mainly in memorization and routine exercises, responsible for the failure of students to acquire real understanding as well as adequate problem-solving and critical thinking skills.

In Indonesia, schools science quality improvement has never been easy. Now it might be more difficult than ever. Teachers are expected to make changes, but within contexts that fail to actually support making and sustaining the changes. Moreover, one of the education problems in Indonesia is the problem of quality. The related issue is how to provide every student with the learning materials and resources that can be accessed instantly and easily anytime and anywhere (Ali, 2004). The method that provides student with rich learning resources in a various

format will support their ability to undertake continuous lifelong learning faster which later on may be the only sustainable competitive advantage. In order to realize this, it needs to change the teaching-learning process paradigm.

A large majority of teachers, especially in rural schools, work in challenging conditions with a large number of non-teaching duties, resulting in a lack of time and space for advance preparation of their teaching. Hence, they have either remained the same or have hardly made any significant changes to their teaching methods. Teachers are expected to implement new policies and programs, but they receive either little help or staff development assistance in the form of one-shot or short-term workshops at school level and these generally fail to produce meaningful changes. Compounding this problem is that teachers usually work in isolation from each other and from other professionals who could contribute to their pedagogical knowledge.

In Indonesia, recent quality improvement projects have involved training and managing teachers, revising curricula, providing textbooks, rehabilitating classrooms, supporting school-based management, and promoting packaged inputs both on specific subjects (for example, the Science Education Quality Improvement package or SEQIP) and on modern teaching methods (for example, the Creating Learning Communities for Students' joyful learning package or CLCC). The purpose of quality improvement programs is to improve school conditions and raise school performance. However, quality improvement simply means upgrading inputs, learning environments, teaching practices, school organization, and school performance to bring them closer to the expectations of both the state and parents.

The SEQIP's purpose is to improve the quality of teaching science in primary school grades 3 and 6. This is being accomplished through a package of inputs that addresses all factors affecting classroom activities simultaneously. The logic is that sustainability at the classroom level is ensured by a package approach. The package includes: in-service training for selected teachers in active learning methods, in lesson planning, and in using a SEQIP science kit; training for principals and school supervisors so they can support the teachers, science kits for teachers and students, and a system for kit maintenance; teachers' guides on how to use the kits in lessons and guidelines on using new pupil textbooks; improved end of term test items to match the new emphasis in teaching science; and a project monitoring system.

Even though there are some efforts in improving the quality of science education, the teaching and learning that incorporates students' culture and interest have not been considered. In addition, there is a gap between the actual and preferred perceptions held by the students at all schools regardless of school locality (Wahyudi & Treagust, 2004b). Obviously, students are not contented with the actual learning environment as indicated in their preferred perceptions of what kind of learning environment should be created by the teacher.

1.3 Statement of the Problem

It is recognized that there are many cultural and economic differences within Indonesia. Indonesia is an archipelago with 17.000 islands inhabited by more than 350 ethnic groups speaking about 300 local languages and embracing various religions and beliefs in God Almighty (Semiawan & Natawidjaja, 2000). Indonesia is a country where many people live with their uniqueness of race, ethnic, culture, and

religion. Various lifestyles are commonly practiced in different regions of the country. People in every region can practice their own language, custom, ritual, artifact, and belief in accordance with their properties. All the diversities are ensured by the legal constitution and supported by the so-called national motto *Bhineka Tunggal Ika* (unity in diversity).

In such diversity, education as a sub-system of culture cannot be developed through a single perspective of a certain community. One community cannot cope and monopolize others, even though the community constitutes a major race, ethnic, culture or religion. Related to this, the most important issue is not laid down on the superiority of one citizen over others, but on how to create a multicultural understanding and mutual respect among them. People should understand the right of citizen by which the differences of way of life take them for granted. And, they also must know that natural distinctiveness is not only because they are socially constructed by human beings but also naturally created by God (Mulyana, 2005). There are also multiplicities of learning situations in science schools in Indonesia, because of the variety of school environments. Many schools are in rural areas and the others are in urban areas. There are many differences among them in terms of resources, facilities, teachers' abilities, and the students' backgrounds. This is particularly so for teaching with students with diverse cultures.

The Indonesian students' diversity may affect the implementation of science curriculum. The problem of effectiveness in the teaching-learning process is used to implant the awareness of diversity. One of multicultural education premises states that teaching learning is a cultural process in a social context. In order that teaching and learning can be accessible and fair for various background and origins of

students, it needs to understand their cultures clearly. Such understanding can be achieved by analyzing the education from various cultural perspectives by which it can avoid the hegemony of dominant cultural experience (Baidhawy, 2004). The local contents approach in the curriculum should be considered. Through this approach the teacher can deliver the learning of attitude, behavior and multicultural skills internalize them and make the students accustomed to behave in tolerance, respect and recognition ways with deeper, wider understanding and practice in accordance with the local needs and context (Baidhawy, 2004).

At the moment, there are several projects in effect that are taking various demand-driven approaches to teachers' in-service training, but no systematic evaluation has been done of their impact on student learning. No matter how sound the proposed innovations or how well supported by research (very often lacking of Indonesian context) meaningful change cannot take place under circumstances where coherence and continuity are nonexistent. As Supratiknya (2005) states education improvement and innovation in Indonesia should be in the form of internal recursive action that considers the context of cultural diversity.

Since the implementation of competence-based curriculum in formal schools in Indonesia, teachers are required to present the teaching and learning materials in a very different method. However, the process of teaching and learning in the Indonesian school setting has been unrealistic in that almost everything that the student learns is something coming from nowhere (Indonesia, 2004b). Teachers in Indonesia must change their approach, paradigm, and technical know-how in teaching and learning activities and consider their students' cultural diversity.

In spite of all the efforts to promote inquiry teaching and learning in science schools, the practice of inquiry in the Indonesian school context has rarely been implemented by practicing teachers in honoring and incorporating students' cultural differences in science learning. By examining students' funds of knowledge and thought processes, and incorporating them into science teaching and learning through this research, learners' culture and their everyday experiences and means of bridging the gap in their development of sustained attitudes and interests, an understanding of science concepts will be characterized. Furthermore, research in exploring Indonesian students' cultural differences and how this is best incorporated into science instruction will emerge. Because the importance of students' cultural differences in science learning, this research was carried out to integrate students' funds of knowledge into teaching and learning, particularly in physics at secondary school level, and has found out the extent to which this method was helpful in developing a sustained interest in science.

1.4 Purposes of Research

In this research, a detailed account of knowledge claims that already exist in the literature in terms of developing students' interests towards science by incorporating funds of knowledge in science instructions has been explored. The purpose of this research was to gain insights about developing students' interests towards science through incorporating funds of knowledge in science instructions especially in the Indonesian context.

Therefore, existing theories of learning in science would not to be tested in this study but rather utilized in building the research methodology and subsequently

in the interpretation and analysis of the data. The purpose of this research was not aimed at proving or disapproving the effectiveness of science instruction developed here, which would be well beyond the realm of this case study. Rather, the aim of this study was to portray a case of a learning process during implementation of science instruction developed in this study with possible successes and failures along the way and to evaluate the whole process in its entirety to develop an understanding of how the different parts might contribute to the whole. This research was intended to investigate a single case as thoroughly as possible to support any achievable conclusion for the case. Hence, this study can be best characterized as 'descriptive, explanatory, and exploratory' rather than being 'confirmative'.

1.5 Research Objectives

This research has been carried out to integrate students' fund of knowledge into teaching and learning, particularly in physics at secondary school level. The research objectives are as follows.

1. To identify and document Indonesian students' funds of knowledge' specifically into facets of historical, cultural and community knowledge as it relates to the phenomena in science.
2. To explore difficulties of students in understanding science concepts.
3. To design science lessons incorporating students' funds of knowledge with a focus on making explicit objectives for congruence in science instruction.
4. To investigate the effect of science instruction based on funds of knowledge of certain science topics on learning science among Indonesian learners.

5. To investigate the change in students' attitudes and interests engaging in science after implementing the science instruction developed in this study.

1.6 Research Questions

In this study students' funds of knowledge, attitudes, interests, and difficulties related to science were explored. The initial result was used to develop science instruction in order to reduce the low interests in science. The research questions of this study are:

1. What are the students' funds of knowledge which can be incorporated into the teaching of science?
2. What are the difficulties faced by students in understanding science concepts?
3. How can the teacher develop and implement science instruction which incorporate students' funds of knowledge with a focus on making explicit objectives for congruence in science instruction?
4. How can students' funds of knowledge be best incorporated into science instruction which emphasize on instructional congruence to develop a sustained interest in science?
5. How and what do students with diverse cultures learned about scientific ideas, and the ways they organize and construct meaning in science, as they participate in activities?

1.7 Significance of Research

This study focused on Indonesian secondary school students developing their interests and attitudes, and the extent to which they develop understandings of

science concepts through incorporating their funds of knowledge into teaching and learning science. This study is expected to contribute to the research about culture study in Science Education. Research findings show that utilizing students' funds of knowledge could enhance science engagement and learning (Furman & Barton, 2006; Upadhyay, 2006). The science teacher has been participated in this study to experience incorporating funds of knowledge into teaching and learning science, and to reflect on how he/she can implement this method into their own teaching in the future.

Perspectives from social constructivist and socio-cultural views of learning shaped this study (Vygotsky, 1978). According to this line of thinking, science learning can be viewed as a participatory process that includes the negotiation of the cultural practices of scientific communities. These cultural practices include constructing explanations, defending and challenging claims, and interpreting evidence, transforming observations into findings, and arguing theories. In this framework, learning is regarded as a participatory process in which the learner gradually becomes an active member in a cultural community by learning its discourse practices, norms, and ways of thinking. From this perspective, knowing refers to belonging, participating and communicating. In order to enhance students engagement in which the process of cultural practices to happen appropriately, the learning instructions need to honor and incorporate students' funds of knowledge in a science learning environment. In this way students would be engaged in the science content and skills they are learning, and will take the initiative and develop long-term commitments to their science activities, and perhaps pursue careers in science.

By examining and documenting students' funds of knowledge, exploring students' difficulties, developing and implementing congruence of science instruction, this study provided some insights into how to feasibly integrate this method into science education practices. This is expected to enhance students' interests and attitudes towards science. Data and insights attained from this investigation will be of benefit in improving the teaching and learning process of science in schools. In addition, this study will increase science educators' awareness of the potential use of students' funds of knowledge in enhancing the teaching-learning experience in the classroom. The result of this study is also helpful for developing a future research program and for planning curricular activities.

1.8 Limitations of Study

Even though there are several aspects of the factors that affect the improvement of science education in the Indonesian setting, this study only focused on developing students' learning which stress on incorporating students' funds of knowledge. The scope of the study was limited only to two lower junior schools. As this study was to portray a case of a learning process during implementation of developed science instruction with possible successes and failures along the way and to evaluate the whole process in its entirety to develop an understanding of how the different parts might contribute to the whole, the differences between public and private school, as well as rural and urban school were not considered in this study.

1.9 Definition of Terms

Student's funds of knowledge are students' cultural artifacts and bodies of knowledge that underlie household activities which refer to knowledge and skills

gained through historical and cultural interactions, and also experiences and knowledge that may be more particular to a given family within the context of a community (Basu & Barton, 2007). *Student's' funds of knowledge* is essential to function appropriately in a community.

Sustained interest in science means students are able to keep their interests in science. By sustained interest, students might complete more than the task at hand in a classroom, become self-motivated in science exploration outside the context of classroom, and using science in an ongoing way to improve, expand or enhance an exploration or activity to which they are already committed (Basu & Barton, 2007).

Incorporating students' funds of knowledge means teacher uses this knowledge in teaching to promote social relations between school science and students' knowledge and culture. This can be in the forms of, for example: generating science topics, creating students' activities relevant to a community, and creating learning environment.

Instructional congruence means instructional learning mediates the nature of science content with students' language and cultural experiences to make such science content accessible, meaningful, and relevant for diverse students. In the learning process, it occurs in the forms of, for example: communicating and interacting with students in culturally appropriate ways, using students' home experiences to promote understanding, and using the teacher's shared cultural examples and experiences to enhance students' understanding of science (Lee and Fradd, 1998).

Journal writing is a continued series of students' writings in response to their experiences and events during their learning. Journal writing may include a description of events, but it also contains reflections on what took place and expresses emotions and understandings about them.

Chapter 2
LITERATURE REVIEW

2.1 Introduction

In this literature review a socio-cultural approach to learning science and the concept of 'funds of knowledge' will be described. It sets out to develop a new insight that incorporates the students' funds of knowledge into the teaching and learning of science, the notion of instructional congruence will be explored and the importance of developing sustained students' interest toward science will also be identified. Based on this review and with an emphasis on the current situation in science education in Indonesia, the framework of the study is established.

2.2 A Socio-cultural Approach to Learning Science

2.2.1 A Brief Description of a Socio-cultural Approach

In a socio-cultural approach, Rogoff (2003) has identified that learning can be viewed as a cultural process and the learning development of the student is facilitated through participating in cultural activities of their communities. Thus, learning occurs through students' participation in their socially and culturally-determined activities. This learning approach is influenced especially by the work of Vygotsky (1978). In line with this learning view, Kozulin *at al.* (2003) has remarked that the importance of understanding of human cognition and learning is social and cultural rather than individual phenomena.

The Vygotskian approach emphasizes the importance of socio-cultural forces in shaping students' development and learning, the crucial role of adults (parent,

teacher, and peer) and the community where the interaction occur between students and their environments (Kozulin *et al.*, 2003). From a socio-cultural perspective, the students construct their knowledge through communicating and collaborating with peers and groups, and their understanding develop through their critical thinking and mutual meaning making (Tal & Kedmi, 2006). From this perspective, knowledge and understandings, including scientific understandings are constructed when students engage socially in discourse and activity about shared problems or tasks. Thus, learning occurs through social interactions rather than in each individual's mind.

These socio-cultural perspectives have been described as learning in a 'situated activity' occurring through participation, and learning as mediated action (Eames, 2006). Lave (as cited in Eames, 2006) describes that situated learning put emphasis on socially-negotiated meaning and interest, the thought and action of people who are engaged in an activity, and the social and cultural structure of world or society. Thus, in a situated activity, students and teachers construct meaning and understanding in the context of education through activity based on psychological tools and practices, as developed and used by members of the community. This does not mean that teachers are just being "nice" to students in the classrooms: in practice, students are respected and expected to learn highly valued curricula and to engage in critical thinking. But meaningful relationship between students and their teacher is precisely as the characteristic of mediation to fulfilling the demand of the academic content. In this regard, Hanrahan (2002) identified learning as a holistic process that depends on cultural values to provide the significance which enable students' words or concepts to make sense of their reality.

2.2.2 Science in a Multiculture Perspective

The standard account of science can be called "Western" given its historic origins in Ancient Greek and European culture. Speculative thought about nature, natural philosophy, and later what became known simply as "science" has always engaged Western culture (Cobern & Loving, 2001). However, Aikenhead (2006) describes that the accounts of the origin of what we today call science vary depending on one's cultural or academic perspective.

Yamada's (1970) view (as cited in Ogawa, 2001b, p. 2) described that "every society and culture has its own science, and its function is sustaining its mother society and culture". In line with this description, Cobern (1996) argues that different cultural environments produce different "worldviews" (sets of beliefs, held consciously or unconsciously, about the nature of reality and how one gains knowledge about it) that predispose people to feel, think, and act in particular ways. As a consequence, there are likely to be very significant cross-cultural differences in the way people conceptualize and interact with the natural world and significant differences, therefore, in the ways they respond to Western science and its distinctive conventions for conceptualizing and investigating the natural world (Hodson, 1999).

Ogawa (2001a) has identified that there are two major views of science in ways of accounting for a phenomena of nature. These are universalistic perspective and multiple perspectives. From the viewpoint of universalistic perspective, science is the only way of knowing reality. On the other hand, from the multiple perspectives, science is regarded as a way of knowing reality, and other ways of knowing reality are possible to exist (Ogawa, 2001a). However, if there are different

ways of accounting for phenomena of nature, it is possible that some people reject some of these accounts, including the account offered by Western science and possibly accepts others (Cobern & Loving, 2001).

According to Ogawa (2001b), there are three different sciences. The first type, “indigenous science” is the science held by a specific cultural group, not by a specific individual. The second type, “personal science” is the science at the personal level and defined as “a rational perceiving of reality, which is unique to each individual” (p. 2). The last type of science is “Western modern science”, which is defined as a collective rational perceiving of reality, which is shared and authorized by the scientific community.

Ogawa (2001b) further describes that Western modern science is justified only by the scientific community itself. While the former two types of science relate to the everyday life world, they are characterized by a human liveliness and purpose found in the descriptions and explanations of what scientists called natural phenomena. Western modern science relates to a Cartesian materialistic world in which humans are seen in reductionistic and mechanistic terms. While indigenous science and personal science relates to the everyday-life world, the Western modern science relates to the scientists’ theoretical world. Thus, science educators are just in the multi-science setting (Ogawa, 2001b) when they are involved in the practices of science education.

In science education, the definition of science is a gate keeping device for what can be included in a school science curriculum and what cannot (Cobern & Loving, 2001). Hodson (1999) maintains that in education, science that is exclusively