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INTRODUCTION Background of the Topic Teaching science as inquiry is common in many nations due to the powerful impact of the inquiry methods. The educational system in Kuwait has also adopted these inquiry methods in teaching science. The State of Kuwait is assiduously working to meet the goals of the educational standards of the advanced world countries (Ebrahim, 2004). To create professionally-skilled science teachers, an integration of well-designed programs at the college level supported by well-prepared school environments are needed as a means of accomplishing the goal of teaching science as inquiry. Kuwait University offers scholarships to master and doctoral level students to study in different developed countries such as the United States, Canada, and Australia (Kuwait University, 2003). The aim of these scholarship funds is to create an expert faculty in different concentration areas including education (Kuwait University, 2003). More specifically, the program for preservice teachers in science education is designed to meet the standard goals of teaching science in the modern world. The Kuwaiti Ministry of Education also adopts the latest pedagogical methods by attending regional and global educational conferences (Kuwait University, 2003). Both professors and supervisors from the ministry are required to attend these conferences (Kuwait University, 2003).

This wave of reform in education both generally and more specifically in the area of science education is occurring within a world in which significant and dynamic changes are occurring. The world is increasingly becoming a “global village” in which actions in one part of the world exert powerful influences on other parts of the world. Modes and speed of travel and communication have changed dramatically in the last half of the twentieth century. Taiwan has a unique role to play in that

context, and the educational reform underway in Taiwan is strongly influenced by reforms that have been initiated in other parts of the world, sometimes in very different cultural settings. Establishing literate citizen starts in the schools while the future of the nation's productivity may very well be affected by what is learned in the science classroom. In order to meet the goals for science education, it is necessary to create science teachers who are skilled and meet the goals of the science education standards.

The model that science educators focus on throughout world is the teaching through inquiry. Inquiry itself has many levels and categories. Teachers model behaviors and skills to show students how to use new tools or materials; guide students in taking more and more responsibility during investigations; and help students design and carry out processes of recording, documenting, and drawing conclusions. Teachers also support content learning by helping students form tentative explanations while moving toward conceptual understanding; introducing tools and materials and scientific ideas appropriate to content learning; and using appropriate content terminology, as well as scientific and mathematical language (National Science Foundation [NSF], 2000). Moreover, teaching science as inquiry is about talking to students, asking questions, making suggestions, sharing, and interacting. Teachers should move around the classroom, make themselves available to all students; and help them with appropriate clues and prompts. Science teachers must facilitate cognitive thinking in their students by using open-ended questions that encourage investigation, observation, and thinking. Moreover, they should listen to students' ideas, comments, and questions, in order to help them develop their skills and

thought processes. They should suggest new things to look at and try, encourage further experimentation, and encourage student dialogue (NSF, 2000).

Given the emphasis on inquiry in the National Science Education Standards [NSES] (NRC, 2000), the present study examined the K-12 literature, uncovering a myriad of usages for the word “inquiry”. Inquiry-based learning or inquiry-based science describes a range of philosophical, curricular and pedagogical approaches to teaching. Its core premises include the requirement that learning should be based upon students’ questions. Pedagogy and curriculum requires students to work together to solve problems rather than receiving direct step-by-step instructions on what to do from the teacher. The teachers job in an inquiry learning environment is therefore not to provide knowledge, but instead to help students along through the process of discovering knowledge themselves. In this form of instruction, teachers should be viewed as facilitators of learning rather than vessels of knowledge. Even though this form of instruction has gained great popularity in the past decade, there is ongoing debate regarding the overall effectiveness (NSF, 2000).

Inquiry-based teaching is an instructional method developed during the discovery learning movement of the 1960s in the modern countries. It was developed in response to an overall failure of the traditional forms of instruction, where students were required simply to memorize facts for the purpose of passing exams (Aikenhead, 1999). During this time, the traditional science content was transformed into applied science projects and remodeled to fit within the new theories of education. Inquiry learning is a form of active learning, where progress is assessed by how well students

develop experimental and analytical skills rather than how much knowledge they possess (Bybee, 2000).

Teaching science through the inquiry model requires a consistent program that builds strong teacher beliefs about this unique style of teaching science and prepares teachers to participate in science rather than simply reading about it. Preservice teacher programs at many universities, globally, provide both content and pedagogical courses. The courses serve in structuring and scaffolding teachers' skills to implement inquiry. A study done by the 2000 National Survey of Science and Mathematics Education, found that elementary teachers feel less qualified to teach science than any of the other subjects for which they are responsible, and that on a typical day, over 30 percent of K-8 level students have no science instruction at all (Varelas, Plotnick, Wink, Fan, & Harris, 2008). These underlying beliefs are important to address when attempting to create a strong teaching program in Kuwait. Beliefs in the teaching arena are important because individual behavior on the part of both the teacher and the student is important and behavior is shaped by one's beliefs (Richardson, 2003). Everything you do can be traced back to the beliefs you hold about the world. This means that beliefs are not an entirely a private matter, particularly when you enter the teaching profession. One essential factor for teachers' success is their sense of well-rounded beliefs. Teaching is a complex activity involving much more than a series of actions by the teacher (Clark & Peterson, 1986). Notions of "teacher thinking" focus on the complexity of thought that informs the teachers actions and decision making in a particular teaching situation.

Purpose of the Study

The purpose of the present study was to measure the implementation of

inquiry by middle school teachers in Kuwait and their beliefs about teaching science as inquiry as a part of the science curriculum. I administered a survey from a previous study in the United States conducted by Czerniak and Lumpe in 1995 and presented at the Annual Meeting of the National Association for Research in Science Teaching. The survey was distributed to 126 teachers in Hawalii County public middle schools in Kuwait.

Research Questions:

1. What are the beliefs of middle school science teachers from Kuwait regarding effectiveness of inquiry-based science lessons?
2. How often do teachers use inquiry while teaching science?
3. Is there a correlation between beliefs and use of inquiry?

Significance

This study will increase the present knowledge regarding how middle school science teachers in Kuwait apply inquiry methods while teaching science. In addition, this study will provide information about teachers' beliefs about inquiry and their implementation of this approach in classrooms. The data from this study can also be used to identify the science teacher's philosophy regarding teaching science as inquiry. The knowledge gained from this study will be made available to the Ministry of Education of Kuwait and College of Education at Kuwait University.

Assumptions

Before I started my research, I had some assumptions about the data analysis and the results:

1. The size of the sample was adequate for answering the research questions.
2. The sample was satisfactory to represent the population.

3. Since there was no communication between the researcher and the participants, there was not any bias toward any group.

4. The three different instruments employed measured what they were designed to measure.

5. There will be a close relationship between teachers' beliefs and what they think about their implementations.

Definition of Terms

Teaching Science as inquiry: there is not one definition for teaching science as inquiry; however Martin-Hansen (2002 p. 35) defines it as: " any process that has the aim of augmenting knowledge, resolving doubt, or solving a problem". Martin-Hansen (2002 p. 35) furthered that " theory of inquiry is an account of the various types of inquiry and a treatment of the ways that each type of inquiry achieves its aim."

Teachers' Implementation: According to Lotter, Harwood, and Bonner, teachers' implementation can be defined as " the carrying out, execution or practice of a plan, a method, or any design for doing something" (2007, p21). Lotter, Harwood, and Bonner explained " As such, implementation is the action that must follow any preliminary thinking in order for something to actually happen" (2007, p21).

Teachers Beliefs: Richardson defines a teachers sense of efficacy beliefs as the teachers beliefs about his/her ability to positively influence students (1998).

LITERATURE REVIEW

Science as inquiry is basic to science education and a controlling principle in the ultimate organization and selection of students activities. The standards on inquiry highlight the ability to conduct inquiry and develop understanding

about scientific inquiry. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.

Teaching Science as Inquiry

Based on Bybee's outcome in his article "Inquiry Science as Inquiry", he states that inquiry is an advanced method of learning which involves a process of exploring the natural or real world and that leads to "exploring questions, making discoveries, as well as carefully testing the said discoveries in the search for new perspectives" (Bybee, 2000, p 25). Further, inquiry, as it applied to science education, should reflect on the activity of doing actual science (Bybee, 2000). Inquiry is not negotiable, it is something that must be applied in the lesson when teaching, and it is part of the standards. Thus, methods classes in college should focus and reform students' understanding about inquiry in order to impart a more effective form of science education.

There is no simple recipe for 'doing' science. Jarrett states that the general method of scientific inquiry usually begins with a question that is raised while observing some natural phenomenon (1997). Jarrett extends if there is no known answer to the question created then one or more reasonable assumptions or explanations can be tested in terms of a scientific experiment to answer the question (1997). Therefore, Jarrett concludes that

the process of doing science commonly begins with an issue that there is no answer for (1997). Thus, inquiry is characterized by a degree of uncertainty about outcomes (Bybee, 2000). In addition, Lotter, Harwood, and Bonner give as explanation about the sequence or process of inquiry science lessons. Regarding the procedure, they say: “ repeated experiments and re-designed, scientists continually refine the existing scientific laws, theories and models to better match experimental results, and to better predict natural phenomena” (2000, p 1327).

Windschitl explained that teaching science as inquiry provides teachers with the chance to develop student abilities and enrich student’s understanding of the nature of science (2004). Teachers should be aware of students’ understanding such as focusing on the processes of doing investigations, developing the ability to ask questions and naturally investigating aspects of the world around them. There is no one true method of inquiry waiting to be exposed; rather it is an understanding of the notion of inquiry and the ability to deliver this concept to the participants (Keys, & Bryan, 2001). According to Windschitl (2004), knowledge is something adaptive; the worth of knowledge is not determined by its degree of truth, but by its viability. Those forms of knowledge about inquiry that are viable in classroom practice will become constructed forms of inquiry.

In his article, Bybee scaffolds his thoughts about inquiry methods with Dewey’s viewpoint (2000). According to Bybee, John Dewey, the father of modern education, made a major case for the importance of inquiry teaching as a method of caring about values in everyday life (2000). At the present time, the necessity of scientific beliefs and skills is needed more than ever, as the world copes with the challenges of environmental overload in this

modern era (Martin, 2006). Thus, the need for inquiry teaching is important to cope with this advanced and technological world as it is ever-changing and must keep up or be lost behind. Bybee (2000) argued that Dewey's perspective about inquiry teaching involves the idea that children gain knowledge from direct experience and effective teaching promotes their natural curiosity. In addition to that, Bybee suggests that intellectual processes are the same whether practiced in the pre-school level or in the scientific laboratory, meaning that children naturally think like scientists (Bybee, 2000). Thus, students who learn through inquiry achieve deeper perceptions of the resulting concepts and retain these concepts for a longer term than when the same concepts are offered through lecture or readings (Duke, Nowicki, & Martin, 1996). In addition, students will gain the skills of inquiry and scientific attitudes desired by the standards, and will gather more knowledge about how scientific research is really performed (NSTA, 2003).

Essential Elements in Teaching Science as Inquiry

According to the Standards for Science Teacher Preparation, science teachers must encourage their students to learn scientific content through various scientific inquiry methods which involve: 1) asking questions; 2) collecting data; 3) collaborating on work; 4) and developing theory from experimental experiences (NSTA, 2003). The questionnaires in the present survey will facilitate the findings regarding teachers' preparation to teach through inquiry methods. In addition, the National Science Teachers Association (NSTA, 2003, P17) research signifies that science teachers, in order to teach science, must:

1) Understand the procedures, and hypotheses of various methods of inquiry

principals to scientific knowledge;

2) Motivate students effectively in suitable inquiries that involve them to develop concepts and interaction from their observations, data, and inferences in a scientific method;

3) Understand and can clear the knowledge and practices of modern science;

4) Interrelate and interpret important concepts, ideas, and applications in their fields of licensure; and can conduct scientific investigations;

5) Show that they are prepared in content;

6) Explain to students the major concepts, principles, theories, laws, and interrelationships of their field licensure and supporting fields as recommended by the National Science Teachers Association.

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One of the most important targets of science education, according to the Benchmarks for Scientific Literacy, American Association for the Advancement of Science (AAAS, 1993) and the National Science Education Standards (NRC, 1996) is to facilitate students to use inquiry to solve problems. The talent to engage in inquiry should be developed by using systematically valid methods that would be considered as a feature of scientific literacy (NRC, 1996). To teach science as inquiry involves using complex and higher-order thinking skills to address open-ended problems (Windschitl, 2004). In addition, the teacher, while teaching science, must use multiple, sometimes differing, principles to assess his or her students' procedures and findings (Mohrig, Hammond & Colby, 2007). The sequence of inquiry lesson ends with an elaboration and assessment that depends upon the earlier interpretation processes (Anderson, 2002).

In science education, inquiry may characterize in different ways. The first of

these is discovery learning, in which the teacher sets up the problem and processes but allows the students to make sense of the outcomes on their own, with assistance in the form of primary questions (Martin-Hansen, 2002). Another type of inquiry method that Martin-Hansen (2000) described was the guided inquiry, in which the teacher poses the problem and may assist the students in designing the inquiry and making sense of the outcome. Farrell, Moog, and Spencer (1999) claim that guided inquiry is designed to lead students to hypothesis formation and testing. The student begins by collecting data and looking for trends or patterns. Ideally, a hypothesis is formed and then tested (Farrell, Moog, & Spencer, 1999). The interaction between all of these types of inquiry meets with the emphasis of solving problem by observing, collecting, and creating assumptions from data (Jarrett, 1997). More advanced forms of inquiry, as Ibarra argues, are about the inquiry that requires students to ask questions that can be addressed by research, design experiments, and evaluate conclusions (2006). The three multiple developed methods for inquiry are fairly common (Colburn, 2000). Colburn states also the meanings of these types of inquiry and their implementations are widespread at the present time (2000).

When students learn science through inquiry, they communicate their thoughts and ideas through hands-on activities (Jarrett, 1997).. As a result, teachers can provide better help to their students in developing their understanding of the nature and the process of science (Lotter, Harwood and Bonner, 2007)). According to Krajcik (2006), inquiry also contributes to students' social development, and their logical development. Krajcik (2006) discusses that science inquiry in the classroom is carried out in a social context. Students discuss plans and work collaboratively in carrying out

inquiry activities. As they conduct an experiment, they keep science notebooks containing written and graphic records and reflections (Krajcik, 2006). Science journals also prepare them to present their work in a public forum to their classmates (Ibarra, 2006). Nevertheless, activities not only advance collaboration among children, they also help develop language and literacy capability (Ibarra, 2006). Lastly, inquiry requires students to access written material in order to compare their investigation with authentic science knowledge, and, by reading and comprehending the fundamental topics, students join the larger scientific community on the many topics as a literate citizen (Ibarra, 2006).

The Role of the Teacher in the Inquiry Classroom

Teachers are one of the essential elements in developing curriculum, and they are the key to accomplishing the goals of the curriculum. They play an essential role in establishing the inquiry-based classroom and they are the main mechanism of the education system. Hence, science teachers have great responsibilities to help develop literate citizens. Although inquiry teaching demands a different relationship between teacher and student than more traditional teaching methods, it necessitates a high level of organization, planning, and arrangement, both by the teacher and the students. It is a fact that a science classroom milieu that is accommodating and encouraging doing inquiry must be consciously developed. The teacher must create a climate for doing inquiry (Ibarra, 2006). Ibarra states that the teacher's role in the inquiry classroom is a very active and dynamic one. Acting as a facilitator, or guide, the teacher identifies a set of carefully considered techniques to explore big ideas called a conceptual framework from which children build up their explorations (2006, p71). This conceptual

framework is the basis for guiding students to learn something deeper about a scientific concept (Ibarra, 2006).

During the inquiry lesson, the teacher walks around the room, cooperates with groups of students as they work on assigned experiments. He/she listens to their questions and concerns, constantly assessing their progress and determining the appropriate next steps for their learning (Flick, 1995). Then, the teacher gathers the whole class to explain and add additional knowledge through modeling, demonstrations, or discussions (Flick, 1995). Nevertheless, in order for inquiry to be effective, a teacher must set a base foundation in which students can begin to take more responsibility for their own learning (Hackling, 2004). For example, the teacher creates a rich physical atmosphere in which students learn how to sort out and manage materials. In addition, the teacher must develop an encouraging social milieu in which students can work collaboratively in small and large groups, participate in speech, and be trained to respect other students who do not share his or her same thoughts, understandings or beliefs (Ibarra, 2006). Windschitl and Buttemer explain that the inquiry process is more than talking about one element; it is more like a compound of different elements blended together in the form of a lesson (2000). Inquiry is the use of language in discussions, and writing journals is a part of the scientific literacy for that inquiry (Bybee, 2000). It also involves the use of technology and incorporating the image of natural phenomena that cannot be seen in their everyday life (Ibarra, 2006). Inquiry includes the use of modeling in building or drawing a situation to solve or accomplish an experiment, then, analyzing its data through the use of mathematical analysis (Mohrig, Hammond, and Colby, 2007).

Another important tool in teaching science as inquiry is the assessment which serves in evaluating students' understanding. The assessment should provide teachers and students with timely feedback about students' knowledge that, in turn, supports teachers' efforts to improve instruction (Hackling, 2004).

Thus, teachers must be aware of their responsibilities in the science classroom, and they should be aware of their greater role which is establishing the inquiry when teaching science (Keys, Bryan, 2001). They are also the main mechanism of the education system in shouldering a great responsibility to develop a literate, thinking citizen (Keys, Bryan, 2001).

Influence of teachers' beliefs and implementations in teaching science

Teachers' scientific epistemological views are often consistent regarding their instructional beliefs and practice (Lotter, Harwood and Bonner, 2007).

Teacher beliefs are often difficult to change because they are based in part on their practical teaching knowledge that is learned over many years of classroom experience (Lotter, Harwood & Bonner, 2007). Keys and Bryan define "teacher content knowledge" as "the integrated set of understanding, conceptions, beliefs, and values that develops in the milieu of the teaching" situation (2001, p 637). Teachers' background knowledge helps them to develop theories about certain topics in science as well as contributes to the decisions they make in their classrooms. The content knowledge and pedagogical theories of teaching that teachers hold have an impact on and influence the teachers' students and school environment (Lotter, Harwood & Bonner, 2007). Lotter, Harwood and Bonner indicate that teachers who are well trained and aware of the nature of science tend to use inquiry very effectively. For instance, teachers will address indirect ideas,

asking more open-ended questions, leading rather than directing, and motivating more student-centered discussions (Lotter, Harwood & Bonner, 2007)

Lotter, Harwood and Bonner state that, to have better teaching skills in science, teachers must understand and know how “ the science standards; curricula, assessment, and instruction follow from our conclusions” (2007, p 1342). Hence, teachers must be able to build lessons in the light of pedagogical science standards, curriculum, assessment, and instruction. On the other hand, to provide a professional development for science teachers, programs should be conceived of, planned, and implemented as a coordinated system. Standards and curriculum should be taught specifically. The goals for the program should be coherent and reflect on scientific ideas and practices that can be realized through sustained instruction over several years of K-8 schooling (Lotter, Harwood & Bonner, 2007). Teacher preparation and professional development should be focused on developing teachers’ knowledge of the science they teach, how students learn science, and specific methods and technologies that support science learning for all students (Lotter Lotter, Harwood & Bonner, 2007). Teachers are indeed intelligent decision makers who will have their own perspectives and definitions of inquiry (Krajcik, Novak, Gleason & Mahoney, 2006). The National Science Education Standards present important proposals for the goals of inquiry teaching, content for inquiry learning, and some examples of the types of activities in which students may be engaged. However, it will be up to classroom teachers to plan models of teaching procedures that achieve these goals (Martin, 2004). Teaching actions will automatically differ based on aspects in the local environment, such as

teacher understanding, student age, student economy status, and many other factors (Czerniak & Lumpe, 1995). Martin states that “ there are multiple modes and patterns of inquiry based instruction that are not only inevitable but also desirable because they will paint a rich picture of meaningful learning in diverse situations” (2006, p 231). The multiple modes of inquiry teaching and learning will invite teachers to engage in participating in inquiry in ways that match their own beliefs and teaching styles (Martin, 2006).

Teachers and their beliefs

Everything undergoes changes in the current world. Teaching methods and learning methods are also changing constantly and the teachers need to adapt to the changing trends in education to be more effective in their profession. For that, teachers need to change their beliefs and attitudes with respect to the current learning needs of the students. The view of change in teaching practice focuses on the failure of teachers to adopt teaching activities, practices, and curricula that are suggested or mandated by those who are external to the setting in which the teaching is taking place: administrators, policy-makers, and staff developers (Richardson, 1998). Most of the people believe that teachers are reluctant in implementing changes in their teaching strategies because they feel threatened, defensive, and perhaps rushed when somebody demands change in their methods. In fact teachers undertake change voluntarily, following their sense of what their students need and what is working. Voluntary change is what teachers actually do in their classrooms; it does not necessarily lead to exemplary teaching (Richardson, 1998).

The induction and experienced teacher’s approach to change management

may be different. The induction teachers experienced more change in their beliefs than their practices, whereas experienced teachers demonstrated more change in their practices than their beliefs (Luft, 2001). The experienced teachers always have a strong belief in the traditional methods of teaching; but they were forced to change their practices because of the external pressure from the authorities. On the other hand, the induction teachers may not have much practical experiences and their beliefs also may not be adequate. So they will be more flexible as far as change in beliefs is concerned. “ If all teachers make decisions autonomously, the schooling of an individual student could be quite incoherent and ineffective. This, too, suggests that help, direction, or encouragement provided to staff rather than to individuals could be necessary to promote change that is valuable to the learner” (Richardson, 1998, p 4) Beliefs are critical when it comes to understanding a teacher’s practice. For example, two mathematics teachers with similar knowledge may taught in different ways.

Understanding of beliefs was more useful in predicting teachers’ classroom decisions (Luft & Roehrig, 2007). on the other hand, Institutions cannot behave like a market place where all the deals were based on competitions and bargaining. It should be functioned in a structured manner with a clear vision and mission. For that purpose, the teaching strategies must be unified and standardized irrespective of the individual beliefs of the teachers. “ Individuals can hold beliefs that are independent of one another and have a varied impact on actions or cognitive processes” (Luft & Roehrig, 2007).

Historical Background of the State of Kuwait

Country Review

Kuwait is located at the northwestern corner of the Persian Gulf. Its area is

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about 6200 square miles, with a population of 2 million (Ebrahim, 2004).

Only 45 per cent of the population is Kuwaiti, while the rest of the population originates from more than 120 different countries around the world

(Ebrahim, 2004).

In 1912, Al Mubarakiyya School was founded as Kuwait's first modern educational institution (Al-Houly, 1999). According to Al-Houly (1999), Kuwaiti schools in the past were funded by merchants, he also informs us that “in order to supply the clerks who had a primary foundation in commerce, arithmetic skills, as well as letter drafting skills. Later, subjects like history, geography and also art courses were introduced to the curriculum” (Al-Houly, p 25). English course offerings followed in 1921 at the Al Ahmadi School, then shortly after the establishment of the first girls school, there was instruction in home economics, Arabic and Islamic studies (Mohammad & Almahmeed, 1988).

Since the oil boom in the 1950s, the developments or social changes in Kuwait have accelerated speedily (Meleis, El-Sanabary & Beeson, 1979).

Before the super affluence brought about by oil, Kuwait was known to be a poor sheikdom, economically as well as technologically undeveloped, a state consisting of people without a stable source of living such as fishing, herding, pearling, herding, or trading (Meleis, El-Sanabary & Beeson, 1979). It wasn't until later in the 1960's that Kuwait's standard of life improved. In addition; the Kuwait Constitution was initiated in 1961 with a strong emphasis on educating Kuwaiti citizens (Meleis, El-Sanabary & Beeson, 1979). The Kuwait Constitution is also responsible for establishing a free education system to Kuwaiti citizens from kindergarten to college level.

According to the constitution of the state of Kuwait:

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Article 10:

The state cares for the young and protects them from exploitation and from moral, physical, and spiritual neglect. (The Constitution of the State of Kuwait, 1962, p. 7)

Article 13:

Education is a fundamental requisite for the progress of the society, assured and promoted by the state. (The Constitution of the State of Kuwait, 1962, p. 7)

Article 40:

Education is a right for Kuwaitis, guaranteed by the state in accordance with law. Law shall lay down the necessary plan to eliminate illiteracy. The State shall devote particular care to the physical, moral, and mental development of the youth. (The Constitution of the State of Kuwait, 1962, p. 11)

For a long time, Kuwaiti society deeply felt the need of having a national work force in the field of education. It recommended that a four-year post-secondary teacher training college should be established (Ebrahim, 2004). A sequence of efforts led to the actualization of such a recommendation. “ On May 17th 1980, an Amir decree was issued ordering the establishment of the College of Education as a separate institution within Kuwait University, responsible for the preparation of teachers” (Kuwait University, 2003, p 142). Throughout two decades of work; the College of Education has operated in the context of proactive response to a national demand for education. Continuous work in policymaking, implementation, reform, and development has been done. Fruitful results are seen and left in all domains of national development through the improvement of the teaching work force (Kuwait University, 2003).

Structure of the educational system in Kuwait

The educational system in Kuwait is adapted from the latest educational theories and fall into the Arabic traditions (Al-Houly, 1999). Kuwait also has a standard twelve year public school system which is subdivided into four intervals named: kindergarten, elementary, intermediate, and secondary (Al-Houly, 1999).

The stages of formal education in Kuwait Public school are:

Kindergarten: A two year course ages from 4-6

Elementary: A five year course ages from 6-11

Intermediate (Middle): A four year course ages from 11-15

Secondary: A three year course ages from 15-18

Students are advanced annually to higher levels after successfully completing comprehensive non-standardized examinations (i. e. school specific) at the end of each school year (Mohammad & Almahmeed, 1988).

The final year of secondary school is the most important for all university hopefuls (Mohammad & Almahmeed, 1988). At the end of their final year all twelfth grade students in the country take an extensive set of standardized tests that determine their secondary school examination score (Mohammad & Almahmeed, 1988).

The science curriculum in middle school in Kuwait

From the beginning the Ministry of Education in Kuwait was centralized. It controls all district decisions and pedagogical issues (Ebrahim, 2004).

However, the Ministry has adapted many current methodologies such as teaching science as inquiry to meet the primary goal of education which is developing literate citizens (Ebrahim, 2004). Science teachers in all six counties use the same book and the same strategies. For example,

according to Ebrahim, “ a science teacher must teach his/her students in a science laboratory; plus, both teachers and students must wear lab coats during the science class” (2004, p 28). He also states that laboratory supplies and instruments are funded from the school budget that has been assigned from the ministry (2004).

Next, all teachers in different districts teach from the same book, the same curriculum, and the same styles of laboratories. Nevertheless, teachers are assessed and followed up by: 1) supervisors; 2) science chair teacher; and 3) the principal twice a year. The reason for this assessment is to assure that the teacher is adhering to the standards and following the pedagogy. The supervisor’s mission is to assess the science content, the principal’s mission is to assess the pedagogical matters and the science chair is to follow up with teachers as well as track curriculum, help teachers in solving problems with students, and assess and advise teachers under his/her department (Al-Houly, 1999).

Preservice teacher program at Kuwait University

More specifically, the curriculum for preservice teachers in Kuwait is very concentrated. The aim of the program is to establish a literate science teacher who is fully prepared to teach science. Table 1 shows the graduate requirement for undergraduate pre-service teachers. The course major has two main categories: content knowledge of science and knowledge of mathematics as well as attention given to the pedagogical knowledge that enriches the two concentrations. This program focuses on three elements: 1) inquiry, 2) other teaching strategies, and 3) the use of multimedia and visualization tools in teaching and learning about inquiry in science education. Inquiry in Science Education examines how using inquiry-based

teaching and learning strategies can improve students' understanding of science (Kuwait University, 2003). Through the readings, videos, discussions, assignments, and other interactive experiences, learners in pre-service teacher programs will have multiple opportunities to develop content knowledge about inquiry in science education and the processes of science (Kuwait University, 2003). Learners will experience a rich multimedia, inquiry-based learning environment as their students ideally would in their own classrooms. The course provides effective teaching methodologies, strategies and tools that can be used when teaching life (Kuwait University, 2003). The preparations of the education program for preservice, elementary and middle science teachers in Kuwait, take place both on campus and off campus. In the pre-service teacher program at Kuwait University there are two main roles:

Roles on-campus:

- a. Cooperating with other colleges in reviewing and implementing policies and procedures.
- b. Maintaining constructive partnerships in actualizing Kuwait University's mission and aims.
- c. Providing counseling services, guidance, and subsidiary or elective courses for students.
- d. Graduation, to ensure quality preparation for national work force
- e. Participating in inter-collegial activities (Kuwait University, 2003, p 126).

Roles off -campus:

- a. Maintaining partnerships with other institutions to ensure quality preparation of teacher preparation.
- b. Designing and implementing training sessions for the workforce, to ensure

institutional development.

c. Fostering highly organized policies and procedures for the improvement of research and practice, in national institutions (local, Gulf and Arab)

d. Cooperating with the Ministry of Education to ensure quality education, advance the reform of education, and gearing the workforce to meet the demands of society and development requirements, based on established knowledge and sound professional practice

e. Holding, hosting, and participating in national and international seminars, symposia, and conferences for the development of education and the betterment of life. (Kuwait University, 2003, p 126)

Table 1 shows that the preservice program for science education is very concentrated in constructing a firm content knowledge in science.

Additionally, the program is developed only for teachers who are interested in teaching science and who will be hired after their graduation by the Ministry of Education.

Table 1 Elementary and intermediate science education program

The Intermediate and Elementary program for preservice teachers shown in Table 1 is very concentrated and it only focuses on science and mathematics education. Teachers, who graduate from this program, can teach science and mathematics for first to eighth grades only. The program's content knowledge is very comprehensive and rigid. Preservice teachers take 57 credits of science and mathematics classes. In addition to that they take 45 pedagogical credits including 10 credits of student teaching in public Kuwaiti schools. Figure 1 shows the preservice teachers preparation to teach science.

METHODOLOGY

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The study employed the descriptive research design. The descriptive research as defined by Best is concerned with: relationships or conditions that exist; prevailing practices; points of views, beliefs, and attitudes which are held; processes which are going on; effects that are felt; or the developing trends (Czerniak & Lumpe, 1995). Further, descriptive research reports new phenomena across across certain group At times, descriptive research may be concerned about how this development occurred, what it is or what presently exists and is related to some proceeding phenomenon that has influenced or may have affected a present condition or event (Czerniak & Lumpe, 1995). Teachers are the key to successful reform and studies have found that many teachers have beliefs about science that are incompatible with reform efforts in science. Incompatible beliefs about science reform would seem certain to doom our current efforts at restructuring science for middle schools in Kuwait. The selected science teachers completed their questionnaires during school time. Once the answers had been collected, data were analyzed using Statistical Package for the Social Science (SPSS) a descriptive method of analysis (Green, & Salkind, 2008). Results obtained from data analysis were reported in the form of narrative and tables. These results were thoroughly discussed and related to the findings of similar previous studies.

Participants

The study took place in all 26 middle schools districts in Hawali County in the state of Kuwait. There were 126 participants in the survey. There was no communication between the participants and the researcher. The survey took approximately 40 minutes to complete. The study was voluntary; participants were allowed to choose not to participate or to withdraw from

the study at any time without penalty. The research investigated teachers' beliefs and their implementations of inquiry in their science classrooms.

Data collection:

Clearing the IRB:

In order to answer the research questions, the researcher used the following procedures

A questionnaire was used from a previous study done in the United States in. Then, the questionnaires was translated into Arabic language. Arabic is the first and the official language in Kuwait.

After translation had been completed, it was reviewed by three Arabic language speakers to assure that the language was coherent and understandable.

Both English and Arabic surveys were submitted to the IRB for approval.

After the IRB approval, the survey was ready for implementation

Teachers completed the surveys in their school during their free time.

Purpose

The main purpose of the present study was to investigate the beliefs of the science teachers in middle schools in Kuwait and the degree to which they feel that they implement teaching science as inquiry. This analysis is organized according to the survey that was distributed to the science teachers in middle schools in Kuwait. At this point the researcher will provide an analysis of the data which were gathered by surveying a sample of 126 science teachers in Kuwait. The study is mainly descriptive in nature and this required using the statistical package for social science (SPSS) procedure to determine whether there will is a correlation between privately held beliefs and use of inquiry.

Data Analysis

Scores

The data analysis will present and analyze a specific area of the available data gathered through the questionnaires. The first section describes the participant sample, the second section reports analysis relevant to the study's research questions of teachers' beliefs about inquiry. Questionnaires are scored according to the following scale: 1= Unnecessary; 2= Not very necessary; 3= Undecided; 4= Necessary; 5= Very necessary. The third section reports analysis relevant to the study's research question regarding teachers' implementations of inquiry in their classrooms, and questionnaires are scored according to the following scale: 1= Never; 2= Less than once a week; 3= About once a week; 4= Several times a week; 5= Almost Everyday. The fourth section reports analysis to the third part of the questionnaires which are scored according to the following scale: 1= Strongly disagree; 2= Disagree; 3= Uncertain; 4= Agree; 5= Strongly agree. The wording of all three surveys is positive so that the greater the participant's agreement, the more positive their perception of the item. The midpoint of the scale is 3, with results less than 3 reflecting negative perceptions.

Survey Questions

This study of teachers' beliefs about the importance of being an effective science teacher will be guided by the following concepts. Below Table 2 shows the concepts used in this study that were adopted from Czerniak and Lumpe, report mentioned previously .

Table 2 Concepts

Concept

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Definition

Constructivism.

A learning theory that assumes that all learners construct their own meaning for concepts based on their personal experiences with the natural world. The teacher bases instruction on students prior knowledge. For example: teaching for conceptual change.

Learning Styles.

Students have preferred modes and styles of learning. Teachers use a diversity of instructional strategies to meet the needs of all students. For example: basing instruction on learning styles by including a variety of activities and approaches

Thematic Approach.

A curricular organization using major concepts or ideas in science and technology to provide a sense of continuity across a unit, chapter, or year. For example: systems, patterns of change.

Classroom Management.

Procedures and techniques teachers employ in planning learning tasks, using educational resources, and conducting instruction to maximize student learning. For example: providing helpful hints for setting up laboratories.

Assessment and Evaluation.

Teachers gather data from diverse sources to judge the degree which the students achieve the intended outcomes for the program. It is a continuous process to make decisions about instruction. For example: portfolios, performance assessment.

Equity.

Teacher provides learning experiences so that students develop positive

attitudes, self-efficacy, and an understanding of science and technology. For example: making sure minorities, physically challenged, and low achievers. Science/Technology/Society.

Curriculum and instruction includes emphases on the history and nature of science and technology; the interactions among science, technology, and society; on science-related social issues; understanding how things are made and how they work; and how science relates to our lives through such things as the environment, medicine, and engineering. For example: a unit on acid rain or studying the development of the germ theory of disease.

Educational Technology.

Teacher uses a wide range of educational technologies (computers, video, print, manipulative) to promote student learning. For example: using microcomputer- based laboratories or laser disks in science.

Science Subject Matter.

The teacher possesses knowledge of those basic concepts, principles, facts, laws and theories that constitute the current body of scientific knowledge. For example: the teacher is knowledgeable enough of astronomy to teach the content and answer most all questions the students might ask.

Cooperative Learning

A strategy emphasizing conceptual learning through social interaction within small groups of students. For example: balancing instruction within small groups emphasizing the social skills along with content to be learned.

Hands-On/Minds-On Activities.

Teacher chooses and uses effective science activities which promote student learning and positive attitudes toward science. Example: In a unit on sound, students actually experience how sound travels through air, water, and

solids by manipulating equipment.

The Nature of Science.

Teachers enable students to understand and engage in scientific inquiry; to make evidence-based decisions through an understanding and appreciation for the modes of reasoning involved in scientific inquiry. Also includes the social and historical contexts in which science evolved along with the values underlying the work of scientists. For example: the teacher has students use a candle, water, flask, and pan to see why water rises in a flask when it is put over a burning candle sitting in a pan of water. Student's reason why water rises and discusses with each other why they think the water rises. The teacher does not give an "exact answer," but allows students to explore the idea over several hours or days.

Description of the sample: Middle Science Teachers in Kuwait

A sample of 126 middle science teachers from 26 different Kuwaiti public schools at Hawali County was used for the study. All 126 of the questionnaires were completed and returned (100 %). The teachers who were selected to complete the questionnaires were from Hawali County schools, because Hawali County is more densely populated than any of the other counties in Kuwait (Al-Houly, 1999).

FINDINGS

What are the beliefs of middle school science teachers from Kuwait regarding effectiveness of inquiry-based science lessons?

Table 3 shows the percentages of teachers from Kuwait who responded to each item measuring the necessity of the reforms to be an effective science teacher. As can be seen in Table 3, over eighty-five percent of teachers believed that the reforms strands were "necessary" or "very necessary" to

be an effective science teacher. Apart from reform strand classroom management (12%), in all other reforms, less than ten percent teachers did not believe the reforms were necessary or were uncertain it was needed.

Table 3

Percentage of Teachers Responding to Each Reform Strand: Necessity of the Reform to be an Effective Science Teacher

Reform Strand

Response

UN = Unnecessary

NVY = Not Very Necessary

U = Undecided

N = Necessary

VN = Very Necessary

X = Didn't answer the question

UN

NVY

U

N

VN

X

Constructivism

0.0

1.6

1.6

14.3

81.7

0.8

Learning Styles

0.0

0.8

0.0

22.2

77.0

0.0

Thematic Approach

0.0

4.0

2.4

34.9

57.1

1.6

Classroom Management

0.0

11.9

0.0

46.0

42.1

0.0

Alternative Assessment

0.0

1.6

6.3

19. 8

72. 2

0. 0

Equity

0. 0

0. 0

0. 0

11. 9

88. 1

0. 0

STS

0. 0

2. 4

2. 4

27. 8

67. 5

0. 0

Technology

0. 0

0. 8

4. 8

33. 3

61. 1

0. 0

Science Subject Matter

0. 0

0.8

0.0

25.4

73.8

0.0

Cooperative Learning

0.0

5.6

2.4

38.1

53.2

0.8

Hands-On Activities

0.0

4.8

0.0

29.4

65.9

0.0

Nature of Science

0.0

1.6

1.6

23.0

73.8

0.0

Bar graph of Teachers Responding to Each Reform Strand: Necessity of the Reform to be an Effective Science Teacher

Figure 2: Teacher's belief of constructivism

As can be seen in figure 2, almost all (96%) of the teachers believed that the reform strand constructivism was “ necessary” or “ very necessary” to be an effective science teacher. Only few (3%) of the teachers did not believe that reform strand constructivism was necessary or were uncertain it was needed.

Figure 3: Teacher's belief of learning styles

As can be seen in figure 3, almost all (99%) of the teachers believed that the reform strand learning styles was “ necessary” or “ very necessary” to be an effective science teacher. Only few (1%) of the teachers did not believe that reform strand learning styles was necessary.

Figure 4: Teacher's belief of thematic approach

As can be seen in figure 4, the majority (92%) of the teachers believed that the reform strand thematic approach was “ necessary” or “ very necessary” to be an effective science teacher. Only some (6%) of the teachers did not believe that reform strand thematic approach was necessary or were uncertain it was needed.

Figure 5: Teacher's belief of classroom management

As can be seen in figure 5, the majority (88%) of the teachers believed that the reform strand classroom management was “ necessary” or “ very necessary” to be an effective science teacher. Only some (12%) of the teachers did not believe that reform strand classroom management was necessary.

Figure 6: Teacher's belief of alternative assessment

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As can be seen in figure 6, the majority (92%) of the teachers believed that the reform strand assessment and evaluation was “ necessary” or “ very necessary” to be an effective science teacher. Only some (8%) of the teachers did not believe that reform strand assessment and evaluation was necessary or were uncertain it was needed.

Figure 7: Teacher’s belief of equity

As can be seen in figure 7, All (100%) of the teachers believed that the reform strand equity was “ necessary” or “ very necessary” to be an effective science teacher.

Figure 8: Teacher’s belief of science/technology/society

As can be seen in figure 8, the majority (95%) of the teachers believed that the reform strand science/technology/society was “ necessary” or “ very necessary” to be an effective science teacher. Only some (5%) of the teachers did not believe that reform strand science/technology/society was necessary or were uncertain it was needed.

Figure 9: Teacher’s belief of educational technology

As can be seen in figure 9, the majority (94%) of the teachers believed that the reform strand technology was “ necessary” or “ very necessary” to be an effective science teacher. Only some (6%) of the teachers did not believe that reform strand technology was necessary or were uncertain it was needed.

Figure 10: Teacher’s belief of science subject matter

As can be seen in figure 10, almost all (99%) of the teachers believed that the reform strand science subject matter was “ necessary” or “ very necessary” to be an effective science teacher. Only some (1%) of the teachers did not believe that reform strand science subject matter was

necessary.

Figure 11: Teacher's belief of cooperative learning

As can be seen in figure 11, the majority (91%) of the teachers believed that the reform strand cooperative learning was “ necessary” or “ very necessary” to be an effective science teacher. Only some (8%) of the teachers did not believe that reform strand cooperative learning was necessary or were uncertain it was needed.

Figure 12: Teacher's belief of hands-on activity

As can be seen in figure 12, the majority (95%) of the teachers believed that the reform strand hands-on/minds-on activity was “ necessary” or “ very necessary” to be an effective science teacher. Only some (5%) of the teachers did not believe that reform strand hands-on/minds-on activity was necessary.

Figure 13: Teacher's belief towards necessity of the nature of science

As can be seen in figure 13, the majority (97%) of the teachers believed that the reform strand nature of science was “ necessary” or “ very necessary” to be an effective science teacher. Only some (3%) of the teachers did not believe that reform strand nature of science was necessary or were uncertain it was needed.

How often do teachers use inquiry while teaching science?

Table 4 shows the degree to which teachers from Kuwait report implementing the reform strands in their own classroom. As can be seen in Table 4, teachers report using many of the reform strands almost every day or several times a week. The reforms most used (by at least 70% of the teachers) were constructivism, learning styles, thematic approach, alternative assessment, equity, STS, technology, and science subject matter.

Alternative assessment (90%), equity (88%), and technology (83%) were the most used reform strands the teachers reporting using it “ almost every day” or “ several times a week”.

Classroom management stood out among the reform strands least implemented in the classroom. Only 45% of teachers reported using classroom management almost every day or several times a week. Less frequently used reform strands (used once a week, less than once a week, or never) by over 30% of teachers include classroom management (55%), cooperative learning (42%), hands-on/minds-on activities (37%), and nature of science (30%).

Table 4

Percentage of Teachers Responding to Each Reform Strand: Implementation of the Reform in Their Classroom

Reform Strand

Response

AED = Almost Every Day

STW = Several Times a Week

OW = About Once a Week

LOW = Less than Once a Week

N = Never

X = Didn't answer the question

AED

STW

OW

LOW

N

X

Constructivism

55. 6

19. 8

19. 8

3. 2

0. 8

0. 8

Learning Styles

36. 5

42. 1

20. 6

0. 8

0. 0

0. 0

Thematic Approach

38. 1

33. 3

20. 6

4. 8

2. 4

0. 8

Classroom Management

20. 6

24. 6

25. 4

24. 6

4. 8

0. 0

Alternative Assessment

63. 5

26. 2

7. 9

1. 6

0. 8

0. 0

Equity

70. 6

17. 5

8. 7

3. 2

0. 0

0. 0

STS

49. 2

26. 2

15. 1

8. 7

0. 0

0. 8

Technology

42. 9

39.7

10.3

6.3

0.0

0.8

Science Subject Matter

54.0

19.8

14.3

6.3

3.2

2.4

Cooperative Learning

38.1

19.8

20.6

15.1

6.3

0.0

Hands-On Activities

39.7

23.8

24.6

10.3

1.6

0.0

Nature of Science

48.4

20.6

15.9

12.7

1.6

0.8

Bar graph of Teachers Responding to Each Reform Strand: Implementation of the Reform in Their Classroom

Figure 14: Teacher's implementation of constructivism

As can be seen in figure 14, the majority (75%) of the teachers report using reform strand constructivism almost every day or several times a week in their classroom during the year. Few teachers (24%) report using reform strand constructivism about once a week, less than once a week, or never.

Figure 15: Teacher's implementation of learning styles

As can be seen in figure 15, the majority (79%) of the teachers report using reform strand learning styles almost every day or several times a week in their classroom during the year. A few (21%) of the teachers report using reform strand learning styles about once a week, or less than once a week.

Figure 16: Teacher's implementation of thematic approach

As can be seen in figure 16, the majority (71%) of the teachers report using reform strand thematic approach almost every day or several times a week in their classroom during the year. Few teachers (28%) report using reform strand thematic approach about once a week, less than once a week, or never.

Figure 17: Teacher's implementation of classroom management

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As can be seen in figure 17, the teachers were divided for reform strand classroom management. The teachers report classroom management in their classroom during year as almost every day (21%), several times a week (25%), about once a week (25%), less than once a week (25%), and never (5%).

Figure 18: Teacher's implementation of alternative assessment

As can be seen in figure 18, the majority (90%) of the teachers report using reform strand assessment and evaluation almost every day or several times a week in their classroom during the year. A few (10%) of the teachers report using reform strand assessment and evaluation about once a week, less than once a week, or never.

Figure 19: Teacher's implementation of equity

As can be seen in figure 19, the majority (88%) of the teachers report using reform strand equity almost every day or several times a week in their classroom during the year. A few (12%) of the teachers report using reform strand equity about once a week or less than once a week.

Figure 20: Teacher's implementation of science/technology/society

As can be seen in figure 20, the majority (75%) of the teachers report using reform strand science/technology/society almost every day or several times a week in their classroom during the year. A few (24%) of the teachers report using reform strand science/technology/society about once a week or less than once a week.

Figure 21: Teacher's implementation of educational technology

As can be seen in figure 21, the majority (83%) of the teachers report using reform strand technology almost every day or several times a week in their classroom during the year. A few (17%) of the teachers report using reform

strand technology about once a week or less than once a week.

Figure 22: Teacher's implementation of science subject matter

As can be seen in figure 22, the majority (74%) of the teachers report using reform strand science subject matter almost every day or several times a week in their classroom during the year. A few (24%) of the teachers report using reform strand science subject matter about once a week, less than once a week, or never.

Figure 23: Teacher's implementation of cooperative learning

As can be seen in figure 23, the majority (58%) of the teachers report using reform strand cooperative learning almost every day or several times a week in their classroom during the year. A number the teachers report using reform strand cooperative learning about once a week (21%), less than once a week (15%), or never (6%).

Figure 24: Teacher's implementation of hands-on activity

As can be seen in figure 24, the majority (64%) of the teachers report using reform strand hands-on/minds-on activity learning almost every day or several times a week in their classroom during the year. A number the teachers report using reform strand hands-on/minds-on activity about once a week (25%), less than once a week (10%), or never (2%).

Figure 25: Teacher's implementation of the nature of science

As can be seen in figure 25, the majority (69%) of the teachers report using reform strand nature of science almost every day or several times a week in their classroom during the year. A number the teachers report using reform strand nature of science about once a week (16%), less than once a week (13%), or never (2%).

Is there a correlation between beliefs and use of inquiry?

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Considering all items measuring the necessity of the reforms to be an effective science teacher are equal, a new variable “belief” was formed. Similarly, a new variable “implementation” was formed by adding all items in implementation of the reform in teacher classroom.

Figure 26: Scatterplot of belief and use of inquiry (implementation)

Figure 26 shows the scatterplot of belief and use of inquiry (implementation) to be an effective science teacher. As can be seen in figure 1, it appears that there is a strong linear relationship between teacher’s beliefs to be an effective science teacher and their beliefs about the use of inquiry in their classroom during the year.

The teacher’s belief to be an effective science teacher and use of inquiry (implementation) in their classroom during the year were strongly correlated, $r(124) = .65, p < .001$. (Table 4)

Table 3

Descriptive Statistics

Mean

Std. Deviation

N

Belief

55.079

3.876

126

Implementation

48.683

7.500

126

Table 4

Correlation between Belief and Use of Enquiry

Belief

Implementation

Belief

Pearson Correlation

1

. 646(**)

Sig. (2-tailed)

. 000

N

126

126

Implementation

Pearson Correlation

. 646(**)

1

Sig. (2-tailed)

. 000

N

126

126

** Correlation is significant at the 0. 01 level (2-tailed).

DISSCUSTIONS AND IMPLICATIONS