

**IRAQI SECONDARY SCHOOLS BIOLOGY TEACHERS'  
COMPETENCY AND PERFORMANCE IN  
LABORATORY SKILLS**

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LABORATORY SKILLS**

**By**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

### **DECLARATION**

For the greatest family:

My dear husband who fill my heart with love and life with beauty, and  
our beloved sons: Taef and Fady, for being part of this amazing journey to get  
“our” master! And trust that they will see value in the pursuit of knowledge.



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## **LIST OF ABBREVIATIONS**

ANOVA	-	Analysis of Variance
BLSQ	-	Biological Laboratory Skills Questionnaire
BTCK	-	Biology Teacher Content Knowledge
BLS	-	Biology Laboratory Skills
CK	-	Content Knowledge
CCK	-	Common Content Knowledge
M	-	Mean
MEERC	-	Ministry of Education, Educational Research Centre
MoNE	-	Ministry of National Education
NoT	-	Number of Teachers
PCK	-	Pedagogical content knowledge
SK	-	Science Knowledge
SPSS	-	Software Package for the Social Science
SCK	-	Special Content Knowledge
SD	-	Standard Deviation



TNoT	-	Total Number of Teachers
TF	-	Teacher Female
TE	-	Teaching Experience
TCK	-	Teacher Content Knowledge

# **KOMPETENSI DAN PRESTASI GURU BIOLOGI SEKOLAH MENENGAH DI IRAQ DALAM KEMAHIRAN MAKMAL**

## **ABSTRAK**

Penekanan kepada kemahiran makmal bagi guru biologi telah meningkat pada kebelakangan ini. Pengkaji terdahulu rata-rata memberi tumpuan kepada keperluan guru untuk meningkatkan kaedah inkuiri dan kemahiran berfikir untuk mempunyai kemahiran seperti seorang saintis. Tujuan kajian ini adalah untuk mengenal pasti kompetensi guru biologi dan prestasi kemahiran mereka dalam makmal biologi (*laboratory skills*). Selain itu, kajian ini turut menyiasat hubungan antara kompetensi dan prestasi guru biologi berkaitan kemahiran makmal biologi di sekolah menengah Iraq Najaf. Kajian literatur membincangkan dua pemboleh ubah iaitu kompetensi guru biologi dan prestasi guru biologi. Kajian ini menggunakan satu instrumen kajian bagi mengumpul maklumat daripada 265 orang guru biologi. Instrumen pertama adalah soal selidik yang terdiri daripada item demografi seperti jantina dan pengalaman mengajar dalam bahagian pertama. Bahagian II soal selidik dinamakan Kompetensi dalam Kemahiran Makmal, yang diubahsuai daripada *Biological Laboratory Skills Questionnaire (BLSQ)*. Manakala Bahagian III pula ialah Prestasi dalam Kemahiran Makmal bertujuan menentukan prestasi guru biologi. Dalam kajian ini pembolehubah bersandar adalah prestasi guru biologi, manakala kompetensi guru biologi adalah pemboleh ubah bebas. Data yang diperoleh daripada setiap instrumen penyelidikan kemudiannya dianalisis. Analisis kekerapan, min, peratus dan sisihan piawai telah menunjukkan kompetensi guru biologi dan prestasi guru biologi adalah pada tahap yang sederhana. Analisis Ujian-t juga menunjukkan tidak terdapat perbezaan yang signifikan antara guru biologi lelaki dan guru biologi perempuan dari segi kompetensi dan prestasi

dalam kemahiran makmal biologi. *Analisis Varians* (ANOVA) pula menunjukkan perbezaan yang signifikan antara pengalaman mengajar dari segi kompetensi dan prestasi dalam kemahiran makmal biologi. Analisis korelasi Pearson menunjukkan terdapat hubungan linear yang signifikan antara kompetensi guru biologi dan prestasi kemahiran makmal guru biologi. Selain itu, terdapat korelasi yang negatif di antara kompetensi guru biologi dan prestasi kemahiran makmal guru biologi. Analisis regresi linear merumuskan bahawa kompetensi dalam kemahiran makmal adalah peramal bagi prestasi guru biologi. Oleh itu, kajian ini menambah satu dimensi baru kepada kompetensi guru dan prestasi guru dalam kemahiran makmal. Penyelidikan ini dijalankan dalam konteks guru biologi di Iraq dan seterusnya menyumbang kepada penemuan yang berkaitan dengan konsep tersebut.

# **IRAQI SECONDARY SCHOOLS BIOLOGY TEACHERS'**

## **COMPETENCY AND PERFORMANCE IN LABORATORY SKILLS**

### **ABSTRACT**

The emphasis on laboratory skills for biology teachers has increased in recent years. Past researchers had mainly focused on the need for teachers to improve methods of inquiry and thinking skills to be similar to those of active scientists. Therefore, the purpose of this study is to identify biology teachers' competency and their performance as well as investigating the relationship between teachers' competency and performance in biology laboratory skills in secondary schools. Information was gathered, using two instruments, from a sample of 265 biology teachers. The first instrument is a questionnaire consisting of demography items such as gender and teaching experience in the first part. Part II of the questionnaire named Competency in Laboratory Skills, adapted from the Biological Laboratory skills Questionnaire (BLSQ) was used to determine biology teachers' competency while Part III, Performance in Laboratory Skills was used to determine the performance of biology teachers. Data obtained from research instruments was then analysed. Through frequencies, means, percentages, and standard deviations it was indicated the competency and performance of biology teachers is at the (weak) low level. T-test analyses revealed no significant differences between male and female biology teachers in terms of competency and performance in biology laboratory skills. Analysis of Variance (ANOVA) showed significant differences between teaching experience in terms of competency and performance in biology laboratory skills. Pearson's correlation analysis showed that there is a strong significant linear relationship between biology teachers' competency and performance of laboratory skills. However, it was found that there is a negative correlation between

biology teachers' competency and performance of laboratory skills. Based on linear regression analysis it was concluded that competency in laboratory skills is a significant predictor of performance of biology teachers. This research therefore adds a new dimension to teachers' competency and performance in laboratory skills. As this research takes place in the Iraqi context, it contributes to the bank of findings relating to the concepts.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction**

As a developing country, Iraq greatly needs to improve science teaching and laboratory skills of teachers at all levels of schooling. It needs a considerable number of technicians, specialists in the fields of science, and scientists to carry out its plans for economic and social development. Therefore, improving skills in science laboratory is required to produce human capital with suitable scientific skills at all levels. This has been progressively identified as a background for economic stability and growth (Atav and Altunoglu, 2009; Borgerding and Koroly, 2013). There is a great change in the science teaching curricula which has assigned an essential role to the laboratory. This changes take effect in many countries in the world (Atav and Altunoglu, 2009; Esin and Bahattin, 2010).

Biology teachers play an important role in the education system of the country because knowledge in biology is necessary for many fields like foundation medicine and science. Therefore, the growth of the country in terms of medicine or science depends partly on the biology teachers' laboratory skills (Ruiz et al., 2006; Atav and Altunoglu, 2009).

The success of any educational system depends on competency and performance of the teacher. Even for the best teacher educational programs of common content knowledge (CCK) teachers know information from university. There is still a need to improve these programs. Furthermore, there is a need for an advanced curriculum for

laboratory in many teacher training institutions in order to develop special content knowledge (SCK) which means teachers also need extra content knowledge and identify information from different sources (Adams and Krockover, 1997; Atav and Altunoglu, 2009; Ksal, 2011).

Improvement of biology education depends on teacher competency and performance related to his/her content knowledge (such as reviewing of biology and science education journals, joining science teacher organizations, attending workshops, participating in science with their students and organizing science fairs). All these actions lead to the professional development of the teacher special content knowledge, which can then increase teachers' competency and performance in laboratory skills. They also develop performing technical tasks in the laboratory and provide basic underpinning knowledge like safe handling of chemicals, using basic laboratory equipment, following procedure, and performing other tasks within a laboratory-related workplace that can increase teachers competency and performance (Adams and Krockover, 1997; Ksal, 2011).

As novice biology teachers enter the teaching workforce, they may not always have the necessary skills and competency to teach efficiently. In many cases, common laboratory skills are performed by laboratory assistants and not by teachers. When teachers were still students at university, laboratory skills are performed by laboratory assistants while they have little hands on experiencing experiments (Atav and Altunoglu, 2009). The same situation occurs when teachers are in the training course (Ksal, 2011). Therefore, teachers may not have adequate experience and performance to plan and implement biological laboratory skills (Ksal, 2011).

Biology education experiences occur in many places such as classrooms, the fields, and the laboratory. During these experiences, biology teachers discover and learn more information about the facts of the concepts, and laws of biological science, more like scientists do in their professional scientific life. Experiences in the laboratory allow biology teachers to discover, observe and investigate facets of the natural world and develop those content knowledge that cannot be developed in the classroom-learning environment (Abd-El-Khalick and Lederman, 2000; Borgerding and Koroly, 2013).

Teacher-training courses may not offer training in the competencies of some of the necessary laboratory skills. Thus, teachers may not teach laboratory skills successfully (Borgerding and Koroly, 2013) and they need to be upgraded in terms of both their laboratory skills knowledge and performance (Atav and Altunoglu, 2009; Borgerding and Koroly, 2013).

One of the objectives of biology teaching is to develop students' scientific skills. These skills include thinking skills, science process skills such as making observations, measuring, classifying, making an inference, and experimenting, as well as manipulative skills in using relevant scientific laboratory equipment. To achieve these skills, biology teachers should be trained to master competencies in various laboratory techniques in order to increase their content knowledge in laboratory skills. Therefore, laboratory work plays an essential role in the educational processes for biology teachers while laboratory skills increase teachers' performance of teaching biology (Borgerding and Koroly, 2013).



## **1.2 Background of the Study**

Undeniably, laboratory work characterises science and technology education as well as other supported fields. Nonetheless, laboratories are costly resources that are not often equipped fully in practice. However, equipment in laboratories contributes to high quality learning because they assist in enhancing teachers' competency and performance. This is done through development of teachers' content knowledge related to the laboratory skills by observation and discovery of facts (Esra, 2009).

Biology teachers are trained in the theoretical aspect of pedagogy with little emphasis on teaching laboratory skills (Esin and Bahattin, 2010). Training in conducting science practicals is completely ignored. The consequence is that the biology teachers lack the required laboratory skills for effectively conducting laboratory work (Feser, et al., 2013).

Novice biology teachers require some technical skills to be applied in laboratories so that they possess the competency and ability of performance in the laboratory. Ksal (2011) highlighted that many novice teachers agree they do not have sufficient competency and appropriate performance to design experiments. Therefore, specific training courses and seminars are necessary to help reduce these difficulties.

Iraq is in great need of science teachers who are competent in laboratory skills because of the unstable situations in Iraq today due to fighting. This situation causes many injuries; therefore, there is a need to improve staff competence in the laboratory to help those people. This competency helps them gain suitable scientific skills at all levels (secondary or college levels).

Teachers who do not have the necessary competence may fail to gain suitable skills to help students develop good understanding of laboratory skills (Esra, 2009).

Laboratory skills are considered as essential components of biology knowledge to ensure full understanding of biology lessons. Additionally, laboratory skills assist in enhancing conceptual understanding, problem solving and teachers' performance (Ruiz et al., 2006; Ksal, 2011).

There is a huge amount of literature on the difference between male and female biology teachers regarding their competency and performance in laboratory skills in the world and particularly in Iraq. Historically, there was always a gap favouring males in the sciences and a gap favouring females in the arts and languages. This has been well recognised in many places (Abd-El-Khalick and Lederman, 2000; Randy et al., 2011). In recent times, this pattern has changed with females improving in the sciences and even outperforming males in many countries (Esin and Bahattin Deniz, 2010; Randy et al., 2011). In Iraq it is common for females to outperform males in laboratory skills in secondary schools (Ministry of Education in Iraq, 2008).

When biology teachers have high competency and performance in laboratory skills he/she can be engaged in the laboratory skills processes perfectly. Biology teachers must first experience the laboratory skill and the technique which will be used and help in the laboratory experiments. This gives them time to react on their experiences and develop their content knowledge. In addition, attaining practical laboratory skills (i.e. safety, hazards, procedures, and observation of methods) and other vital skills (such as teamwork, time management, communication, presentation, information retrieval, and data processing) help teachers increase understanding in

laboratory skills. If teachers want to understand the nature of scientific inquiry, they must have the enough experience of working as scientists (Randy et al., 2011).

There are many methods for providing biology teachers with the experience of laboratory working as scientists such as placing selected teachers in the research laboratories of scientists who are actively involved in scientific research. Teachers should be given opportunities to work like scientists to increase their competency and performance in laboratory skills (Fraser-Abder and Leonhardt, 1996; Esin and Bahattin Deniz, 2010). Even though this method allows teachers to improve their understanding of the process of basic scientific research, the laboratory skills often cannot be transferred to the classroom. The researchers, who do not have a background in the laboratory skills of observations, measuring, classifying and experimenting, may not be prepared to help teachers translate what they are doing in the laboratory into the classroom.

Biological scientific knowledge is growing tremendously. This growth follows biology teaching through developing science and medical college teaching. It requires the teacher to keep up-to-date with modern development. Professional understanding will keep the biology teacher up-to-date about laboratory skills, and help maintain an understanding of current topics of interest and new developments. Some publications can help biology teachers to increase his/her knowledge include science journals, books, webpages and newsletters.

In Iraq, there are numerous problems that biology education suffers from; including, first, lack of trained biology teachers; this results in teachers with low competency. Second, the use of traditional teaching methodologies like using traditional laboratory skill (e.g safety procedure and observation methods) that result in low

teachers' performance. The main focus of biology teachers is on the memorization technique for learning while practical work in laboratory is overlooked. Furthermore, biology teachers are not good at managing experimental work, for example, using measuring, classifying and experimenting (Mbajiorgu and Reid, 2006; Ministry of Education in Iraq, 2008).

Biology teachers' responsibilities are not only to develop the methodological competencies related to the design of experiments and observations but also to develop competencies related to the use of laboratory skills. Teacher competencies can be defined as having skills and professional knowledge in the performance of duties that are unique to the teaching profession. Besides, teachers' performance can be defined as enabling teachers to use their knowledge and apply skills in realistic situations by performing or producing something. Furthermore, performance focuses on engaging teachers in a task as well as enabling them to solve problems and make decisions throughout the learning process. (Atav and Altunoglu, 2009; Ministry of Education in Iraq, 2008; Randy et al., 2011).

Biology teachers are expected to be more active in guiding students' activities as well as doing experiments and they are expected to have a sufficient level of competency related to the use of laboratory skills. Biology is an area that is open for experiments and activities, by nature. In addition, during these experiences, science teachers discover and learn more information about concepts, facts, and laws of biological science (Wenglinsky and Silverstein, 2006; Randy et al., 2011).

Laboratory skills have played an important role to help teachers attain full competency of laboratory skills. However, learning and practice in the laboratory are still highly controversial issues among science educators. Hence, some researchers

believe that learning can give teachers more information about conception of biology but others believe that practice skills in the laboratory give teachers more facts about phenomena in biology (Atav and Altunoglu, 2009). Laboratory skills cannot be developed just by transmitting the body of knowledge without minds-on and hands-on experience. Therefore, there is a need to increase teachers' competency through laboratory inquiry activities (such as investigation and observation). According to Bibi (2005), laboratory skills are regarded as a necessary part of theory classes. The laboratory skills help enhance teachers' competency as well as their performance.

Teachers need to be involved in scientific investigation, in order to develop the necessary laboratory skills. A deeper understanding of laboratory skills is more important to help teachers gain competency and performance need in laboratory investigation (Al Faleh, 2005; Esin and Bahattin Deniz, 2010). Ruiz et al. (2006) documented that biology teachers do not have full access to new research techniques; yet this is necessary for improving their laboratory skills.

In Atav and Altunoglu's (2009) study, it was highlighted that some of the problems in biology education in secondary schools in Iraq include the lack of proper training course and seminar for biology teachers as well as the use of traditional laboratory teaching methodologies by biology teachers. According to Sadiq (2003), teaching is geared toward memorization of key concepts and their reproduction in the examinations. Testing and verification of knowledge is hardly done. Training in conducting laboratory practice is completely ignored. The consequence is that science teachers lack the required practical skills to conduct laboratory work effectively (Jinan and Jamil, 2010).

### **1.2.1 Biology Teaching**

As a discipline of science knowledge, biology includes many concepts that have complex relationships with each other. Teachers' competency and performance are two indispensable components that are necessary for shaping and understanding biology laboratory concepts and relating these concepts to each other is really important. Therefore, competency and performance in the laboratory, which are necessary to create information and produce tools for biological science, are also indispensable for biology education at all levels: university and work field (Esra, 2009).

Biology is an open experimenting and activity area. It needs a teacher with high competency and performance to perfectly investigate about concepts, facts, and laws of biological science. For example, it is sometimes probable to explain a subject by using only a microscope (Charles, 2006). In this scope and as a necessity of their profession, biology teachers have to develop not only methodological competencies which cover design of experiments and observations but also performance namely how teachers use laboratory skills in implementing these methods (Wilhelm and Walters, 2006).

Relevant studies underline the importance of laboratory skills in biology education. In a study conducted by Charles (2006), teaching using the microscope as a laboratory skill was compared with teaching using the video player. Nearly 80% of the students who have participated in that study preferred using the microscope to the video player. Furthermore, students who were taught the subject with the help of a microscope were found to be significantly more successful in understanding the content of this subject than those who were taught with the help of a video player. In his study, Wenglinsky (2000) discovered that students who were taught by teacher who have attended applied courses about using laboratory skills were more successful than the

students taught by teachers lacking competence about using laboratory skills. On the other hand, it was revealed that the teachers who took laboratory training courses on skills in professional life in their professional development were more successful to teach science subjects than teachers who did not take such courses (Wenglinsky, 2000; Randy et al., 2011). In another study conducted on two groups of elementary teachers trained according to two different education programs, the teachers in the group who have taken applied biology education which included a training on laboratory skills were found better and have significantly higher performance and competency in teaching a biology science course than the teachers in the group who were not given such training on laboratory skills (Andersen et al., 2006).

Millar (2004) defines laboratory work as any teaching and learning activity which involves at some point where students observe or manipulate real objects and materials. Laboratory work enables the students to act in a scientific manner. According to Tamir (1989), laboratory work helps teachers in inducing scientific attitude and, developing competency and improving performance in laboratory skills, in addition to developing critical thinking skills in investigation and observation in the laboratory; all this leads to increase in teachers' content knowledge about laboratory skills (Boud and Hegarty, 1986; Tamir, 1989; Randy et al., 2011).

Earlier researchers have found that teachers who do not have laboratory skills, unfortunately, do not achieve the required objectives. Esin and Bahattin Deniz (2010) referred to the same issue and consider the laboratory work performed in schools by these teachers failed to achieve its objectives. According to them, the laboratory work contributed little to the students' learning about science due to the teachers' lack of competencies about laboratory skills. Similarly, Van Ng and Nguven (2006) carried out

research on the laboratory work exhibited by biology teachers in Vietnam. They observed that biology teachers do perform demonstrations in their class but the frequency of these demonstrations was very low. 75% of these biology teachers admitted the futility of laboratory work in developing the students' scientific concepts. The biology teachers preferred to carry out demonstrations rather than allowing students to perform the experiments themselves. This was due to the lack of proper arrangements, unavailability of scientific equipment and the shortage of time for performing laboratory skills. Furthermore, the teachers have to complete the curriculum within a scheduled time. In this study, the focus is only on the teachers' performance in relation to their laboratory skills.

A study which was conducted in order to investigate teacher's competency and performance especially in laboratory skills has shown the problems faced by teachers and students. This study, conducted by Al Faleh (2005) in Saudi Arabia, found that the laboratory skill competency in secondary school were at the lower level. According to a study carried out by Meis and Dana (2005) on first year tertiary students in Western Europe, it is claimed that many students cannot answer the basic questions about laboratory skills and fundamentals involved in experiments.

In Korkmaz's (2000) study in Turkey, it is shown that Turkish teachers who participated in the study were competent in half of the skills related to laboratory skills. In another study by Koseoğlu and Charles (2006), biology teachers in Turkey considered themselves as being able to perform highly in terms of using educational tools which required laboratory skills. In a study conducted by Esin and Bahattin Deniz (2010) in an Arabia Gulf secondary school, both male and female teachers showed similar level of performance in terms of their laboratory skill competencies. In addition, teachers with



more than ten years teaching experiences exhibited a significant difference in terms of their laboratory skills performance compared to those with less than ten years' teaching experience. In a study conducted by Koseoğlu and Charles (2006), Turkish males teachers revealed different levels of competencies in comparison to females teachers in as far as most laboratory skills are concerned. They also displayed a significantly higher level of competency in laboratory skills when comparisons are made based on teaching experiences.

Furthermore, studies were also carried out by Borgerding and Koroly (2013) to examine the link between gender, teaching experiences and education qualifications of United States biology teachers and their level of the competencies. In particular, they examined the link between teachers' level of laboratory skills competencies and the training that they received from their tertiary education. Some of these studies confirm that teachers have high performance while other studies indicate that there were problems in teachers' competency and teacher content knowledge related to their university training as well as additional knowledge derived from training or seminars with regard to using laboratory skills (Wenglinsky, 2000). Hence, identifying biology teachers' competencies with regards to laboratory skills is necessary in building knowledge-based teaching methodology especially in the field of biology teaching.

In Iraq, secondary school pupils are taught by senior science teachers. The minimum educational requirement to become a senior science teacher is a bachelor degree in any science subject or a bachelor degree in education. However, the teacher training colleges in Iraq are under severe criticism for their short duration and poor quality of training (Sadiq, 2003). The science teachers are trained in theoretical aspects

of pedagogy with little emphasis on teaching practice (Jinan and Jamil, 2010). Consequently, the science teachers lack the required practical skills to conduct laboratory work effectively. According to Sadiq (2003), teaching new skills and concepts can generate successfully taught laboratory skills. A weakness in the level of biology teachers' competencies and performance in biological laboratory skills has a negative effect on biology teaching, for example teachers are unable experiment perfectly and cannot use the microscope correctly (Randy et al., 2011). Furthermore, the success of biology teaching in the laboratory depends on the competency and performance of laboratory skills that the teacher has (Bibi, 2005; Randy et al., 2011).

Some progress has been achieved towards the improvement of science teaching in Iraq, but greater efforts are still needed in this respect due to the unstable situation of the Iraq life in this time which include a lack of some laboratory equipments and training programs (Shlash et al., 2008). A study by Al Faleh (2005) shows that pre-service teachers felt themselves inadequate in terms of using laboratory equipment. More of these studies show that there are problems in teachers' competency and performance of biology teachers in Iraq with regard to laboratory skills. Identifying biology teachers' competencies and performance with regard to laboratory skills is necessary in building up the specific knowledge in the field of biology teaching. Moreover, measuring the level of teacher competency and performance focusing on the laboratory skills is necessary to prepare teachers to teach biology in laboratories (Shlash et al., 2008).

Therefore, the emphasis of this research is to determine the biology teachers' competency and performance in biology laboratory skills. In addition to examine the relationship between biology teacher competency and performance in biology laboratory skills in Najaf Directorate of Education in Iraq.

### **1.3 Problem Statement**

There are numerous problems that science education in Iraq suffers from, including the lack of laboratory skills of science teachers (Esra, 2009; Borgerding and Koroly, 2013). Here, the main focus of biology teachers is on the memorization technique for learning, whilst laboratory skills are overlooked. Furthermore, biology teachers are not good at managing experimental work. However, the training of biology teachers is under severe criticism for its short duration and poor quality.

Many studies on the biology teachers' competency especially in laboratory skills have shown the problems faced by teachers. In Randy et al. (2011) study, it is highlighted that some of the problems in biology education in Iraq include the lack of properly trained biology teachers and the use of traditional laboratory teaching methodologies by biology teachers. Another study has been identified problems to be the poor quality of laboratory skills related to preparation and use of laboratory equipment (Borgerding and Koroly, 2013). In Iraq the focus of biology teachers is always on rote learning (Jinan and Jamil, 2010). The teachers' competency and their performance related to laboratory skills is so ignored that the biology teachers are not good at conducting experimental work (Feser et al., 2013). In Esin and Bahattin Deniz (2010) it is suggested that the teachers who participated in the study has only mastered half of the competencies related to laboratory skills applications. Studies by the Ministry of Education, Educational Research Centre in Iraq (MEERC) (2008) have found that biology teachers felt themselves inadequate in terms of using biological laboratory techniques. All of these studies indicate that there are problems in teachers' competency and biology teachers' performance with regard to using biological laboratory skills.

The laboratory skills of secondary teacher education students are often poorly developed (Esin and Bahattin Deniz, 2010). Their lack of skills is part of a more general and widespread problem. Esin and Bahattin Deniz (2010) states that teachers show poorly developed laboratory skills of carrying out of controlled experiments. In a study of first year secondary students, Feser et al., (2013) claims that many students cannot identify the basic laboratory skills and even the basic question about laboratory skills involved in experiments due to the poor laboratory skills that teachers have.

Iraq greatly needs to improve biology teachers in order to provide them with the appropriate competencies and performance in biology laboratory skills. A great generation have a perfect laboratory skills to help them gain suitable scientific skills when transfer from secondary levels to medical or science college levels (Selvaratnam and Mavuso, 2010). The principal goal of secondary school science education through laboratory skills in the laboratory is to prepare students successfully for university level science (Zauton, 1986). These studies also focus on the extent to which the teacher education curriculum prepares science teachers to teach in a laboratory environment. The studies reported inadequacy in some curriculum preparation programs with respect to training teachers to teach in the laboratory. In addition, there is a need for training in laboratory techniques to develop teachers' competencies and help to improve those skills as a value of laboratory teaching.

Several studies have examined the differences in the achievement of male and female biology teachers inside the laboratory (Baumert et al., 2010; Esin and Bahattin Deniz, 2010; Zauton, 1986; Abd-El-Khalick and Lederman, 2000). There are many problem Iraq male and female teachers facing, male teachers have same CK with female by involving in the same training course (Al-Hubaishi, 2005). Farther more, 80% from

Iraqi school system does not depend on the mixed school (Zauton, 1986; Abd-El-Khalick and Lederman, 2000). In study conduct in Arabia Gulf secondary school by Esin and Bahattin Deniz (2010) generally, both male and female teachers are graduate from same university therefore there is a similar performance between them. These studies also show a significant level of competency in laboratory skills in differences between teaching experiences. In the study conduct by Koseoğlu and Charles (2006), Turkish males perceive that they are equally competent with females in most laboratory skills. This study also shows a no significant level of competency in laboratory skills in differences between teaching experiences. Teachers' problems often find themselves having to practice laboratory skills that they did not have the chance to experience by themselves in university level. Therefore, these skills do not given teachers the opportunity to plan their own methods or to apply problem solving methods that they have been taught (Baumfield, 2006).

#### **1.4 Aim of Study**

The aim of this study is to identify the biology teachers' competency and performance in biology laboratory skills, in relation to other factors such as gender and teaching experience.

#### **1.5 Research Objectives**

The current study has several objectives as listed below:

1. To identify the level of competency in laboratory skills of biology teachers.
2. To identify any statistically significant gender difference in the competency in laboratory skills of biology teachers.

3. To identify any statistically significant difference in the competency in laboratory skills of biology teachers with different teaching experience.
4. To identify the level of performance in laboratory skills of biology teachers.
5. To identify any statistically significant gender difference in the performance of laboratory skills of biology teachers.
6. To identify any statistically significant difference in the performance of laboratory skills between biology teachers with different teaching experience.
7. To identify any significant correlation between competency in laboratory skills and performance of laboratory skills of biology teachers.
8. To identify the competency in laboratory skills is significant predictor of performance in laboratory skills of biology teachers.

## **1.6 Research Questions**

The current study seeks to answer the following questions:

1. What is the level of competency in laboratory skills of biology teachers?
  - a. Is there a statistically significant gender difference in the competency in laboratory skills of biology teachers?
  - b. Is there a statistically significant difference in the competency in laboratory skills of biology teachers with different teaching experience?
2. What is the biology teachers' performance level of laboratory skills?
  - a. Is there a statistically significant gender difference in biology teachers' performance of laboratory skills?

- b. Is there a statistically significant difference in the performance of laboratory skills between biology teachers with different teaching experience?
- 3. Is there a significant correlation between competency in laboratory skills and performance of laboratory skills of biology teachers?
- 4. Is competency in laboratory skills a significant predictor of performance in laboratory skills of biology teachers?

### **1.7 Research Hypotheses**

Based on research questions 1, 2, 3 and 4 the following null hypotheses would be tested at the alpha level  $p=0.05$ :

**H<sub>01</sub>:** There is no statistically significant gender difference in biology teachers competency in laboratory skills.

**H<sub>02</sub>:** There is no statistically significant difference in biology teacher competency in laboratory techniques with different teaching experiences.

**H<sub>03</sub>:** There is no statistically significant gender difference in biology teachers performance in laboratory skills.

**H<sub>04</sub>:** There is no statistically significant difference in biology teacher performance in laboratory techniques with different teaching experiences.

**H<sub>05</sub>:** There is no statistically significant correlation between competency in laboratory skills and performance of laboratory skills of biology teachers.

**H<sub>06</sub>:** A competency in laboratory skills is not a significant predictor of performance in laboratory skills of biology teachers.

## 1.8 Significance of the Study

The significance of the current study lies in the hope that it could:

1. Provide the Ministry of Education in Iraq with current data that aids the ministry in making better policy decisions about biological laboratory syllabus and applying education strategies with greater certainty for biology.
2. Let school officials, policy makers, and service providers in Iraq know about the level of the biology teacher competency and performance in lab skills. This may be valuable for the authorities to enhance training and modify the biology course at universities.
3. Provide information about the factors which influence teacher competencies and performance in laboratory skills, in order to increase the efficiency of the teaching process in the schools.
4. Helps Ministry of Education and Ministry of Higher Education in Iraq develop teacher preparation programs and training programs to improve teacher competencies and performance in laboratory skills.
5. Show the strengths and weaknesses of biology teachers in the laboratory, in order to prepare an improved training program for developing teacher competency and performance in laboratory skills.

## 1.9 Operational Definitions of Terms

For the purpose of this study, the following terms have been defined as follows:

**Teacher competence** refers to having the professional knowledge, skills and attitudes in the laboratory required for the performance of duties that are unique to the teaching profession (Ministry of Education, 2008).



Esra (2009) defined it as having skills and professional knowledge in the performance of duties unique to the teaching profession.

In this study, competency refers to the system of laboratory skills and conceptual and procedural parts of knowledge organised into competency and performance that help identify a problem-task in the laboratory.

**Teacher performance** enables teachers to demonstrate specific skills and competencies by performing something in the laboratory (Ministry of Education, 2008). Teacher performance is also defined as a demonstration of teachers' skills by producing one or more skills in the experiment (Al-Faleh, 2005).

Skill Al-Faleh (2005, p.23) defined skill as:

“The basic skills of planning, analysis and evaluation will be of great value to those who follow laboratory works (UCIE, 2005)”

According to these definitions one can describe laboratory skills as skills that biology teachers use to impart knowledge and understanding of biological experimental techniques, including practical laboratory skills. This will enable them to improve skills and knowledge about laboratory investigation.

**Laboratory skills** are the basic skills needed to conduct experiments in the laboratory. It relates to a teacher's level of competency by improving the knowledge and understanding of biological skills and experiment techniques in the laboratory (UCIE, 2005).

**Content knowledge (CK)** is knowledge about the actual subject matter. This is related to teacher's competencies because only by enhancing teacher's knowledge about laboratory skills, can the subject matter be learnt or taught properly (Burns, 2005).

**Length of teaching experience** refers to the total number of years of teaching that biology study teachers have taught in secondary school (UCIE, 2005).

**Level of competency** In this study, the level of competency refers to competency score of the six grades according to Iraqi grade system, scoring between 90-100, called the excellent competency; 80-89, called very good competency; 70-79, called good competency; scoring between 60-69, called satisfactory competency; 50-59, called acceptable competency and scoring below 50, called weak competency.

**Performance level** In this study, performance level refers to the performance score of the six graders according to the Iraqi grade system. The scoring system can be divided into several categories starting with a score between 90-100, called an excellent performance; 80-89, called a very good performance; 70-79, called a good performance; a score between 60-69, called a satisfactory performance; 50-59, called an acceptable performance and a score below 50, called a weak performance.

#### **1.10 Limitations of the Study**

While exploring the factors influencing the biology teachers' competency and performance the study confines itself to following:

1. This study has focused on biology teachers' competency. As a result, the raw data were collected from teacher informants.
2. The data is teachers' self-assessment of their competence.
3. The findings are not representative of all subject teachers. Therefore, generalizing the results to teachers of other subject areas may not be possible.
4. In this study, the data were collected from biology teachers in seventy one secondary schools participating in the biological laboratory techniques survey. Therefore, the

results of this study can be generalized only to the population of biology teachers in the sample of secondary schools.

5. In this study, only biology teachers' competency and performance were investigated regarding some independent variables, while, there were a number of demographic variables in the study such as age, training, teachers' highest level of education, and teachers' subject matter were not included.

### **1.11 Summary**

So far, a number of studies have shown the importance of laboratory skills in teaching biology. Currently, biology teachers agree that laboratory skills are essential to the understanding of biology. The main purpose of using laboratory skills in biology education is to provide teachers with laboratory concepts and skills to helping them gain a good competency and increase their performance. A laboratory skill gives the teachers the opportunity to develop their competency and performance by using scientific research procedure. Biology education has become a major concern of developing countries. Iraqi biology teaching in the secondary schools is in need of development at laboratory skills levels of biology teachers. This study focuses on secondary school teacher competency and performance and the relationship between them in laboratory skills in Iraq. More specifically, this study will investigate the competency and performance of biology teachers in the laboratory and the relationship between teachers' competency and performance. This study also aims to investigate the level of competency and performance in laboratory skills of biology teachers and differences between them according to two variables namely gender, length of teaching experience.

## **CHAPTER 2**

### **REVIEW OF RELATED LITERATURE**

#### **2.1 Introduction**

Mastery of laboratory skills is considered essential to ensure full understanding of lessons. Additionally, laboratory skills assist in enhancing teachers' content knowledge and conceptual understanding (Ruiz et al., 2006; Jessica and Dan, 2011). Therefore, the objectives for laboratory skills education is to attain practical laboratory skills for example the microscopy and light microscopy, preparation of solution, diffusion and osmosis techniques and techniques for measuring. Another objective is the stimulation of thinking by explanation of phenomena and developing content knowledge (Ruiz et al., 2006; Al Faleh, 2005; Di Trapani et al., 2012).

Biology teachers' responsibilities are not only to develop the methodological competencies related to the design of experiments and observations but also competencies in laboratory skills. Teacher competence can be defined as having skills and professional knowledge in the performance of duties unique to the teaching profession (Esra, 2009).

Biology teachers' competencies are necessary for them in order to be able to teach skills in the biology laboratory, and also to set out the methodological criteria for the design of training activities. Development of competencies of biological process and learning includes several activities. Blosser (1988) suggests that laboratory skills is a value as science skills could help teachers understand biology classes. Thus, teachers should obtain competencies in skills of all laboratory processes. However, it is necessary

for teachers to have some command of biological process skills. Another study claimed that teachers lack basic biology skills. They suggest that teacher education should involve almost all of the laboratory processes in biology to develop the appropriate teachers' skills (Maupins and Hitchings, 1998; Feser et al., 2013).

Iraq is a developing country in north-west Asia. The students start choosing arts, humanities or science optional subjects after passing grade nine. The final examination at this stage is known as matriculation, which is led by the local boards of intermediate and secondary education (UNESCO, 2011; Ministry of Education in Iraq, 2008).

Iraqi students in secondary schools are taught by senior science teachers. The minimum educational requirement to become a senior science teacher is a bachelor degree in any science subject or a bachelor degree in education. However, the teacher training colleges are under severe criticism for their short duration and poor quality of training (UNESCO, 2011). The science teachers are trained in theoretical aspects of pedagogy with little emphasis on practical work in the laboratory (Jinan and Jamil, 2010). Training in conducting practical lessons in science is completely ignored. The consequently, science teachers lack the required practical skills to conduct effective laboratory work. According to Sadiq (2003), teaching is geared toward the memorization of key concepts and their reproduction in the examinations. Testing and verification of what is learned is hardly done. However, there are numerous problems that science education in Iraq suffers from, including the lack of trained science teachers and the use of traditional teaching methodologies (Esra, 2009). Here, the main focus of biology teachers is on the memorization technique for learning while practical work is