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  - Clarity of presentation
  - Technical adequacy

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EDITOR’S NOTE

Welcome to the second issue of JIRSEA 2011.

In this issue we are presenting to you five articles that I am sure you will find to be interesting, informative and catalysts for further significant research and investigations into IR around the world. It also presents a Comment column to provoke thoughts on whether higher education as we know it and as an institution will continue.

As I mentioned in the previous issue of JIRSEA, SEAAIR runs an annual conference which is hosted by different universities in the region and therefore held in various places in the countries within the region. In addition to this Journal, the SEAAIR annual conferences provide further opportunities to discuss IR with colleagues and peers from around the world. You may find further information on SEAAIR website http://www.seaairweb.info

As most if not all of us know, Mathematics and English are two subjects of intense discussion in many higher education institutions in Southeast Asia in particular and around the world generally. Is this an indictment of Maths and English language teachers or even an indictment of the training of these teachers? The first paper in this issue talks about aspects related to this through analyzing blogs that Maths teachers were involved in. Certain characteristics of these teachers may be discerned that may lead to further understanding of the requirements of training Maths and English language teachers.

Whether university and college lecturers in Southeast Asia realize or not, an increasingly inevitable situation is fast developing around them. Traditional way of teaching which sums to rote teaching and learning, must give way to student-centered teaching. Saed Sabah et al reported in their paper that currently the opportunities for empowerment are not as yet available to students generally. They used inquiry-based teaching in laboratory instructions of science as the subject. They concluded that lecturers/teachers will need continual re-training especially in understanding the right pedagogy to use to meet the various requirements brought about by changing technology and changing student generations’ characteristics.

Juxtaposed on the above continual training of lecturers/teachers is also the need to ensure the quality of the students entering the higher education system. Mahasneh and Al-Alwan in their paper in this edition of JIRSEA reported on a study where they looked firstly at whether students have any goals at all and then sought any correlations between having these and the self-motivation that is so necessary in university studies.

Jawarneh et al reported on a study they carried out to find out whether Social Studies curriculum and/or textbooks on these subjects contain any education general principles
which are considered able to help students develop a number of soft-skills required for employment.

Kasawneh et al conclude this edition of JIRSEA with a report on their studies about lifelong learning and the impacts on continual employment of graduates.

Just to complete the cycle of discussions, I have included in this edition a Comment column which we publish from time to time written either by myself as Editor or an invited person depending on the expertise required.

All in all I hope that we have brought you this time a collection of relevant articles and reports on studies in areas of aspects of institutional research from developing countries the discussions and results of which may be of some help to other higher education institutions in other developing countries.

Pleasant reading to you and we continue to extend our invitation to authors to submit papers to JIRSEA. Please note that all papers are subject to double blind reviews. So while the process certainly takes a much shorter time than printed publications, it nevertheless takes time. This practice ensures that JIRSEA continues to be a journal of choice in the area of institutional research and its indexing with SCOPUS, DOAJ, Elsevier and others is maintained.

Thank you again to those who have contributed this time around.

Nirwan Idrus

Editor
Jordanian college students' perceptions of inquiry experiences in science laboratories

Saed Sabah, Akram Al Basheer, Areej Barham, and Merfat Fayez
Hashemite University, Jordan.

Abstract

The purpose of present research was to investigate to what extent college students at the public universities in Jordan were offered the opportunities to engage in scientific inquiry in the introductory science laboratories. The participants, N = 244, were randomly selected from students who were taking general physics, general chemistry, or general biology laboratories in the summer of 2011. To collect data, this research utilized a translated and validated version of PSI-S instrument. The current research used SPSS to conduct the descriptive and inferential statistics, and utilized WINSTEPS to check on the quality of items based on the Rasch model. It could be concluded that the opportunities offered to students varied across the dimensions of scientific inquiry aligned with reformed calls for engaging students in scientific inquiry. Students were given better opportunities for conducting investigations and collecting data than framing research questions and designing investigations. The less emphasis on framing questions and designing investigations might result from the poor preparation of teachers and providing students with step by step procedure. Students’ perceptions of inquiry experiences across science labs were similar. Some implications and suggestions of further research are given in this paper.

Keywords: Inquiry, Inquiry-based laboratories, College Science Education
Introduction

Improving learning and teaching science at all levels has been a concern for many nations around the globe. It is strongly believed that improving teaching science and increasing the number of well-prepared scientists and engineers is necessary for developing strong industrial and economical systems. However, teaching science at college level still needs a lot of work to move from traditional approaches to student-centered approaches which would be consistent with the basic assumptions of constructivism, and the nature of science.

Scientific inquiry causes a fundamental change in science education, moving it away from traditional teaching practices of lecture and demonstration to a collaborative relationship between teacher and student (Wetzel, 2008). Inquiry “refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world” (NRC, 1996). It is ‘a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results.’ (NRC, 1996). To better understand what inquiry is, the document Inquiry and the National Science Education Standard (NRC, 2000) identified the essential features of inquiry: ‘Learners are engaged by scientifically oriented questions; Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions; Learners formulate explanations from evidence to address scientifically oriented questions; Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding; Learners communicate and justify their proposed explanations.’ (NRC, 2000).

Science Education researchers further elaborated on the meaning of inquiry. Abd-El-Khalick et al. (2004) distinguished ‘Inquiry as means’ and ‘Inquiry as ends’. As to Abd-El-Khalick et al., ‘Inquiry as means’ refers to inquiry as an instructional approach to help students develop an understanding of science content while ‘Inquiry as ends’ refers to inquiry as instructional outcomes. Liu (2010) introduced science inquiry as a comprehensive construct for organizing science curriculum, teaching and learning science, and teacher professional development. Based on that, this comprehensive construct may include, but not limited to, students’ inquiring abilities, understanding science inquiry, and science teachers’ understanding and practices of inquiry as a teaching approach. Although the National Science Standards (NRC, 1996; NRC, 2000) and researchers clarified and elaborated on the definition of inquiry, many teachers are still uncertain about the term inquiry (Asay & Orgill, 2010).

To describe inquiry practices in classroom, Asay and Orgill (2010) analyzed articles published in The Science Teacher from 1998 to 2007 based on the five essential features of inquiry detailed in the Science Education Standards (NRC, 2000). They found that: "students often gathered evidence and participated in teacher-guided analysis of that
evidence, but seldom were they asked to grapple with scientifically oriented questions, create evidence-based explanations, connect explanations to accepted scientific concepts, or justify the results of their investigations to a larger group of peers" (Asay & Orgill, 2010).

Based on the degree of complexity in investigations through inquiry, Rezba, Auldridge, and Rhea (1999) stated four levels of inquiry:

1. **Confirmation** is the simplest level where students confirm a principle through an activity in which the results are known in advance;

2. **Structured inquiry**- Students investigate a teacher-presented question through a prescribed procedure;

3. **Guided inquiry** – Students investigate a teacher-presented question using students selected procedures; and

4. **Open inquiry** – Students investigate topic-related questions that are students formulated through student designed procedures. Understanding the nature and characteristics of these levels may help science educators plan and move gradually from a simple level to a more complex one.

Implementing and planning inquiry is not an easy task, it is challenging for many teachers. It requires several kinds of knowledge such as science content knowledge, science pedagogy knowledge, and knowledge of inquiry (Schuster & Cobern, 2011). Other barriers may limit implementing inquiry-based laboratory work such as lack of time, safety issues, management problems, class size, and the shortage of resources (Cheung, 2008; Zhang et al., 2003).

**Review of Literature and Conceptual Framework**

Inquiry-based instruction has positive impacts on learning science (Anderson, 2002; Simsek & Kabapinar, 2010). The Inquiry-based laboratories provide students with the opportunity to involve actively in learning high school chemistry (Hofstein, Nahum, & Shore, 2001). Simsek and Kabapinar found that inquiry-based learning had positive impact on students' understanding of matter and scientific process skills. Martin (2010) also found a significant relationship between teachers’ self-reported use of inquiry and students' achievement based on the data of 7377 US eighth graders who participated in TIMSS 2007.

To benefit from inquiry-based laboratory, Ketpichainarong, Panijpan, and Ruenwongs (2010) reported a case study of using inquiry-based laboratory to help college students to construct their understanding of enzyme. Students were asked to design experiments, formulate hypotheses, perform experiments under the guidance of their instructors, and draw conclusions. Most of the students seemed to be ready for inquiry-based laboratory and they engaged in and enjoyed inquiry-based laboratory activities. As to Anderson
Inquiry-based instruction is basically aligned with the constructivist models of learning science. Inquiry is an active learning process in which students answer their questions through data analysis (Bell, Smetana & Binns, 2005). It is believed that scientific inquiry causes a fundamental change in science education, moving it away from traditional teaching practices, teacher directed approach, to student-centered approach (Wetzel, 2008; Justice, Rice, Roy & Hudspith, 2009). Inquiry-based instruction usually offers concrete and hands-on science in a way students design their experiments which may improve learning science and attitudes toward science. It is fully understood that conducting hands on science in a traditional way does not guarantee inquiry (NRC, 1996).

In sum, inquiry is based on and aligned with basic assumption of the constructivist models of learning science. Moreover, Inquiry offers concrete and hands-on experiences which may improve learning science and attitudes toward science. This research was driven by the huge potential for inquiry in improving the way college science is taught. The current study is grounded on the definition and essential features of inquiry introduced by the document *Inquiry and the National Science Education Standard* (NRC, 2000). Based on that, the present study explored to what extent Jordanian college students are offered the opportunity to practice the essential features of inquiry in science laboratories.

**Research Problem**

Traditional laboratories fail to offer students with appropriate environment for learning science meaningfully (Roychoudhur & Roth, 1996). Although many of science faculty members recognize the importance of inquiry-based approach, they may not know how to move from traditional approaches toward inquiry teaching (Reiff, 2004; Gengarelly & Abrams, 2009). Many science faculty members over-focused on memorization and ignored illustrations, and applications; the poor instruction in undergraduate science has been recognized as a national problem for many nations (Brown, Abell, Demir, 2006).

Many science faculty members may lack a working definition and a practical framework of inquiry to guide their instructional practices (Bell, Smetana & Binns, 2005). Brown et al. (2006) found that science faculty members held “an all-or-nothing view” of inquiry which may constrain them from considering inquiry in their teaching introductory college courses. In other words, students may have not been offered the opportunities to implement inquiry while learning science. Thus, recognizing the concerns about inquiry is important for improving inquiry-based pedagogy at college level of education. Yet, the literature on the inquiry-based instruction on college science teaching is very thin (Brown, Abell & Demir, 2006; Crawford, 2009).
This research may help educators diagnose and improve the laboratory-based instruction through inquiry. Diagnosing the dynamics of teaching laboratories may be the first step toward improving teaching undergraduate laboratories in Jordan and many countries that have similar educational context. Also, the current research provides an international perspective of inquiry experiences in undergraduate science laboratories.

The purpose of the present research was to investigate to what extent college students at the public universities in Jordan were offered the opportunities to engage in the scientific inquiry in introductory science laboratories (physics, chemistry, and biology). The findings would inform us if science faculty members were moving toward inquiry-based instruction. In particular, this research aimed at answering the following research questions:

(1) To what extent Jordanian college students are offered the opportunities to implement inquiry in introductory science laboratories; and

(2) Are there statistically significant differences exist in the levels of inquiry across the subjects of science laboratory (physics, chemistry, and biology).

**Methodology**

**Participants**

The data was collected in the summer of 2011. The participants, N = 244, were randomly selected from students who were taking general physics, general chemistry, or general biology laboratories. The resulting sample consisted of 96 males and 146 females, a few cases missed information. About 74 percent of participants were majored in science and engineering. The participants were enrolled in general physics labs (n₁ = 107), general chemistry labs (n₂ = 97), and general biology labs (n₃ = 36).

**Instrument and Data Collection**

To collect data, this research utilized a translated version of PSI-S instrument (Campbell, Abu-Hamid & Chapman, 2010). The Instrument composed of 20 items separated into five categories. These categories are:

(1) framing questions;
(2) designing investigations;
(3) conducting investigations;
(4) collecting data; and
(5) drawing conclusions.

Each stem has five options (1 = almost never, 2 = seldom, 3 = sometimes, 4 = often, 5 = almost always). Evidence for the reliability and validity of PSI-S for assessing to which students are experiencing inquiry in science laboratories were provided (Campbell, Abu-
Hamid, & Chapman, 2010). The development of the instruments went through several steps and stages. They estimated the internal consistency of the instrument and conducted factor analysis (see Campbell et al. for more details).

Validity of Translated Version of PSI-S instrument

Two bilingual faculty members translated the English version into Arabic. The Arabic version was compared to the original English version and evaluated by 4 bilingual faculty members to check on the quality of translation and to make sure that the items have the same meaning in both versions. The Arabic version was pilot tested with a group of 20 students; the participants of the pilot study were asked to provide responses to the twenty items and provide the researchers with any comments regarding any ambiguous statements or terms. For example, the initial, literate, translation of "investigations" was not clear for students. Thus, some statements were reworded and the final draft was checked again by two science education faculty members. The Cronbach's Alpha for the translated version of PSI-S was 0.81.

We utilized the Rasch model to provide evidence that support the validity of the instrument. Rasch analysis programs (e.g., WINSTEPS) provide INFIT and OUTFIT mean square statistics to evaluate how well each item fits the model. FIT statistics refers to whether the items are of sufficient quality to interpret the outputs in interval scale, and “whether each item contributes to the measurement of only one construct” (Bond & Fox, 2007). “MNSQ is a chi-square model-data-fit statistics based on the difference, or residuals, between the observed response patterns and the predicted response patterns based on Rasch model. Bond and Fox considered the (MNSQ) values between 0.7 and 1.3 as acceptable indicators for fitting the model. The values of INFIT MNSQ of all items but two, items 5 and 10, fall within the accepted range for fitting the model as shown in Table 1. Based on the results of FIT statistics, it can be concluded that overall the data fit the model very well and the items contribute to the measurement of one construct.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Measure (Logits)</th>
<th>INFIT MNSQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITEM5</td>
<td>2.32</td>
<td>1.77</td>
</tr>
<tr>
<td>ITEM10</td>
<td>1.85</td>
<td>1.7</td>
</tr>
<tr>
<td>ITEM2</td>
<td>0.92</td>
<td>0.86</td>
</tr>
<tr>
<td>ITEM1</td>
<td>0.76</td>
<td>0.93</td>
</tr>
<tr>
<td>ITEM4</td>
<td>0.66</td>
<td>1.02</td>
</tr>
<tr>
<td>ITEM3</td>
<td>0.52</td>
<td>1.04</td>
</tr>
<tr>
<td>ITEM8</td>
<td>0.03</td>
<td>0.94</td>
</tr>
<tr>
<td>ITEM18</td>
<td>0.03</td>
<td>0.51</td>
</tr>
<tr>
<td>ITEM20</td>
<td>-0.01</td>
<td>0.76</td>
</tr>
<tr>
<td>ITEM19</td>
<td>-0.20</td>
<td>0.77</td>
</tr>
<tr>
<td>ITEM13</td>
<td>-0.22</td>
<td>0.89</td>
</tr>
<tr>
<td>ITEM17</td>
<td>-0.22</td>
<td>0.71</td>
</tr>
<tr>
<td>ITEM7</td>
<td>-0.50</td>
<td>1.28</td>
</tr>
<tr>
<td>ITEM14</td>
<td>-0.56</td>
<td>1.02</td>
</tr>
</tbody>
</table>
ITEM | Measure (Logits) | INFIT MNSQ
---|---|---
ITEM16 | -0.61 | 0.82
ITEM15 | -0.71 | 0.90
ITEM6 | -0.75 | 1.25
ITEM9 | -0.97 | 1.26
ITEM11 | -1.13 | 1.06
ITEM12 | -1.23 | 1.04

**Data Analysis**

Both of SPSS and WINSTEPS software were used to analyze the data of the current study. WINSTEPS was used, as mentioned above, to check on the quality of items based on the Rasch model. SPSS was used to conduct the descriptive and inferential statistics related to the research questions.

To answer the first research question, a descriptive statistics was conducted to provide the mean and standard deviation of each item and dimension as described in Table 2 below.

**Table 2: Descriptive statistics of students’ responses to the items of PSI-S instrument**

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Asking questions/ Framing Research</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1. I formulate questions which can be answered by investigations.</td>
<td>2.77</td>
<td>1.12</td>
</tr>
<tr>
<td>A2. My research questions are used to determine the direction and focus of the lab.</td>
<td>2.61</td>
<td>1.07</td>
</tr>
<tr>
<td>A3. Framing my own research questions is important.</td>
<td>3.02</td>
<td>1.18</td>
</tr>
<tr>
<td>A4. Time is devoted to refining my questions so that they can be answered by investigations.</td>
<td>2.87</td>
<td>1.22</td>
</tr>
<tr>
<td><strong>B. Designing Investigations:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1. I am given step-by-step procedures before I conduct investigations.</td>
<td>4.52</td>
<td>0.83 (0.84)</td>
</tr>
<tr>
<td>B2. I design my own procedures for investigations.</td>
<td>4.12</td>
<td>1.04</td>
</tr>
<tr>
<td>B3. I engage in the critical assessment of the procedures that are employed when conducting investigations.</td>
<td>3.94</td>
<td>1.1</td>
</tr>
<tr>
<td>B4. I justify the appropriateness of the procedures that are employed when I conduct investigations.</td>
<td>3.5</td>
<td>1.12</td>
</tr>
<tr>
<td><strong>C. Conducting Investigations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1. I conduct the procedures for my investigation</td>
<td>4.26</td>
<td>0.97</td>
</tr>
<tr>
<td>C2. The investigation is conducted by my teacher in front of the class.</td>
<td>4.23</td>
<td>1.0 (0.99)</td>
</tr>
<tr>
<td>C3. I am actively participating in investigations as they are conducted.</td>
<td>4.34</td>
<td>0.82</td>
</tr>
<tr>
<td>C4. I have a role as investigations are conducted.</td>
<td>4.39</td>
<td>0.81</td>
</tr>
<tr>
<td><strong>D. Collecting Data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1. I determine which data to collect.</td>
<td>3.71</td>
<td>1.06</td>
</tr>
<tr>
<td>D2. I take detailed notes during each investigation along with other data I collect.</td>
<td>3.98</td>
<td>1.02</td>
</tr>
<tr>
<td>D3. I understand why the data I am collecting is important.</td>
<td>4.09</td>
<td>0.91</td>
</tr>
<tr>
<td>D4. I decide when data should be collected in an investigation.</td>
<td>4.02</td>
<td>0.93</td>
</tr>
<tr>
<td><strong>E. Drawing Conclusions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1. I determine which data to collect.</td>
<td>3.71</td>
<td>1.06</td>
</tr>
<tr>
<td>D2. I take detailed notes during each investigation along with other data I collect.</td>
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<tr>
<td>D3. I understand why the data I am collecting is important.</td>
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<td>0.91</td>
</tr>
<tr>
<td>D4. I decide when data should be collected in an investigation.</td>
<td>4.02</td>
<td>0.93</td>
</tr>
<tr>
<td><strong>F. Drawing Conclusions</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As mentioned before, the twenty items of the scale were categorized into five dimensions. The results show that dimension framing questions (\( \bar{X} = 2.82, SD = 0.90 \)) had the lowest mean while the dimension of data collection had the highest mean (\( \bar{X} = 3.95, SD = 0.76 \)). Basically this means that students were not offered good opportunity to frame their questions that guide investigations in science labs. On the other hand, students were given much better opportunity to collect data in a way aligned with scientific inquiry. The dimensions could be ranked from the lowest to the highest level of implementing inquiry as framing questions, designing investigations, drawing conclusions, conducting investigations, and then collecting data. In short, students were offered less opportunity to asking questions and designing investigations compared to the opportunities of conducting investigations and collecting data.

At the item level, items C1: I conduct the procedures for my investigation, C3: I am actively participating in investigations as they are conducted, and C4: I have a role as investigations are conducted, had high means, higher than 4.25. Thus, it could be concluded that students were highly engaged in conducting investigations in science labs. They also reported that they had a role as investigations were conducted (\( \bar{X} = 4.39 \)), actively participated in investigations (\( \bar{X} = 4.34 \)), conducted the procedures for investigations (\( \bar{X} = 4.26 \)). Similarly, students reported that they understood why the data they collected were important (\( \bar{X}_{D3} = 4.09 \)), and took detailed notes during each investigation (\( \bar{X}_{D2} = 3.98 \)). The results provided positive indicators for developing conclusions and connecting conclusions to scientific knowledge.

On the other hand, and most importantly, items A1 and A2 which were related to framing questions, the core of inquiry, and using research questions to determine the focus of the lab had relatively low means (\( \bar{X}_{A1} = 2.77; \bar{X}_{A2} = 2.61 \)). The results also indicated that science labs were taught traditionally. For example, students were often given step-by-step procedures before conducting investigations (\( \bar{X}_{B1} = 4.52 \)), and the investigations were usually conducted by teachers in front of the class (\( \bar{X}_{C2} = 4.23 \)).

To determine if differences existed among science labs, a one-way ANOVA was conducted. The subject of lab (Physics, chemistry, and biology) served as independent variable while the level of implementing the scientific inquiry served as a dependent variable. The descriptive statistics showed that implementing inquiry was close among science labs (General physics: \( \bar{X} = 3.49, SD = 0.45 \), General chemistry: \( \bar{X} = 3.44, SD = 0.51 \), General biology: \( \bar{X} = 3.48, SD = 0.46 \)). There was no statistical significant overall

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1. I develop my own conclusions for investigations.</td>
<td>3.71</td>
<td>0.96</td>
</tr>
<tr>
<td>E2. I consider a variety of ways of interpreting evidence when making conclusions.</td>
<td>3.5</td>
<td>0.91</td>
</tr>
<tr>
<td>E3. I connect conclusions to scientific knowledge.</td>
<td>3.7</td>
<td>1.04</td>
</tr>
<tr>
<td>E4. I justify my conclusions.</td>
<td>3.53</td>
<td>1.09</td>
</tr>
</tbody>
</table>

*The data of items B1 and C5 were reverse coded.*
difference in implementing inquiry between science labs, one-way ANOVA $F(2, 231) = 0.263, p= 0.77 > 0.05$.

**Discussion and Implications**

It could be concluded that the opportunities offered to students varied across the dimensions of scientific inquiry aligned with reformed calls for engaging students in scientific inquiry. Students were given better opportunities for conducting investigations and collecting data than framing research questions and designing investigations. Students were usually given a demonstration and step by step procedures, “cookbook activities”, for the investigations they were conducting. The less emphasis on framing questions and designing investigations might result from poor preparation of teachers for inquiry (Anderson, 2002). Science faculty members need to be comfortable in doing inquiry before expecting them to implement inquiry in their teaching (Barrow, 2006).

Understanding the new roles of teachers and students may still be challenging for Jordanian lab instructors (Anderson, 2002). Therefore, to promote inquiry experiences for college science laboratories in Jordan, the five essential features of inquiry may be employed for developing science instructors’ understanding of inquiry (Kang, Orgill, & Crippen, 2008).

Further, they need to attend workshops which enabled them to see models for inquiry pedagogy, reflect on them, and prepare for integrating them in their teaching (Barrow, 2006; Gengarelly & Abrams, 2009; Hogan & Berkowitz, 2000).

Furthermore, schools of science and schools of educations are advised to work collaboratively to promote inquiry-based instruction (Duran, McArthur & Hook, 2004).

Providing students with “cookbook” activity sheet is key challenge for promoting inquiry experiences in college science labs; therefore, moving away from cookbook labs may be valuable (Brown et al., 2006).

The cookbook labs should be transferred to guided inquiry by asking students to develop their own procedures and methods (Bell, Smetana & Binns, 2005). Because implementing and planning inquiry is not an easy task, students should move gradually, with appropriate scaffolding, from low level to higher level of inquiry (Bell, Smetana & Binns, 2005).

Students may be asked to design experiments, formulate hypotheses, perform experiments under the guidance of their instructors, and draw conclusions (Ketpichainarong, Panijpan, & Ruenwongsa, 2010).

Researchers are invited to investigate in some depth, science faculty members’ pedagogy knowledge, and knowledge of inquiry. They are also invited to develop a working research-based framework to guide the workshops and other professional development models to promote inquiry experiences in science laboratories.
Students’ perceptions of inquiry experiences across science labs (physics, chemistry, biology) were similar. In other words, students’ perceived similar inquiry experiences in general physics labs, general chemistry labs, and general biology labs though the nature of these labs is different. It was expected, for example, that the students would be offered better inquiry experiences in physics labs more than chemistry labs which are more dangerous, but that was not the case. Therefore, the above discussion, interpretations, and implications may be applied similarly to the general physics labs, general chemistry labs, and general biology labs.

References


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