Introduction

The introduction of the new Junior Certificate Science syllabus in 2003 saw an increased emphasis on scientific investigations and the application of science process skills in student activities. To complement this change a new assessment structure was devised and presented, providing practical assessment components: Coursework A and Coursework B. However, since the introduction of the Coursework B assignment significant problems have been highlighted by science teachers. These include the workload involved, poor ability of students to carry out the investigations, lack of resources and the effect the increased workload is having on the teaching time required to finish the syllabus (Higgins, 2009).

In order to overcome these barriers new teaching and learning strategies need to be incorporated into the science classroom to help the students and teachers prepare for Coursework B. One such approach is Inquiry Based Learning (IBL). IBL is not a new approach; it has been in existence in many forms for some time. These include Problem Based Learning, Project Based Learning and Investigations.

Before the author presents definitions and characteristics of IBL it is firstly important to recognise why there is a need for IBL in junior certificate science classrooms.

Background – Why do we need to integrate Inquiry Based Learning in the Science Classroom?

- Since the introduction of the revised Junior Certificate (JC) science syllabus, practical work and problem solving have become the forefront of the science classroom through the incorporation of scientific investigations both within Coursework A and B.
- Science teachers around Ireland reported that since the introduction of the revised syllabus their workload has increased, as the majority of them (91.4%) are giving a considerable or very considerable amount of time to help their students with coursework B (Higgins, 2009).
- The impact of coursework B on teachers’ satisfaction with the syllabus is also reported in a study carried out for the Department of Education and Science (DES, 2006). The report states that 41.2% of science teachers are dissatisfied or very dissatisfied with the Coursework B element of the syllabus (DES, 2006, p. 15).
- One possible reason for this dissatisfaction may be that teachers are required to spend...
What are the benefits of Inquiry Based Learning?

Inquiry-based learning has benefits for both the students and teachers. The following two diagrams represent the benefits for both (Figure 1 and Figure 2 respectively).

![Figure 1: The benefits of IBL to the Student](image1)

![Figure 2: The benefits of IBL to the Teacher](image2)

What is Inquiry Based Learning (IBL)?

IBL is a teaching approach that has several key characteristics that together promote students’ learning of a subject. The approach provides students with the opportunity to take responsibility for their own learning as they direct the line of inquiry which is driven by research. The following list outlines the key characteristics of IBL.

IBL:
- Usually starts with a question or scenario
- Is student-centred
- Encourages students to ask questions
- Promotes student dialogue in the class and hence can provide opportunities to improve scientific language
- Emphasises data collection
- Promotes critical thinking
- Develops transferable life skills
- Encourages collaborative learning
- Is guided by the teacher who acts as a facilitator

A large amount of time helping their students complete their work because the students are unable to carry out the investigations themselves due to poor problem-solving skills and lack of experience using investigative practical approaches.

- The Junior Certificate syllabus suggests that the experience gained through the completion of Coursework A is sufficient to develop the students’ skills in planning, conducting experiments and writing reports and hence prepare them to complete the Coursework B component. However, this is not the case as the students do not get the opportunity to develop their skills in planning and conducting investigations when completing the Coursework A experiments, as these are often taught using a ‘recipe-style’ approach and the students simply complete the task without thought or reflection.
The Process of Inquiry Based Learning

IBL is often described as a cycle or spiral, involving the formation of a question, an investigation, creation of an appropriate solution or answer, student-centred discussion and reflection on the outcome. In practice, not all these steps need to be carried out or need to be followed in sequence. Figure 3 represents a sequence for an IBL process (Golding and Wood, 2009). This process wheel represents how IBL works and what skills are developed in a typical IBL cycle or session. The development of an IBL lesson using the six steps is outlined below.

1. Define the problem

All IBL sessions must begin with a problem. What are we trying to find out? What problem are we faced with? This is identified as the ‘trigger’. It is central to IBL that the ‘trigger’ is sufficiently open-ended to allow a variety of responses or solutions (Golding and Wood, 2009). The ‘trigger’ must also stimulate curiosity in the students which will in turn encourage them to actively explore and seek out the solution. In essence a question under investigation must obey the following guidelines:

- The questions must be answerable
- The answer cannot be a simple fact
- The answer cannot be already known

Below are possible trigger questions/problems that could be used when teaching junior cycle science.

Food: Why do you think athletes and sports people consume so many carbohydrates in their diet?

Micro-organisms: What do micro-organisms need to live and survive?

Light: Why is a shadow larger in size than its object?

Mixtures and Compounds: How do you separate soil? Can this process be used to separate salt? Why?

2. Identify what you already know

IBL is based on the constructivist theory of learning. Pedagogically, the teacher’s role within a constructivist class is characterized as that of a facilitator in which he/she encourages more “student-student interaction that in turn promotes negotiation to reach consensus about the meaning of scientifically acceptable concepts” (Hand et al., 1997). This encourages the student to build “new knowledge upon the foundation of previous learning” (Hoover, 1996). It is essential to determine the students’ prior knowledge at the beginning of a lesson as this will inform the direction of the lesson. This can be carried out through a simple exercise at the onset of the lesson.

3. Allocate tasks to fill gaps in existing knowledge

In order for IBL to take place in the science classroom (or any classroom for that matter) the learning environment needs to promote interaction and discussion. It is important to realise that the handling of the problem defines and drives the whole learning experience for the students. One of the key elements of IBL is collaborative work and to ensure this is facilitated correctly it is advisable to organise the students in groups of two or three. Groups composed of students with diverse backgrounds, abilities and interests expose students to multiple
perspectives and problem-solving methods. It is advisable also to assign roles of responsibility prior to any work being carried out. Some typical roles in groups include the following:

**Chair:** The chair keeps the group moving forward and helps to finalise strategies to solve the problem. The chair also helps to ensure that everyone is involved, and that each member of the group has a task to do.

**Scribe:** The recorder or scribe keeps records of assignments to be done and strategies, as well as ideas and issues the group have discussed at meetings.

**Timekeeper:** The timekeeper is responsible for keeping the schedule to enable the group to meet deadlines.

4. **Do individual or joint research**

This refers to whether you want your students to carry out individual or group work. It is possible to split the task into minor tasks and in that way it is feasible to have a combination of both.

5. **Collate research**

Whether the task is carried out in groups or individually it is important to allocate time in the lesson for students to share their knowledge and discuss their findings. As Figure 3 shows, this encourages students to debate their results and come to a conclusion on their findings. The focus of this stage of the lesson is that the discussion must be student-centred.

6. **Apply what you have learned**

One reason for learning new knowledge is to improve your ability in answering questions you may have relating to the topic. To examine students’ understanding of the concepts learned, use problems to help your students apply what they have learned. These problems can take many shapes and forms. Yan and Lainghuo (2006) established classifications of questions, where each division includes two categories (dichotomies) or more. These categories can be used to generate a combination of questions for the students to test their application of knowledge.

**Summary**

In summary this Research and Resource Guide presents the important steps involved in IBL. Throughout the process of problem solving the teacher supports and facilitates the students as they pursue their own lines of inquiry. To do this the students must draw on their existing knowledge and identify the gaps in their knowledge and fill them in. Within this process the students take responsibility for analysing and presenting their new knowledge.

The introduction of the new Junior Certificate Syllabus in 2003 emphasises and assesses students’ ability in scientific process skills and the scientific method. However, to facilitate the development of these skills the students must get experience and feedback on the use of them. The incorporation of IBL into science lessons will facilitate this.

"Tell me and I forget, show me and I remember, involve me and I understand."

**References**


