PSI

Problem Solving With Industry

GNVQ Intermediate Science

Sheffield Hallam University

Centre for Science Education,
School of Science.

In partnership with Industry

WMH

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Auto Alloys I & D Ltd.
Barnsley Chronicle.
Barnsley Metropolitan District Council Environmental Health Office.
Bridon Ropes, Doncaster.
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Hadfield, Cawkwell, Davidson & Partners, Architects, Sheffield.
Her Majesty's Stationary Office.
ICI Chemicals & Polymers Ltd., Soda Ash Products, Northwich.
ICI Chemicals & Polymers Ltd., Tunstead Quarry, Buxton.
ICI Fine Chemicals Manufacturing Organisation, Huddersfield.
Local Health Promotion Units.
The Agiculture & Dairy Advisory Servce
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PROBLEM SOLVING WITH INDUSTRY
- GNVQ Intermediate Science

Tutor Support Manual

A guide to support the use of the units

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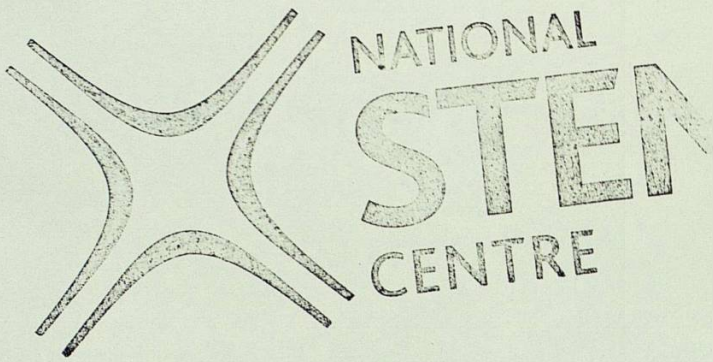

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Problem Solving with Industry
Tutor Support Manual

Problem solving with industry and GNVQ

The skills needed to solve problems make decisions and achieve results are the most valuable we can assist young people to attain, both for their personal and career development. Problem solving is generally regarded as a composite skill, enabling the development of a wide range of personal communication, enterprise, scientific and technological skills.

Intermediate GNVQ in Science is designed to provide opportunities for young people to develop their skills, knowledge and understanding of science through experiencing the types of activity that scientists carry out. With this in mind, industrial problems or applications have been used to provide real and relevant contexts in which to cover science context and processes in GNVQ intermediate science.

Problem solving and active learning

Perhaps more than any other learning strategy, problem solving provides an excellent opportunity to engage students in active learning. PSI units introduce students to a wide range of active learning strategies including active reading and writing, role-play, group discussion, data handling etc. The development of PSI materials has drawn on the ideas and strategies given in another project developed at the Centre for Science Education - ATLAS (Active Teaching and Learning Approaches in Science). ATLAS is published by Collins Educational.

Assessment

GNVQ units consist of a number of **elements** which set out the activities that must be demonstrated by the student.

Each element has a number of **performance criteria.** These both clarify the nature of the activity described by the element and set that standard of performance that must be met. **All** performance criteria must be met for the award of a unit and students must be given an opportunity to meet them.

Care should be taken to deal with the performance criteria as a group when assessing a student's work. It is not acceptable for individual performance criteria to be assessed separately, without recognition of their interaction with one another.

Each element has a **range** which indicates the significant dimensions which must be covered for successful completion of the unit. In GNVQs the range refers primarily to what candidates need to understand.

Assessment in GNVQs is based directly upon national standards set out in the element of achievement for a qualification. The primary form of evidence for assessment will come from activities carried out by a student. It is expected that the student will take a leading role in assessment by collecting and presenting evidence to make sure that they cover all the requirements of the elements, performance criteria and range in each unit.
The evidence in the student's portfolio may take a variety of forms, eg. written reports or investigations.

Achieving Science Performance Criteria

At intermediate level it is possible to put together a programme of assignments which meets the performance criteria and covers most of the range. It is useful to match assignments to elements because this makes it easier to keep track of student achievement.

Achieving the Core Skill Criteria

Students can achieve most of the level 2 core skill requirements during their work in science. The PSI modules also include opportunities to achieve core skill criteria in science/industrial (vocational) contexts.
NB Some of the items in the core skill ranges cannot be linked to specific modules but opportunities to achieve, eg, the performance criteria of information technology elements 2.4 and 2.5 can happen at any time when the students are using software.

The first sheet in each module indicates assessment opportunities both in science and in the core skills. When indicating the assessment opportunities the elements and range dimensions are specified but, because NCVQ states that performance criteria cannot be assessed separately, no attempt is made to match particular tasks to selected performance criteria. The general rule is that all performance criteria should be met on each assessment occasion.

GRASP®

The modules contained in this pack are adapted from a previous publication also called Problem solving with Industry and aimed at Key Stage 4. Those modules most appropriate to GNVQ Intermediate Science have been adapted, but as with the original version they introduce students to the GRASP approach as an effective tool when planning, organising and carrying out work.

The **Comino Foundation's GRASP** approach is much more than just another problem solving approach.
The acronym stands for:

Getting **R**esults **A**nd **S**olving **P**roblems

The process itself has four elements which can be summarised:

- Select the **purpose** or objective and the **criteria for success**
- Generate different ways of **achieving the purpose** or objectives, **compare with criteria and select the most promising**
- Put the chosen plan into operation and **control** the process
- **Review** continually each operation and the results

Throughout this pack the students are encouraged to use the GRASP approach and - more importantly - to reflect upon the process. This is used in both producing workable solutions to science-based problems as well as in planning and executing their own presentations. In this way students are encouraged to see the use of GRASP as a transferable skill which had immediate practical benefits.

It is also hoped that students will make use of the GRASP approach not only with these modules but will see the value of applying it in day-to-day situations.

Vocationally relevant learning activities

GNVQ's have been designed for delivery in full-time education with limited access to the workplace. GNVQ's set the outcomes which students must achieve but they do not prescribe or limit the learning programme itself.

GNVQ's encourage activities based on industry market surveys, investigations of processes and products, case studies of industries or organisations, planning and organising operations and events, and designing products and services.

GNVQs are designed to promote active learning in which students are given scope to plan and carry out activities.

Perhaps more than any other learning strategy, problem solving provides an excellent opportunity to engage students in active learning. An important aspect of problem solving is that students have to gather, evaluate and use information from a variety of sources. This can be used in assessing the GNVQ portfolio of evidence.

In common with the GNVQ philosophy is the development of the skill of action planning since students are required to take control of their own work. Also of critical importance to problem solving but also an important assessment tool is the skill of self evaluation. For each module there is the opportunity to develop an action plan and complete an assessment when the module is completed. Most of the assessment criteria are determined by the unit itself but there is the opportunity for the student to make comments on the completed tasks.

General National Vocational Qualification
Science Intermediate Level

Student Name: Date:

Activity:

Action Plan

What do I need to find out?	What do I need to do?	In which order?	By when?	What changes are needed?

Tutor Comment

General National Vocational Qualification
Science Intermediate Level

Student Name: Assignment Title:

Range covered	Evidence indicators
Performance criteria	Mandatory core Communication Number Information Technology
Students comment	Tutors feedback
Date / Student signature	Date / Tutor signature

Safety and Risk Assessment

It is important to emphasise with students that carrying out any practical procedure carries an element of risk such as using chemicals, handling microorganisms, using electricity, etc. In the past, the responsibility for ensuring the safety of these procedures has rested entirely with the teacher. This presents a potential problem for students following a GNVQ course because the underlying philosophy of the course is one of encouraging independent work. However, the GNVQ specifications do require students to demonstrate a knowledge and understanding of safety regulations together with being able to demonstrate responsibility for safety during practical work.

With all of this in mind, it will be very useful if, prior to embarking on any of the modules in this pack, some time is spent discussing and investigating the whole area of safety and practical work. This could begin with a general discussion about the need for safety and an examination of the various publications available for consultation before starting any practical work. Since any practical work the students carry out as part of any of the modules in this pack requires a completed Risk Assessment form, some time spent on the development of these forms will be most useful. The students will then be able to use their forms on a regular basis for all practical procedures.

The development of Risk Assessment forms in this pack takes the form of an introductory module and not only covers the issue of safety but also gives the students the opportunity to experience the style of the remaining Problem Solving with Industry modules in the pack.

GNVQ Intermediate Science Mandatory Units and PSI

The following tables show the modules available together with the science criteria and the core skills covered by them.

Module Number	Title
0	Safety and Risk Assessment
1	Why Did the Rope Break?
2	Dam Algae!
3	Building a Superstore
4	The White Stuff in the Pipes
5	The Star of Byzantium
6	Preventing Heart Disease
7	The Dye is Cast
8	From Quarry to Food Cans

Science Criteria

Module	Unit 1			Unit 2			Unit 3			Unit 4		
	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3
0	•											
1	•	•			•							
2	•	•		•								
3	•				•							
4			•			•						
5			•						•			
6	•	•								•		
7	•	•				•					•	
8	•	•									•	

Core Skills

Application of Number

Element 2.1 - Gather and process data
Element 2.2 - Represent and tackle problems
Element 2.3 - Interpret and present mathematical data

Communication

Element 2.1 - Take part in discussions with a range of people
Element 2.2 - Prepare written materials on routine matters
Element 2.3 - Use images to illustrate points in writing
Element 2.4 - Read and respond to written material and images

Information Technology

Element 2.1 - Set up storage systems and input information
Element 2.2 - Edit, organise and integrate information from different sources
Element 2.3 - Select and use formats for presenting information
Element 2.4 - Evaluate features and facilities of given applications
Element 2.5 - Deal with errors and failures

N.B. Elements within Information Technology can be gained if, for example, computer software is used to prepare a final report, proposal, laboratory report, presentation, etc.

Module	Application of Number			Communication			
	2.1	2.2	2.3	2.1	2.2	2.3	2.4
0				•	•		•
1	•		•		•	•	•
2				•	•	•	•
3	•	•	•	•	•	•	•
4	•		•	•	•		•
5	•			•	•	•	
6	•		•	•	•	•	•
7			•	•	•	•	•
8	•		•		•	•	•

Safety and Risk Assessment

What is the problem?

To find out about the safety procedures that should be adopted when you carry out any practical work in a science laboratory.
As a member of a team, you will find out what the science department safety policy is and how assessments are made of the potential risks of any practical procedures. Using this information you will develop your own Risk Assessment form for use during any practical work you carry out in Problem Solving with Industry GNVQ Intermediate Science.

What is there to do?

- Draw up an action plan for the group showing each member's role
- Check your action plan with your tutor before you start

The Tasks

Task 1

Carry out a survey of the science laboratories and record all safety points and potential hazards. It is probably worth the group brainstorming some ideas before you start and then splitting up if a number of laboratories are to be surveyed. After an agreed time, the group can get back together and come up with a list of hazards, etc that cover all the science laboratories together with any hazards and safety points associated with specific sciences.

Task 2

Investigate the present safety procedures by interviewing the laboratory technician about how a practical session is normally prepared. It may be possible to observe some apparatus, chemicals, etc being prepared and see just how the potential risks are identified and highlighted. Include in this how chemicals, microorganisms, etc are disposed of when they are no longer needed.

Task 3

With all this information, it will now be possible for your group to design your own Risk Assessment form that you can use whenever you do any practical work. You may find it useful to do this work on a computer but do not forget that a paper copy will have to be completed and checked by your tutor every time you do any practical work.

The GNVQ specifications covered are:

Science Elements

1.1 Examine science-based employment

1 - ways science is used in science-based services and industries
2 - work practices in selected science-based service or industry
3 - effects of commercial factors on work practices
4 - effects of safety regulations on work practices
5 - symbols for standards are identified and explained
6 - ways if reducing risks for hazards identified

Range

Tasks - safety regulations / hazards
- laboratory-based
- working in a team
- short time scale

Data - qualitative

Core Skills

- take part in discussions
- prepare written materials
- read and respond to written materials and images

N.B. If I.T. is used to prepare the Risk Assessment form then there are further core skills possible:

- set up storage systems and input information
- edit, organise and integrate information
- select and use formats for presenting information

Safety and Risk Assessment
Tutor Notes

The end result of this short introductory module should be a usable Risk Assessment form. Therefore, it is important that all the proposals made by the students are carefully checked before they go ahead and use the forms in subsequent work.

Pointers

Task 1

The students may need some suggestions to get them started on where to look for relevant information, such as fire extinguishers, emergency exits, first aid kits, etc, as well as hazards associated with storage, etc.

Task 2

The students' discussions with the technician such touch on storage of hazardous materials and equipment and include any legal implications.

Task 3

Assuming the Risk Assessment form is acceptable it can then be used regularly but each practical procedure requiring a completed form must be carefully checked for evidence that all the hazards have been identified and precautions suggested and the procedures adopted are within the appropriate safety regulations.

N.B. If the students have been unable to design an acceptable for, then they can use the one normally used in the science department, or one could be designed under the guidance of the tutor.