CREATING AND MAINTAINING AN INTEREST IN ENGINEERING IN HIGH SCHOOLS THROUGH A YEAR 11 ENGINEERING REPORT COMPETITION

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Abstract

In 2000, the Board of Studies in New South Wales introduced the subject Engineering Studies Stage 6 in Year 11. One of the major emphases in the subject is the Engineering Report. With the aim of improving student interest in High Schools towards studies/careers in Engineering, the Illawarra/Sutherland Regional Group of Engineering Australia developed its High School Engineering Report Competition. The thrust of this Competition is to invite High Schools to submit for judging the best 2 Engineering Reports prepared by their students. These Reports are assessed by a Judging Panel of 6 Professional Engineers and a significant number of Prizes and Awards, all sponsored by external sponsors, are determined and presented at 2 prestigious Presentation Events.

The Illawarra/Sutherland Regional Group's Competition has been so successful that from 2005 onwards the Competition will be extended into all of Engineers Australia Sydney Division Regions. This will mean that the vast majority of the average enrolment of 1,250 students in Engineering Studies Stage 6 in Year 11 will have the opportunity to enter the enhanced Competition.

The initial and ongoing success of the Illawarra/Sutherland Regional Group Competition will be highlighted in this paper. This success includes a significant increase in enrolments in the Faculty of Engineering at the University of Wollongong and a phenomenal increase in sponsorship of the Competition.

Background and Motivation

In an attempt to increase High School students' awareness of Engineering, in 2000 the Board of Studies in New South Wales introduced the subject Engineering Studies Stage 6 in Year 11. The subject syllabus may be found on the Board of Studies website hhtp://www.boardofstudies.nsw.edu.au.

The following 2 paragraphs are from Section 2 – Rationale for Engineering Studies in Stage 6 Curriculum from the Engineering Studies Stage 6 Syllabus.

"Proceedings of the 2005 ASEE/AaeE 4th Global Colloquium on Engineering Education

"Engineering Studies Stage 6 is directed towards the application and advancement of skills associated with mathematics, science and technology and is integrated with business and management. It will provide students with skills, knowledge and understanding associated with a study of Engineering, its practices and associated methodologies. The subject promotes environmental, economic and global-awareness, problem-solving ability, engagement with information technology, self-directed learning, communication, management and skills in working as a team".

Engineering Studies Stage 6

"Engineering Studies Stage 6 is unique in that it develops knowledge and understanding of the profession of Engineering. It also provides an opportunity to integrate the science and mathematics disciplines with societal development and change. The syllabus is inclusive of the needs, interests and aspirations of all students and provides opportunities and challenges to deal with Engineering concepts".

Section 4 of the Syllabus states the aim of the subject as:

"The aim of Engineering Studies Stage 6 is to develop students' understanding and appreciation of the nature and significance of Engineering and its impact on society with an emphasis on the application of Engineering methodology".

Section 5 states the subject objectives as:

"Students will develop:

1. understanding of the scope of Engineering and the role of the Engineer;

2. knowledge and understanding of Engineering principles and an appreciation of the responsibilities of Engineers in society;

3. communication skills appropriate to Engineering practice;

4. knowledge and understanding of developments in technology and an appreciation of their influence on people and Engineering practice;

5. management and problem-solving skills in Engineering contexts;

6. skills in the application of engineering methodology.

Engineering Studies Stage 6 comprises a Preliminary course made up of 4 compulsory modules and one elective module, and an HSC course made up of 5 compulsory modules. Table 1 is a schematic view of the Engineering Studies syllabus structure.

Table 1 – Schematic View of Engineering Studies Syllabus Structure

Preliminary Modules *120 Hours Indicative Time	**HSC Modules** *120 Hours Indicative Time
ENGINEERING APPLICATION MODULE 1 **Household Appliances**	ENGINEERING APPLICATION MODULE 1 **Civil Structures**
ENGINERING APPLICATION MODULE 2 **Landscape Products**	ENGINEERING APPLICATION MODULE 2 **Personal & Public Transport**
ENGINEERING APPLICATION MODULE 3 **Braking Systems**	ENGINEERING APPLICATION MODULE 3 **Lifting Devices**
ENGINEERING FOCUS MODULE 1 **Bio-Engineering**	ENGINEERING FOCUS MODULE 1 **Aeronautical Engineering**
School-based Elective ENGINEERING APPLICATION MODULE 4 OR ENGINEERING FOCUS MODULE 2	ENGINEERING FOCUS MODULE 2 **Telecommunications Engineering**

*Each module is of 24 hours indicative time

One of the major emphases in the subject is the Engineering Report. The following has been extracted from Section 6.2 – The Engineering Report from the Engineering Studies Stage 6 Syllabus.

"The process of reporting on investigation and practical activities in this subject will be through the preparation of Engineering Reports that must be prepared for each module in the Preliminary and HSC courses. Reports will be less detailed in the Preliminary course than those required for the HSC course. Engineering Reports may include:

- introduction to the purpose of the report
- appropriate research
- analysis/synthesis of related issues
- conclusions and/or recommendations
- references.

The Engineering Reports for the Preliminary course should be based on an analysis of one or more areas of the module content.

Reports developed in the HSC course should encompass a degree of both analysis and synthesis of one or more areas of relevant content, and reflect actual Engineering practice.

Each module is to generate at least one Engineering Report. One Engineering Report from the Preliminary course and one from the HSC course must be the result of collaborative work".

The Engineering Report Competition

With the introduction of Engineering Studies Stage 6, the Illawarra/Sutherland Regional Group (ISRG) of Engineers Australia (EA) developed its High School Engineering Report Competition. The thrust of this Competition is to make use of work already done by Year 11 students as part of their assessment by inviting High Schools to submit the best 2 Engineering Reports prepared by their students on the modules covered by the Schools prior to the closing date of the Competition. In some cases, a third report will be submitted from 2005 onwards because of a new award, the BlueScope Steel Women in Engineering Prize. Table 2 shows the time management of the Engineering Report Competition.

These Reports are then reassessed by a Judging Panel of 6 Professional Engineers and a number of prizes awarded to a total value of $3,250. All of these prizes are provided by 6 external sponsors.

There are a number of aims of the Competition which has run extremely successfully for the past 5 years and was launched for 2005 in March. These include:

- Improving the interest in High Schools towards studies/careers in Engineering.
- Promoting Engineering as an exciting worthwhile future career.
- Overcoming current concerns that exist with growing shortages of Engineering graduates.

Prizes and Sponsorship

The inaugural Competition in 2000 was seed funded by Sydney Division of Engineers Australia and $250 worth of prizes awarded. The Winning Student was awarded $150 while 2 Encouragement Awards of $50 each were presented.

From 2001 – 2003, Australian Business Limited (ABL) were the Competition's major sponsor providing $1,500 while the Faculty of Engineering provided $1,000.

ABL's sponsorship provided prizes to the Winning Student, $500, the Winning School, $500, and the 2 Achievement Awards, $250 each. The Faculty's sponsorship provided a place at the Honeywell Engineering Summer School valued at $495 to the Winner of the Creativity Award and a Finalists Award of $50 to each of the Finalists who did not win a major prize.

In 2004, ABL had to withdraw its sponsorship late in the Competition so Sydney Division became the Competition's major sponsor. Sydney Division also sponsored the Overall Winner's Prize, a palmtop to the value of $500. The Faculty of Engineering continued its generous sponsorship, while BlueScope Steel sponsored the BlueScope Steel Solutions Prize, value $250.

Table 2 – Engineering Studies High School Year 11 Engineering Report Competition Time Management

TIMING	ACTIVITY
November	Meeting with Sydney Division, ISRG, Western Sydney and Metro to establish the ground rules for next year's Competition.
November/December/ January	Organise Sponsorship.
Early February	Prepare Flyer and Entry Forms.
Mid February	Send Flyer & Entry Forms to Printing Department.
Early March	Distribute to High Schools.
May	Follow-up High Schools.
June	Form the Judging Panel.
Late July	Receive Entries by the closing date.
Early August	Reports assessed independently by each member of the Judging Panel.
Mid August	Judging Panel meets to decide Winners and Awards.
Mid August	Winners and Awards announced.
Mid August	Shields engraved and Certificate s prepared. Sponsors' cheques requested from Sydney Division.
Mid August	Regional Winner's Report to Sydney for judging.
Mid August	Organise Publicity.
Late August	Regional Presentation.
Early September	YEA-S Public Speaking and Awards Night.
Early September	Organise follow-up Publicity.
September	Reports returned to the High Schools.

In 2005, each Region (see the Section Expansion of the Competition below) has been responsible for generating its own sponsorship. The Illawarra/Sutherland Regional Group has been successful in attracting the following sponsorship to a total value of $3,250.

- Coffey Geosciences sponsoring the Student First Prize of $500.
- PHD Engineering Pty Ltd sponsoring the Winning School Prize of $500.
- ANSTO sponsoring the 2 Achievement Prizes of $250 each.
- University of Wollongong Faculty of Engineering sponsoring a placement at the Honeywell Engineering Summer School (value $495) and the Finalists Award, total value $1,000.
- BlueScope Steel sponsoring 2 prizes – the BlueScope Steel Solutions Prize and the BlueScope Steel Women in Engineering Prize, value of each $250.
- Northrop Engineers Pty Ltd sponsoring the Northrop Civil Engineering Prize, value $250.

Judging of the Competition

Each year, a Judging Panel of 6 Professional Engineers is formed. Each member of the Panel is a member of the Illawarra/Sutherland Regional Group Committee. These judges assess each submitted Engineering Report independently and then meet (see Table 2) to decide on the Winners and Awards. Table 3 is a copy of the Assessment Sheet for the High School Engineering Report Competition while Table 2 highlights the timing of the Judging of the Competition.

Presentation of Prizes and Awards

From 2000 – 2003, all of the Prizes and Awards in the ISRG Competition were presented at the Young Engineers Australia, Sydney Division Public Speaking Finals and Awards Night in Sydney.

Because of the expansion of the Competition in 2004, 2 Presentations were held for the ISRG Competition: the Regional Presentation in Wollongong and the Young Engineers Australia, Sydney Division Awards N ight in Sydney. At the Regional Presentation, all the Finalists were acknowledged and the majority of the Prizes and Awards presented. The major Prizes and Awards were presented at the Awards Night in Sydney along with Overall Prize.

The 2004 system will continue in 2005 when the Overall Winner of the Competition will be presented with his/her Prize. The Overall Winner will be determined by a separate Judging Panel assessing the 3 Regional Winners.

Table 3 – Assessment Sheet for the High School Engineering Report Competition

Judging Assessment for:

Student's name:

Student's school:

Report title:

Content **/60**

- (Technical) information relevant to the topic/problem statement.
- Accurate information.
- Includes at least the following sections (even early high school students should be familiar with this type of report format, as it is used in science subjects):
- An aim.
- A body of information (e.g. background to problem, history etc)/method of approach.
- Any relevant results.
- A discussion of results of conclusions.
- A list of references.

Presentation **/40**

- Use of formal language (no I, we etc) as well as grammar and spelling.
- Correctly numbered headings e.g.:
  - 1 heading 1
  - 1.1 heading 2
  - 1.1.1 heading 3
- Diagrams, tables, charts etc., labeled and captioned correctly (diagrams must be clear – no fuzzy images etc).
- General formatting including:
  - New pages when starting new chapters/sections.
  - Appropriate use of spacing/fonts etc.
  - Charts and diagrams located in a position that can be easily referred to when referenced in the text.

Total for the report **/100**

Creativity **/100**

- Uses design to solve a problem, i.e:
  - Uses technical drawing to create an object.
  - Creates a process to solve the problem.
- Modifies an existing solution (may be borrowed from a completely different application etc) in order to solve a problem.
- Takes an unorthodox approach in the formulation of the solution (which hopefully succeeds in solving the problem), or even the identification of the problem.

Results and Outcomes

The ISRG's High Schools Engineering Report Competition has been an outstanding success. Its success has resulted in the Competition being extended into all of Engineers Australia Sydney Division's Regions from 2005 onwards. This will mean that the vast majority of the average Statewide enrolment of 1,250 students in Engineering Studies Stage 6 in Year 11 will have an opportunity to enter the enhanced Competition.

Photo 1 shows 2003 Prize Winners, Sponsors and the Chair of Sydney Division's Education and Assessment Sub-Committee.

Photo 2 shows the Regional Winner and a Finalist at the ISRG Regional Presentation while Photo 3 shows the 2004 Overall Winner with the Chair of Sydney Division's Education and Assessment Sub-Committee at the Sydney Division's Awards Night in 2004.

Photo 1 – 2003 Prize Winners, Sponsors and the Chair of Sydney Division's Education and Assessment Sub-Committee

Photo 2 – The Regional Winner and a Finalist in the ISRG 2004 Competition

Photo 3 – The 2004 Competition Overall Winner and the Chair of Sydney Division's Education and Assessment Sub-Committee

There are a number of indicators of the success of the Competition. These include:

- The fact that 65% of the Finalists from the 2000 – 2002 Competition are enrolled at the University of Wollongong, the majority in Engineering.

- In addition, student interest in Engineering at the University of Wollongong is increasing. For example, at 25 September 2003, 10.40% of first preference Engineering students in NSW were for Wollongong, compared with 7.82% as at 25 September 2002. This increase in interest in 2003 among potential 2004 students has continued with the Faculty of Engineering at the University of Wollongong enrolling record numbers of students in its First Year Courses in 2005.

- As a flow-on from the Competition, 4 Engineering Studies Days have been held in the Faculty of Engineering at the University of Wollongong. A total of 248 Year 11 students and 18 Industrial Arts Teachers from 20 High Schools have attended the Days when students participate in laboratory sessions in a number of Engineering disciplines.

- Sponsorship for the ISRG Competition has increased from $250 in 2000 to $3,250 in 2005, a staggering 1,300 percent.

Conclusions and Significance

Attracting High School students into tertiary Engineering study is essential for the on-going technical capability of our economy. The High School Engineering Studies Engineering Report Competition has proven to be a successful strategy for achieving this goal.

BOB WHEWAY has been an academic in the Faculty of Engineering at the University of Wollongong since 1968 and an active member of Engineers Australia. In 2000, he was the prime mover in the organising of the Year 11 High School Engineering Report Competition. He has chaired the Judging Panel for the Competition since 2000.

ANDREW SPENCE is the Sinter Plant Operations Manager for BlueScope Steel at the Port Kembla Steelworks. Andrew has a Masters Degree in Mechanical Engineering from the University of Wollongong and is an active member of the Illawarra/Sutherland Regional Group Committee of Engineers Australia. He has been a member of the Judging Panel for the Competition since 2000.

MICHAEL YASTREBOFF has a PhD in Electrical Engineering. After many years as a Research Engineer in the Steel Industry at Port Kembla he retrained as a School Teacher. He now is a Mathematics and Physics Teacher in the New South Wales Education Department. He has been a member of the Judging Panel for the Competition since 2000.