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***Abstract:** Engineering students complete work placement reports after being on placement in industry, the aim is to increase work place learning and to increase students understanding about the placement, themselves, career direction and skills obtained. Third and fourth year engineering students perceptions on their report writing experience, academic feedback quality, and the effect of completing work placement reports on their learning and report writing ability, were surveyed. Third year students enjoyed the experience more than fourth year students and perceived greater benefits. Fourth year student opinion was mixed, reflecting greater experience and cynicism. Fourth year students rated feedback from academics higher than the third years, perhaps because their reports were more interesting for the academics. The fourth year students were more cynical on the benefits of reflecting and reviewing what they had learned, and many considered this was not important for being an engineer.*

Introduction

Engineering education incorporates a broad range of learning practices and pedagogies, from transmissive and transaction learning at university to transaction and transformation-type learning in the work place (Table 1). The latter provide opportunities for experiential, active participatory, collaborative, and cooperative learning; the aim is for the student to gain confidence and practice in their field of study as well as being involved in communities of practice that will help them become competent engineers.

Table 1. Learning models in cooperative education (Van Gyn and Grove-White 2004).

Orientation	Educational practice	
Transmission	Rote learning	Prescriptive feedback
	Direct instruction	Content mastery
Transaction	Problem based	Experiential
	Inquiry	Observational
	Cooperative	Critical thinking
	Collaborative	Reflective practice
	Active participatory	
Transformation	Reflective practice	Service learning

Learning in a cooperative education setting can be described in many ways (see Eames & Cates, 2003), but in recent times, sociocultural views on learning have taken centre stage. Learning takes place within a community of practice (Lave, 1991). For example, an engineering work placement student becomes a participant within an engineering company and is enculturated into the community (Billett, 1994; Brown *et al.* 1989; Hennessy 1993). Learning is also suggested to be distributed across the community of practice, involving not only the student, but also their surroundings, peers and superiors (Perkins 1997, Cole & Engestrom 1997; Salomon 1997), and is mediated by tools such as equipment used in the placement and workplace jargon (Bell & Cowie, 2001; Vygotsky, 1978; Wertsch, 1991; Westsch *et al.* 1995).

Interventions can be used to encourage students to become active agents in identifying learning objectives and assessing their own learning. One method of formalising student learning on placement is by getting the student to write placement reports. This encourages the student to think about what they did, how they did it, and what the outcomes and implications were. This also provides a way for their academic supervisors to assess student learning. However, the quality of placement reports are affected by student academic ability, writing ability, willingness, and time available to complete the report, as well as support they receive from academics and the their employers.

Written communication is a basic and important skill required by most sectors of society (Bacha Bohous, 2008; Gray *et al.*, 2005). Competent engineers and scientists need to articulate ideas and findings in a comprehensible manner through reports and papers. Swarts and Odell (2001) argue that effective technical writing is essential to engineering because it conventionalizes knowledge and makes it shareable.

At university, engineering students practice their writing skills through laboratory reports, assignments, and technical or project reports. Mathes and Stevenson (1976) argue that while these activities may simulate “real life”, the report writing does not simulate the communication required by industry because the audience and purpose for industry and academic settings are different. Hence, an engineering student’s first “authentic” encounter with writing major reports is often through their work placements.

At the University of Waikato, students completing a Bachelor of Engineering or Bachelor of Science (Technology) degree are required to have six or 12 months work experience respectively as part of their degree. About 200 students from disciplines including biochemical engineering, electronic engineering, materials and processing engineering, mechanical engineering, software engineering, biology, chemistry, computer sciences, earth sciences, electronics, and physics are on work placements from November to February each year. The Cooperative Education Unit is responsible for finding students relevant jobs, providing CV and job interview training, organising job interviews, visiting the students on their work placement, and carrying out the assessment. Work placements can be routine work (e.g. in an analytical laboratory or fabrication industry), project work (e.g. in a research institute or R&D section of a company), or a combination of the two. Work placements are arranged through companies looking to recruit graduates, companies who have routinely employed placement students and research institutes.

Work placements are treated as learning opportunities. Students are expected to learn as much as possible about the company they worked for, the type of work they are doing and its relevance to the company. Also, the Cooperative Education Unit recognises that students develop personally throughout their work placements. The Unit encourages students to reflect on how they developed personally, the skills they gained, and the influence the placement has had on their career focus. Work placement students are required to complete a 30-40 page placement report (Table 2), worth 50% of their overall placement grade. The report details what work they carried out and what they gained from the placement. The remaining 50% comes from an employer evaluation of the student’s performance in the workplace.

Table 2. Components in a typical placement report.

Component (weighting)	Content
Executive Summary	Type of placement, organisation, student position, duties and outcomes, skills gained.
Introduction (10%)	Organisation, work/projects/research done, background information, learning objectives, report outline.
Organisation Overview (10%)	Organisation, history, location, objectives, management structure, products, revenue, funding, markets, student position.
Description of Work (30%)	Work done, background information, theory, methods, relevance to company, results/findings.
Discussion (20%)	Discussion of results/findings, importance of work done, effect on company, conclusions and recommendations.
Reflection and Review (20%)	What student learnt about the organisation and about themselves, impressions of working there, hard and soft skills gained, how learning objectives were met, influence on career objectives.
Presentation (10%)	Includes title page, contents, list of figures, list of tables, formatting, spelling and grammar, and use of figures, tables, references and appendices.

Work placement students are assigned academic supervisors from their University department, who assist the student with technical content and editing and also mark the final report. Students complete their work placement before University courses start and submit their report for editing two weeks into the first term. They make corrections based on feedback from their academic supervisors, and submit their final report for marking in the fourth week of term.

Issues

Casual conversations with students and academics and with the Co-op placement coordinators indicated several issues about the placement report, including:

1. Students generally had difficulty writing the reports and ran out of time.
2. The report structure (Table 2) was better suited to science work placements than for engineering or routine work.
3. Students and academics felt the reflection and review section was not relevant; hence most students did not put much effort in this section.
4. Academics were slow to give feedback about the placement reports, so students were submitting the final report late.
5. Quality of the feedback from academics tended to be poor, either due to lack of interest and/or time.
6. The students' writing ability was generally poor, reflecting little emphasis on this aspect in formal teaching.

To get feedback on these issues, the Co-op placement coordinators formulated a questionnaire to ascertain student perceptions.

Method

This was a preliminary study to identify key issues, so third and fourth year engineering students were surveyed. Third year students have completed two years of academic study and one work placement whilst fourth year students have completed three years of study and two work placements. Students were either surveyed individually, within courses, or during pre-arranged group meetings. Student permission was obtained and survey results were anonymous. Ethics approval for the questionnaire was obtained from the School of Science & Engineering Ethics Committee. A follow-up study will be conducted this year using focus groups to complete this research.

Students were surveyed on placement type; their report writing experience, how prepared they were to write a report; quality of feedback from academics; whether or not writing the report resulted in any improvements in understanding of aspects of the work placement such as company, work done, theory, issues behind work, skills gained, and the report writing process; whether or not completing the reflection and review section helped improved their understanding about themselves, interpersonal skills, career direction; and whether or not the report writing exercise improved their grammar, spelling, report structure, presentation etc. Perceptions were rated on a 5-point Likert scale, where 1 = poor or low and 5 = excellent or high. Survey results were collated and analysed statistically to identify the differences between the two student cohorts.

Results

Placement type

Work placements changed from routine work for third-year student placements to project type work for fourth-year students (Table 3). This was pleasing as the placement coordinators try to expose the more-experienced students to project-type placements because they should have a greater skill set and more experience than the third years.

Table 3. Work placement type.

Placement type	third year students	fourth year students
Routine	40%	13%
Project	40%	58%
Varied	20%	29%

Table 4. Summary of survey results.

Report writing experience	Third years (n=25)		Fourth years (n=23)		T test	Significance
	Average	Stdev	Average	Stdev		
Report writing experience	3.72	0.61	2.57	1.16	8.83	***
Student preparation	3.46	0.61	3.65	0.98	1.48	NS
Preparation from university course work	3.22	0.74	2.96	0.82	1.68	NS
Instructions provided by Co-op for report writing	3.70	0.76	3.52	0.99	1.09	NS
Report section relevance						
Executive Summary	4.20	0.82	4.35	0.83	0.85	NS
Introduction	4.20	0.71	4.26	0.81	0.40	NS
Organisation	3.96	0.79	3.91	0.92	0.30	NS
Description of work	4.44	0.65	4.41	0.80	0.22	NS
Discussion	4.32	0.63	3.90	1.14	3.11	**
Reflection and review	4.04	0.84	3.68	1.32	2.00	*
Report feedback quality						
Overall	3.56	1.12	3.91	1.00	1.48	NS
Grammar	3.60	1.22	4.04	0.88	1.70	NS
Structure	3.52	1.08	3.96	1.02	1.89	NS
Theory	3.24	1.13	3.83	1.15	2.44	*
Content	3.40	1.15	3.65	0.93	1.02	NS
Presentation	3.22	1.14	3.96	0.93	3.04	*
Time academic took to provide feedback	3.12	1.27	3.89	1.19	2.83	*
Did writing the report improve your understanding of						
What is involved in writing a report	3.88	0.44	3.41	0.91	5.02	***
How to write a report	3.84	0.47	3.41	1.14	4.28	***
Company organisation	4.13	0.61	2.91	0.97	9.31	***
Company management	3.64	0.86	2.73	1.03	4.98	***
Work done	3.72	0.84	3.09	1.38	3.50	**
Importance of your work to the company	3.72	0.79	3.05	1.29	4.00	***
Theory behind your work	3.56	0.96	2.86	1.08	3.40	**
Issues behind your work	3.75	0.90	3.14	1.04	3.21	**
Additional work you could have been done	3.54	0.83	3.00	1.23	3.05	**
Technical skills gained	3.64	0.81	3.18	1.26	2.65	*
Soft skills gained	4.04	0.73	3.36	1.18	4.32	***
Did completing the reflection and review improve your understanding about your						
Self in general	3.21	1.22	2.36	1.33	3.26	**
Interpersonal skills	3.46	0.93	2.68	1.36	3.91	***
Attributes needed to be successful in industry	3.56	0.95	2.86	1.36	3.46	**

Career direction	3.54	1.28	2.64	1.40	3.31	**
Learning on placement	3.54	1.10	2.76	1.41	3.32	**
Did completing the report help improve your						
Grammar	2.88	1.12	2.86	1.25	0.05	NS
Spelling	2.88	1.19	2.64	1.22	0.94	NS
Sentence construction	3.29	1.23	2.91	1.34	1.46	NS
Report layout	3.46	1.02	3.32	1.29	0.64	NS
Formal report writing	3.54	0.98	3.18	1.26	1.73	NS
Use of references	3.08	1.10	2.86	1.32	0.94	NS
Use of diagrams	3.63	0.97	2.95	1.21	3.24	**
Use of tables	3.50	0.98	2.95	1.29	2.62	*
General presentation	3.46	0.88	3.09	1.38	1.95	NS

1 = low or poor and 5 = high or excellent. * Significant to 5%, t-test ≥ 2.1 ; ** significant to 1%, t-test ≥ 2.8 ; *** significant to 0.1%, t-test ≥ 3.8 ; NS = not significant.

Report writing experience

The third year students rated their report writing experience higher than the fourth years (Table 4). The responses of the fourth year students was more mixed (greater standard deviation), suggesting that they had become jaded from writing reports and rated the experience less. Although fourth year students rated their readiness to write the report higher and their preparation from university courses lower than the third year students, these differences were not statistically significant.

Relevance of sections in the work report

Both the third years and fourth years thought all sections of the report were relevant. This contradicted past anecdotal feedback that students were dissatisfied with the report structure. The only significantly different result between the student cohorts was that fourth year students viewed the discussion, and reflection and review sections as less relevant than the third year students. We noted that fourth year students tended to discuss their findings in the “description of work” section. As fourth year students were more likely to complete project work, we had expected them to rate the discussion section higher. The fourth year students had mixed opinions on the relevance of the reflection and review and appeared more cynical about the benefits and necessity of this section.

Academic feedback

Fourth year students thought academics gave better feedback than the third year students did. This may be because the fourth year reports are more technical due to the project-type placements; hence academics may be more interested and therefore gave better feedback. Because of the wide variation in responses for both third and fourth year students (high standard deviation), only ratings for feedback on theory, presentation and academic time to provide feedback were significantly different between the student cohorts. We also noted anecdotally that academics seemed to enjoy reading the fourth year student reports more because of the higher technical content.

Effect of report writing on student understanding

The third year students thought the report writing experience increased their understanding for most aspects of the work placement, skills gained, etc. Results for most parts of this section of the survey showed highly significant (to 0.1%) differences between the third and fourth year students, with the third year students rating report writing as being more beneficial.

Reflection and review

The third year students were more positive than the fourth year students about the benefits of the reflection and review section. The fourth year students were variable and ranged between poor and neutral. This may be due to increasing cynicism in engineering students as they advanced through the degree, but could also be due to the School’s and the Cooperative Education Unit’s not emphasising or spending time in teaching reflective learning.

Report writing and presentation ability

There was little or no significant difference between responses of the two cohorts of students on the effect of their report writing experience on their writing and presentation ability. The only significant difference was that third year students tended to rate their experience with using diagrams to explain ideas more highly than the fourth year students.

Conclusions and Implications

The report writing experience appears to benefit third year students' more than fourth year students; probably because this is the first time year three students have prepared formal industrial reports. Fourth year students appear to regard the reports as a hassle and annoyance. However, fourth year students tended to rate feedback from academics better. This may be because fourth year students had more experience and skills and tended to do project-type work, and therefore the reports may be more interesting for the academics. The fourth year students were much more cynical on the benefits of reflecting and reviewing what they had learned and considered this not important for being an engineer. Engineering at Waikato does not encourage or use self-assessment or reflective practice techniques. However, literature heavily promotes reflective learning so Co-op and the academics teaching engineering students at the University of Waikato need to identify how this aspect can be included in the degree.

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