A modular training programme for technical trades in the Australian Defence Force

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***Abstract**: The Royal Australian Signals Corps (RASigs) runs bi-annual trade courses camps for Army Reservists in RASigs. The aim of the courses camps is to provide these soldiers with the same trade competencies as their Regular Army counterparts. The Initial Employment Training (IET) courses for Regular Army soldiers run for many months full time, and it is not feasible for Army Reservists, most of whom have civilian employment, to undertake these long duration courses. In order to provide Army Reservists with the same training, the IET courses are modularised and condensed into multiple 16-day long blocks. The outcome of the courses is that Army Reserve RASigs soldiers are suitably qualified to work and deploy in their trade roles with little or no extra training. The current paper highlights the training methodology used by the Defence Force School of Signals (DFSS) and RASigs to ensure that Army Reserve soldiers receive a sufficient level of training, enabling Army Reservists to deploy on exercises and operations with Regular Army personnel.*

Introduction

Over the last 15 years, engineering education has been assessed to determine how it can be improved. A major review of the Australian engineering education system was commissioned in 1996 by the Institutions of Engineering (now Engineers Australia). The results and subsequent recommendations from this review were published in the "Changing the Culture" report (Johnson, 1996). The review indicated that not only should the content of engineering courses be updated, but also the methods of imparting the required knowledge need to be addressed.

Implementations of the recommendations were undertaken to varying degrees by Australian institutions that provide engineering education. A subsequent analysis of the state of play of engineering education, in relation to the aforementioned recommendations, is provided in the "Engineers for the Future" report (King, 2008). A key finding in this report is that engineering education did not change as much as the architects of "Changing the Culture" intended. Specifically, the content of subjects and the methodology of teaching did not change as much as expected by the architects of the "Changing the Culture" report (King, 2008).

Based on these two reports, it is clear that the methodologies of engineering education need to change. A reassessment of engineering teaching methodologies may be stimulated by comparisons to different educational institutions and environments. One example of an educational environment that provides technical based training is the Defence Force School of Signals (DFSS). As part of the Australian Defence Force (ADF), the DFSS run technical trade training courses in the field of telecommunications for members of the ADF, including members of the Royal Australian Navy, Royal Australian Army and the Royal Australian Air Force. In the army, the majority of members come from the Royal Australia Corps of Signals (RASigs). At the DFSS, soldiers who have recently completed their recruit / basic training course undertake their Initial Employment Training (IET) in

one of three different communications streams. In addition, the DFSS has developed training packages that enable Army Reserve (part-time) soldiers to obtain the same competencies as their Regular Army counterparts, by undertaking a series of 16-day long modularised courses.

The aim of the current paper is to highlight the methodology used by the Defence Force School of Signals (DFSS) in order to assess the suitability of incorporating similar training methodologies into engineering education. Suggestions of how the DFSS methodology can be used in University-taught engineering courses are also provided. It is hoped that the information presented in the current paper will therefore further enable beneficial variations to engineering education methodologies, as recommended in the "Engineers for the Future" report. It should be noted that specific details of the courses are not for public dissemination and therefore not provided in the current paper. Likewise, statistics and measures of quality are also not currently publishable..

Military structure

The Australia Defence Force (ADF) is one of the largest employers in Australia (ABS, 2004). Due to the nature of the work, the training requirements for the ADF can be very specific and also very technical. Consequently, the ADF conducts the majority of training of its members internally, with initial training courses for new members ranging in duration from only a few months to many years.

In a similar manner that there are different streams of engineering, such as civil, chemical, electrical and mechanical, the Australian Army has different corps, such as infantry, artillery, and signals. Furthermore, in the mechanical engineering stream, there are different specialised fields, such as aerospace, biomedical and mechatronic engineering. In the Royal Australian Corps of Signals, there are specialised fields for Operator Communications, Computer Systems Operators and Technicians. These different fields require different training.

For the current paper, the Operator Communications trade will be used as the example of course modularisation. The Operator Communications course for the Australian Regular Army (full-time) soldiers runs for approximately nine months, full-time. This course includes topics that cover the technical aspects of installing, operating and maintaining UHF, VHF and HF military communication systems, power systems, antenna theory, and operational cryptography. These topics have a substantially high level of theoretical and practical knowledge which need to be taught to sufficient standards so that the soldiers are capable of being employed in extremely stressful work environments, such as high-tempo operations where mistakes can result in the death of soldiers and civilians. It is therefore imperative that the levels of training at the DFSS, as well as continuous on-the-job training reinforcement, are of a sufficient standard.

Although the majority of ADF members are full-time, approximately 30% are part-time members (Reservists). Although there is limited time that Reservists have to dedicate to military training, there is still an expectation that these members of the ADF can supplement the full-time component with both operational and non-operational support. A requirement of this support is that part-time ADF members need to have obtained the same training competencies as their full-time counterparts. However, as the majority of Reservists have civilian employment, and very few employers can afford to release employees for long periods of time to conduct military training, a different educational structure was developed.

Course structure

Many topics in an Operator Communications IET course, such as UHF, VHF and HF communications systems, and antenna theory may be treated as separate topics, but there is also overlap of knowledge among them. Analogous to engineering, these fields may be likened to subjects such as thermodynamics, fluid mechanics and heat transfer, which are separate subjects in a mechanical engineering degree, but also have strong overlap in knowledge with each other. The modularisation of entire IET courses can therefore be modularised into individual, or small collections, of topics. However, as there is an overlap of some knowledge, as well as assumed knowledge due to the overlap, there is obviously a requirement to sequence modules to ensure prerequisites are obtained.

A full-time Operator Communications IET course, as discussed above, runs for approximately nine months full-time. However, the full-time course is predominantly run from Mondays to Fridays, with standard working hours. Included in this time is allocation for physical training and exercise. Subsequently, a nine-month long course can be considered as just over 1000 hours of contact time. Although there are many clear differences in civilian and military course structures, assessment of time usage and efficiency may provide many benefits to course development.

During a modularised course, students may end up studying or training for over 10 hours per day for the majority of the 16 days. A 16-day long module may then be considered as approximately 160 hours of contact time. Based on this alone, it is clear that five 16-day long courses is almost sufficient to correspond to the same total contact time as a nine-month long course. The development of the training packages for courses is discussed in Birzer and Birzer (2009).

There are two major difficulties with this simple accounting. Firstly memory retention for soldiers undertaking part-time training may be limited due to the large amounts of information that needs to be learnt. This requires post-course on-the-job training and assessment of members back in their parent units. The second difficulty is that short duration courses can not necessarily enable assessment of students deployed in field environments for periods of time long enough to cause physical hardships, such as sleep deprivation, stress, cold and hunger. These physical stresses are working conditions in which soldiers may be expected to work. To accommodate for the lack of field environment assessment, students are assessed after the training course in their own units over a 6 to 12 month period.

The examinations for both full-time and part-time soldiers are the same. Therefore, condensing of the courses cannot simply be achieved with removal of lessons from the modules. However, with a priori knowledge of the questions in exams, it is not unheard of for instructors to gloss over the components of lessons that do not have any examinable outcome. This can cause a third short coming to the training, in that there is a lack of learning for non-examined material. There is a clear hazard in any institution when courses are focussed on passing exams and tests, rather than learning subject matter.

Although there is a great deal of hands-on training during courses, the theory components are typically presented with in-class slide presentations, accompanied with comprehensive notes. Although this outcomes-based method of teaching may not be ideal, reinforcement of lessons learnt is conducted after-hours as part of nightly homework assignments that students do in their own time. Since students share messing facilities and accommodation blocks together and teamwork is a strong component of all military training, these assignments are typically conducted in groups together with extensive peer tutoring. In addition, assessment and feedback of homework and examinations are very quick (typically the same day), usually in the format of a group discussion.

The instructors at the DFSS are full-time members of the ADF who are posted there for typically two years at a time and have conducted additional courses in military instructions. However, for reserve IET courses, which are only conducted twice a year, instructors are typically part-time soldiers. Rather than providing a lower quality of education, it is shown that senior soldiers who instructor on reserve IET courses have great success in teaching part-time soldiers to the required levels. This is because instructors typically volunteer to instruct, have a strong passion for the topics that they teach, and also have a greater empathy and understanding of the increased workload of part-time students.

It is noted that the students who attend Reserve courses may have significantly different life skills compared with their full-time counterparts. From observations of courses, there are may more mature age students who undertake reserve training than full-time training. Furthermore, the instructors of reserve courses are more likely to have backgrounds that are more diverse than their full-time counterparts.

Discussion

Modularisation of university courses has been discussed previously by Gass, Banks and Wilson (2004) with respect to nursing education. For their work, semester-long courses were structured into separate modules, which could be taught by different lecturers from different departments, thereby spreading the teaching load. They concluded that modularisation works best when there are few links between

each module. As previously noted, there are many engineering subjects that are interrelated, in which case modularisation may not be successful. This highlighting the fact that modularisation may not be suitable for all courses, and must be carefully considered before implementation. However, there are many beneficial aspects of the IET modularised courses that may be adapted to suit engineering education, five of which are outlined below.

The first aspect to be discussed here arises from having trained instructors with diverse backgrounds who are able to relate to the students. All instructors at the DFSS, whether they are full- or part-time members of the ADF, undertake training in giving lessons. The ADF instructors also come from backgrounds where they have worked in the field in which they instruct. These two prerequisites are not always enforced at universities, although a number of universities now expect lecturers to undertake courses to improve teaching techniques. As noted by Birtwhistle (2006), there is generally no requirement in universities that staff have experience as engineers in industry. It is acknowledged that many institutions utilise industry-based lecturers; however these are typically the exception and not the rule.

The second aspect is that students help each other learn. The high pace of learning followed by nightly assignments typically results in students naturally working together. Peer tutoring not only helps those being tutored, but those who are tutoring to clarify their knowledge and retain the information (Bargh and Schul, 1980 and, Annis, 1983). Obviously group work is not a new concept and nor is peer tutoring. Nonetheless, the teamwork focus of Defence promotes peer tutoring beyond that seen in University environments.

The third aspect is immediate and frequent application and reinforcement of knowledge. Assignments are given most nights of a modularised IET courses that cover the information give that day. The students' knowledge is tested, applied and reinforced quickly, leading to better retention. There is also a practical reinforcement of knowledge during the months after the course as the students use their training in their units. There is a clear deterrent with an increased workload for any academic who elects to increase the number of assessments in a subject. However, alternate assessment methods, such as group or online assessment may provide solutions that do not increase academic workload substantially, but support student knowledge through application.

The fourth aspect is a quick turn around in feedback of the assessments. The nightly homework highlights problem areas to the students can clarify poor understanding as soon as possible. It also allows teachers to recognise where their lessons need changing and where their students are struggling. While the IET courses only contain a small number of students, some engineering subjects may contain over 200 students. This may make the practice of frequent homework and fast feedback seem unmanageable, but Smith, Baafi and Carew (2006) shows that it can be done.

The final aspect of the IET modularised courses is that students learn a lot of information within a very short time period. Rather than self-paced learning, the ADF method of modularisation provides intensive learning followed by self-paced reinforcement of learning. This style of teaching could be beneficial for many different types of students. External students who have limited contact time with lecturers and other students don't perform as well as internal students, and may benefits from a two-week course on-campus. More and more students are working part-time to support themselves and have limited time available to attend lectures (Ambikairajah *et al.*, 2006), so those students may find it more convenient to attend a condensed course. A short course may also be attractive to engineers already in full-time employment to broaden or update their skills, or to make it more convenient to complete post-graduate degrees.

A possible change in structure for undergraduate and postgraduate teaching of a semester-long subject, is to present all the lectures in an intensive two or three day period at the beginning of the semester. During the remainder of the semester, students work on assignments at their own pace. Short postgraduate courses of two and a half days have been previously shown by Birtwhistle (2000) to be very popular. By conducting courses in this manner, it may be easier for external students or students who work part-time or full-time to attend the lectures. Once the students have all the information from the course, they can then undertake assignments at their own pace, reinforcing the lessons learnt. Peer tutoring may also be stimulated. In addition to these points, the importance of time management is

learnt as well. It should be noted that teaching of life-skills, including time management, are lessons that industry requires (Hager, Holland and Beckett, 2002).

Summer School courses for some undergraduate subjects that are run at The University of Adelaide have many similarities to the modularisation of courses conducted by the DFSS. Rather than teaching a subject over a semester with two or three contact hours a week, the Summer School program runs seven-week long intensive courses. The same content is taught, but the teaching method is different, following a "work-shop" style system. This is only possible with small class sizes. The result is that average student marks are much higher than compared with those from standard, semester long courses. The motivation of students willing to undertake Summer School courses will account for some of the improved results, but the incorporation of the different teaching concepts should also be acknowledged.

The significance of the modularised courses run by the DFSS is not the individual components, such as group learning of condensing of subject courses, but rather the combination of the aforementioned systems into a single coherent programme. The success of the teaching methodology, in terms of providing the ADF with well trained soldiers, is difficult to quantify with the limitations imposed by data classification. It can be stated that Army Reservists are deploy to the same locations as Regular Army counterparts, and in the same roles. There are strict requires enforced by the ADF preventing insufficiently training soldiers from deploying. It is therefore clear that the training outcomes from modularised courses meet the requirements imposed by the ADF and are therefore effective training packages, comparable with "traditional" training systems.

It is noted that a new Masters of Science in Energy and Resources: Policy and Practice, to be taught at University College London, in Adelaide Australia starting in 2010, follows a similar schedule as that postulated in the current paper. Specifically, short, intensive teaching periods, followed by numerous assignments and group work. It is suggested that the results of the teaching methodology proposed by this new Masters course should be subject to further study.

Conclusion

The ADF, RASigs and DFSS have worked to develop a training package that enables Army Reservists to undertake a series modularised courses, which provide the same educational competencies as Regular Army counterparts. The suitability of the program enables Army Reservists to deploy with Regular Army units and perform the same job.

The current paper identifies five benefits of the modularisation of courses. Possible engineering education applications of the ADF modularisation methodology are presented. However, there are many limitations to the application. The aim of the current work is to encourage new ideas for engineering education.

References

Ambikairajah, E., Epps, J., Hesketh, T., and Sheng, M. (2006). Factors Affecting Engineering Student Learning and Study Behaviour, *Proceedings of the 17th Annual Conference of the Australasian Association for Engineering Education* (pp 808-815). Auckland, New Zealand.

Annis, L.F. (1983). The Processes and Effects of Peer Tutoring, *Human Learning, 2*, 39-47.

Australian Bureau of Statistics (2004) *Year Book*, Australian Bureau of Statistics.

Bargh, J.A. and Schul, Y. (1980). On the Cognitive Benefits of Teaching, *Journal of Educational Psychology*, *72*, 593-604.

Birtwhistle, D. (2006). A model for more relevant and useful Postgraduate Coursework Degrees, *Proceedings of the 17th Annual Conference of the Australasian Association for Engineering Education* (pp 47-56). Auckland, New Zealand.

Birtwhistle, D. 2000 New Paradigms in the postgraduate education of engineers, *Transaction of Multi-Disciplinary Engineering – Policy Issues*, The Institution of Engineers, Australia, Vol. GE424, pp 55-66.

Birzer, C.H. and Birzer, C.H., (2009), How the Australian Army does it: Development of training packages at the Defence Force School of Signals, *Proceedings of the 19th Annual Conference of the Australasian Association for Engineering Education*. Adelaide, Australia.

Gass, J., Banks, D., and Wilson, A., (2004). Modularisation – flexible or restrictive professional education, *Nurse Education Today, 24*, 337-343.

Hager, P., Holland, S., and Beckett, D. (2002). Enhancing the Learning and Employability of Graduates: The Role of Generic Skills, P*osition paper # 9, prepared for the Business / Higher Education Round Table.*

Johnson, P. (1996). *Changing the Culture: Engineering Education into the Future*, The Institution of Engineers Australia.

King, R. (2008). *Engineers for the Future: Addressing the supply and quality of Australian engineering graduates for the 21st century*, Engineers Australia.

Smith, I., Baafi, E.Y. and Carew, A.L., (2006). Minute Papers for Rapid Feedback on Student Learning in Engineering Lectures, *Proceedings of the 17th Annual Conference of the Australasian Association for Engineering Education* (pp 659-668). Auckland, New Zealand.

Acknowledgements

The authors wish to acknowledge the Australia Defence Force and the Defence Force School of Signals. Furthermore, the authors acknowledge the comments made by the reviewers.