

Issues and conflicts of combining MSc modules and industrial short courses

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Abstract

In a specialist field, such as acoustics, where noise and vibration control is promoted through legislation and competition in product refinement, etc., there is persistent industrial demand for courses. Skills shortages in the UK workforce can only readily and practically be met by the running of graduate level short courses. In addition, for chartered engineers such courses are very appropriate for Continuing Professional Development (CPD) requirements. This paper considers the option of post-graduate short course training in combination with MSc module provision, i.e. when the latter can be given in a short course format and duration.

Curriculum content has to be a balance of analytical and mathematically demanding material with the underlying physical and applied principles being taught. It is complicated by the varied background of the students and the industrial delegates. The latter often see the vocational training or skills development as the outcomes rather than education as the benefit in the longer term. Issues such as the selection of appropriate methods of assessment and the alignment or distinction of learning outcomes for different cohorts are briefly discussed. The short course format develops a different learning and cohort experience, which has also necessitated a radically different delivery. Practical work often accounts for 50% of contact time and ranges from simple demonstrations of physical phenomena to industrially relevant problems. Some discussion on forms of assessment which might be suitable or possible for the external engineers in a mixed cohort is also briefly considered.

Keywords

MSc modules, industrial short courses and Continuing Professional Development (CPD)

1. INTRODUCTION AND BACKGROUND

The Institute of Sound and Vibration Research (ISVR), established as a post-graduate research centre, identified the need in 1964 to run a one year masters (MSc) in Sound and Vibration. It facilitated graduates from other disciplines to specialise in acoustics and vibration. However, there still remained a need for suitably qualified and trained graduate engineers and scientists in acoustics in the burgeoning world of acoustic consultancy, environmental noise, automotive vibration and harshness, etc. The first short course introduced in 1968 was the very wide ranging Advanced Course in Noise and Vibration. The lecture notes became the contents of the eventual accompanying book [1], with about half of the lectures dedicated to the basic fundamentals in acoustics, vibration and signal processing as given in the MSc programme and the other to advanced research topics. It was immediately apparent though that such a course is very demanding and highly

analytical containing much overlap, but in a condensed form, with the MSc and it did not really attempt to meet any particular industrial needs or training. Subsequently through to the 1990's there were various successful short course developments. One notable example being an industrial course in Railway Noise and Vibration [2], accepted internationally for dissemination of relevant modelling and measurement technologies. The philosophy throughout the courses being that their primary role was to provide education and not applied training.

A watershed in the design and delivery of industrial short courses came in 1999 with the start of a part time MSc Automotive degree, which required a complete short course delivery. It immediately became evident that with suitable planning, design and delivery, MSc modules such as these could also double up as industrial short courses. This paper draws upon the experience for its comments and observations, attempting to reveal key features and identify where similarities and differences can occur. These can either be beneficial or in some cases produce opposing demands and conflicts.

More recently it has been identified that there is a UK national skills shortage and the Leitch report [3] (and a summary of the Government's response [4]) reported the need for increasing the percentage of the adult population that acquire level 4 skills (a degree or vocational equivalence), so that the UK economy is competitive and a world leader in skills by 2020. Interestingly, it was also briefly commented upon that level 5 skills (PhD and MBAs, for example) are powerful levers for improving productivity, innovation, research and development. Leitch proposed that the vocational skills must be demand-led, with employers voluntarily committing to train eligible employees to level 2 (5 GCSEs at A*-C) and increase investment in levels 3 (equivalent to 2 A levels) and 4 workplace qualifications. There is also increased focus on the level 5 skills. The position and level of the stand-alone courses provided is likely to be at 3/4, whereas when combined with the MSc modules they are aiming at the 4/5 skill level. Although in principle non-graduate engineers can attend, e.g. HND educated, etc., this is not anticipated due to lack of appropriate mathematical/analytical education from such routes. Also, for the graduate courses required it seems that ongoing business-university collaboration might be essential, rather than a particular Government initiative or strategy because of the Government's concentration on the lower skill level priorities.

2. Development of the MSC MODULES AND SHORT COURSES

Aims and learning outcomes

Many engineering masters' programmes aim to provide a firm foundation for employment or research in a particular discipline. Learning outcomes are formulated for the programme as a whole and these in turn cascaded down to coherent learning outcomes of individual modules. Each module contributes to a well-defined whole with complementary modules enabling a themed approach to the final award. Normally the majority of the modules available are optional, although some core compulsory foundational modules are essential. Thus the student has some control over the final combination and content of their masters, with some degree of personal ownership in their study and development. Specifying the learning outcomes of the individual MSc modules often takes place in different ways and is often as the result of many external influences in addition to what academic skills are available. Where necessary the module outcomes can be focused to either include aims and content that are pre-requisites for later modules, or are deemed to be essential core achievable skills necessary for the discipline. The individual student will not directly

be involved in the programme structure and content planning, although each cohort provides reflective feedback to enable programme developments, reviews and future improvements.

In contrast, short courses feed into the framework of life-long learning for the individual. The Engineering Council United Kingdom states that [5] 'All Engineers will be committed to the needs for adapting to change, and to continuous improvement to their performance as professionals. Continuous learning and CPD will be an integral part of this process.' Hence chartered or incorporated engineers should carry out continuing professional development necessary to maintain and enhance competence in their own area of practice [5] as a personal objective and requirement. Whilst there is some strategic planning to ensure that the short courses might be complementary, typically it is rare if any particular attendee attends more than one short course at any one institution. Often they might take management, business training, engineering specific courses, etc., from various places that have particular expertise/training.

Consequently, the starting point for defining learning outcomes for a short course is quite different from an MSc module. The stand-alone industrial short courses are typically one-off and much more vocationally focused in their remit, often market or specific industry/company driven and focused. They can be specifically planned and directed to establish training in particular areas, without any restraint or requirement of any assessed activity in any formal sense. Industry wants the outcomes to encompass specific vocational and directly applicable skill development, rather than dwell on too many theoretical or abstract concepts. The latter are obviously beneficial for research or longer term activities involving technology developments, original problem solving, etc., rather than perhaps the incremental processes that industry prefers. Particular case studies, for example exhaust designs for the automotive course, can be very specific, as can laboratory measurements on actual engineering structures produced by a company supporting the course and providing the majority of the delegates. For other attendees, from other companies, too much specific company bias is to be avoided although engineers can and do appreciate the issues outside of their own particular industry setting and can still contribute to and learn from the experiences.

Hence, is it possible to have some common aims and learning outcomes, especially when the modules are taught in a one week format and are common activities (lectures, labs, etc.)? Our experience has shown that it is possible to achieve some degree of commonality without too much compromise. One common overarching objective for the common MSc/short course is that both are at a graduate level. The learning outcomes for the MSc attendees will require some form of assessment, which is not normally the case for external industrial delegates (see section 4). The combined courses can thus have both academic and vocational/practical outcomes, both of which are valuable assets to students and delegates, but to a greater or lesser extent. The importance of having clearly defined aims/learning outcomes is also relevant to the marketing. External delegates might not be able to interpret or be aware just what level of rigour might be incorporated within the publicised technical brief. These invariably need to be spelled out in more accessible language and terminology appropriate to this group and their requirements. Thus it is often in the depth of these different outcomes that the main differences can occur and these can be complementary and bring benefit to both types of attendees. Without rigour, the short course could be an assembly of lightweight/qualitative ideas that do not ultimately provide useful outcomes.

2.2 Curriculum issues

Typically the academic content in MSc modules is high, with some amount of vocational training included but at a minor level of time and coverage. The latter modules in a programme are typically on advanced concepts, building upon some foundational modules. Non-intensive delivery, over a semester, can allow for extended reading or background material to be covered. Especially where skill development in the use of specific software is necessary there can be freedom for the students to spend additional time applying their ideas, developing their understanding and practical tasks such as programming. Analytical derivations, including rigorous proofs/analysis and theoretical developments are commonplace, with also some generic ideas and issues likely to be covered which are intellectually challenging and not directly or vocationally applicable.

Industrial course content is often constrained by the previous background and knowledge of the delegates, in addition to the requirement to providing practical training without too much recourse to abstract derivations, analytical proofs, theorems, etc. There is no common starting point that can be assumed other than preferably a scientific or engineering degree and some mathematical ability. The first lectures are often basic or revision, also ensuring correct terminology and necessary principles. Where individual companies have sent many delegates there has been some bias in the content. For example a hard disk drive company supplied specific components for a vibration testing session. This not only flavours the course, but has the additional benefit of providing additional insight into the engineering dynamics or acoustics.

The lack of previous study relevant to the courses, in comparison to the MSc students who will have covered the basic/foundational MSc modules, means that the external delegates have to be prepared to 'get up to speed' within the first day of a combined module/short course. For the MSc students this element of revision and basic material is unnecessary but, because it fits into the 'package', needs to be attended. The common modules/short courses need to be as self contained as possible and restrict the amount of more demanding analytical material without losing any of the physical insight for subsequent understanding. This is clearly a challenge for graduate engineers, possibly many years out of education/formal study, in a discipline that is typically heavily dependent on mathematical derivations and analysis. The balance of the academic versus the vocational content is always an issue, as many MSc programmes are vocational in nature and applied to a specific area. In contrast, company specific short courses are often uniquely tailored to the industry or company making it difficult to have other participants, even MSc student attendees.

Interestingly when it comes to the practical element it is often the external delegates who take the lead and are prepared to work at a faster pace, not being less critical or careful but they are often more confident and comfortable with taking practical tasks. Sometimes the MSc students will be required to submit reports on the exercises (be they lab or numerical/computational exercises), but they will be informed of these requirements early on so as to ensure that they take and record the data or save any programming/calculations. The depth of study for these components then has to be sufficient rather than take the form of demonstration exercises, which would often be the case for the stand-alone short courses.

3. The student/delegate experience

The existing MSc had been a year long full time programme, using conventional teaching methods of lectures, laboratories and coursework. The first semester was followed by examinations, with modules in this first semester being geared to the essential basics of the subject (i.e. vibration, acoustics, signal processing, MATLAB and noise control or human factors). This structure prohibits running industrial short courses that are common, although there are some that do run in particular specialisations (e.g. biomedical signal processing). One practical issue in this semester is the number of laboratory classes being timetabled for the full time taught programmes at all levels. It is impossible to overcome the physical space requirements of having intensive short duration industrial courses, with the mixture of up to 40% practical work, in this period. In the second semester and in the spring vacation the pressure on room usage, including laboratories, is considerably relieved and timetabling of such common activities is more feasible.

Some of the earliest MSc modules delivered in a one week format were as a consequence of using some external lecturing staff, whose availability meant that only this format was possible. The number of contact hours was high and incorporated only a limited number of non-lectured activities. It would be expected that the students, as they are effectively full-time, might do subsequent follow up work on studying, assignments, etc., having the full resources of the university available to continue supporting study, including access to the academic staff. This additional learning ability reinforces the subject, at a student set pace and individually organised, but requires significant student maturity in self-study and motivation.

The MSc student experience, when taught over a semester, is significantly different compared to students on a set of short courses/modules. In the former, apart from the extended learning and formative possibilities, there is a large interaction through different laboratories/practical tasks and the informal discussion/sharing of ideas, supporting each other, etc., which means they develop into their own community with a strong bonding which can last many years after the end of their studies. This is not evident when MSc students attend solely short course delivery. The missing factor of identity and common purpose is one underlying reason why completion rates on part time MSc programmes is significantly less than 100%. Possibly it is an issue of maturity and ability to self-study effectively which is the reason, although often part-time MSc students have employment commitments. Also, the fragmentary teaching requiring high levels of intermittent intellectual involvement might be much more difficult than sustaining it over the full time academic year. Extended support outside of the class, via e-learning, tutor input, etc., does not appear to be the complete answer.

For short courses one very important overall constraint is the actual contact time that is possible within the normal one week format. Whereas full time MSc students might be able to cope with many intensive lectured periods covering different modules within one week, this is not the case for external delegates who have not recently experienced lectures or condensed learning. Hence a major amount of the timetabled activity consists of practical work, which generally supports the lectured material rather than introducing new ideas or concepts. The material coverage in a one week format is typically no greater than perhaps 50-70% of that typically contained within a typical semester long module. The traditional teaching methods are not directly applicable, and normally each lecture is followed by a short break for questions and answers, refreshments, etc. The use of a double period for teaching without a break is unacceptable. There is also little possibility for background

material to either be read or used by the cohort to support the ideas being presented during the course duration. So the scope and depth might also be curtailed in addition to the amount of content. Some might argue that concentrating on one subject is actually better rather than the fragmenting of the topic over an extended semester timescale. But in the latter case, on a full time MSc programme, there are gains from the complementary content and nature of the modules taught in parallel which are tangible when students have opted to take specific choices of modules.

Industrial short courses have traditionally been restricted to fewer attendees. The need to run the non-lectured activities all together ultimately caps the numbers. The coverage and linking of the material requires the group to experience the same activities together in parallel and post course activities, where it has been necessary to programme these in for the MSc students in exceptional cases, is quite different with the external delegates absent. The cohort experience and working together under the short course timescales develops different and potentially short term lasting relationships for the external attendees, quite different than those experienced and developed amongst the MSc students. The attendees' background means that more time is spent in covering issues that are foundational in nature, or are misperceptions through lack of prerequisite knowledge. The attendees are unfamiliar with the environment, especially as regards the practical elements, although they are quick to adapt and settle. Often the practical work is the area where more questions are raised when interpretation and understanding gaps are revealed. In too large a group the attendees do not find it easy to raise such issues, but typically on a course with less than 20 participants it does not seem to be an issue.

If short courses are combined with MSc modules, then the teaching methods adopted have to be in the format appropriate to short course delivery with almost a complete set of presentations given in PowerPoint, with accompanying handouts. External attendees expect a professional presentation with full provision of the taught material enabling sufficient subject coverage within the shortened timescales, especially given the real cost. In contrast, the full time MSc programme has a variety of delivery methods including some note taking and using the more traditional 'chalk and talk' delivery, or via electronic distribution of notes. A beneficial consequence of the short courses has been migration of the PowerPoint presentation format to the semester long modules in many cases, as the MSc students' expectations have been raised by the short format experience and preference to reduce note taking. Timetabling the commitments for the full time students has been an issue, and in certain streams of modules the majority of the modules in one semester can be taken in the short course format. For MSc students the retention of the information from a short course, to then carry over to other modules, is not so clearly evident or displayed as they often choose disjointed subjects or choose the format which they misguidedly believe might be an easier option. There is little evidence for ongoing contact with the material by the students other than preparation for any formal written exam, which could be scheduled at some latter time after the course has finished. Additionally, not all full time MSc students can cope with the intensity of the coverage in addition to the assessment requirements, especially if the deadline and submission for the latter are either too soon after the event or delayed too long and then appear to be disconnected from the learning. Generally the MSc students find that more follow up support is welcome and useful, and if students took modules from places other than their registered institution this would be a serious problem. The assessment performance indicates no reduction in student achievement compared to the longer format, but this is in the situation where students cannot presently take solely the short course format for all of their chosen modules.

4. Assessment

Formally the assessment for MSc modules must be at an appropriate standard and level, in addition to workload requirements to meet suitable credit bearing specifications. The assessment should be inextricably linked to the specified learning outcomes, and allow students to demonstrate varying degrees of achievement against these outcomes. Each module is assigned a specific credit point rating for achievement of designated learning outcomes at a specified level. In order to standardise there is a specified Notional Learning Time (or cognitive load) associated with the credit. Typically a MSc module might have up to 40 hours associated with the attendance during the week and up to, say, 60 hours available for study/assignments/assessments. When a module is delivered in a semester long format there is obviously more opportunity for formative assessment, via exercise sheets, assignments, etc., in addition to the summative assessment; the latter might be formal coursework or examinations.

Stand-alone industrial courses do not typically have any formative or summative assessment. Without the restraint of any formal assessment then the coverage need not be so in-depth and rigorous i.e. skills training or physical reasoning is often sufficient. Delegates are strongly encouraged to complete any coursework exercises or reading, but are not required to submit any work for assessment and receive a completed certificate of attendance for CPD credit regardless of any level of achievement. The external participants normally only have the duration of the course available for study, being released from work or external commitments. Whilst it might be possible to allow some time within the course for assessment, etc., it is not the norm or expected. Obviously the benefit from applying the knowledge and ideas in practice is a valuable means of reinforcing and improving the learning experience, and might be an idea for improving the value of attending the course in future developments.

This simple attendance criterion is in direct contrast to the MSc module requirements. Compromises on the scope and coverage due to the short course format obviously affect the assessment. For example, the use of many practical laboratory classes or numerical simulations/computations might necessitate that this component is assessed in some way and subsequently used as part of the coursework element. Typically an additional part of the coursework element will be to apply the methodology or theoretical approaches to a more practical engineering problem which might be numerical/computational and also fairly open ended in its requirements. This latter component can provide further structured and deeper investigation, which the MSc students can undertake over a longer timescale after delivery of the course. A subsequent accompanying written examination can assess recall, understanding and application. Whilst the majority of the non-intensive modules are examined by a written examination, the balance is shifted with up to about half of the assessment for the short course being coursework.

5. Quality assurance and evaluation

A very important issue affecting the MSc module specification and subsequently its acceptance is the area of Quality Assurance (QA). The academic specification of any MSc module is subject to scrutiny at the university at various levels both inside the department and at the University level academic standards committee. Ultimately the university has degree awarding powers and associated responsibility to ensure the standards, integrity, monitoring and review of taught programmes and these are encompassed in the Quality Assurance Agency for Higher Education 2006

Code of Practice [6]. Locally some practical implementation is devolved to the department. Apart from a monitoring aspect and review/reflection of the module each time that it is presented, there is also a requirement that all academic staff are peer observed regularly and their teaching assessed internally within the department, but not necessarily during the short courses.

In contrast, the stand-alone short courses are not considered directly by any of these bodies and have informal requirements in terms of evaluation and questionnaire feedback and quality monitoring. Internally the short course feedback questionnaires are used to identify areas which have been well received or conversely felt to be inappropriate, in addition to comments on the presentational skills, the technical content and other opinions. Sometimes feedback is sought from the company sponsors of the attendees, as ongoing continued support is encouraged and welcomed. Whilst often there are no major issues with the content, some suggestions are made to provide more suitable case studies or experimental investigation which might be possible to incorporate or substitute for the existing content.

A greyer area is where the module and course are commonly taught in terms of lectures, coursework, laboratory work etc., and the MSc requirement has already been scrutinised for QA purposes. Ultimately the QA of the MSc component takes a precedent in dictating what the MSc student experience should be and how it is delivered. Almost without fail delegates' feedback focuses on the content rather than the delivery, i.e. removal of the more complex analytical content in preference for the hands-on practical and vocational element. This suggests that there is always some element of miscomprehension in the aims of the course, with delegates' expectations leaning towards training rather than education. The student response is actually much clearer and thought through, having had other learning experiences including the longer format presentation. Generally there is some preference for the longer format rather than the one week timescale where the subject matter is analytical/academic with many new concepts, and some preference for a short format where the content is more vocational or skills based.

6. Resources

The intensive nature of the courses essentially requires experienced staff to be involved. In some cases external lecturers or non-academic staff are involved in the teaching, but this is normally restricted to specific skills training or case studies type presentations with close monitoring by the academic course leader. Strategically a department needs to balance the teaching load against other pressures of time, research demands and staff availability. Subdividing a fixed number of students into an increased number of modules does not make viable sense. Combining small numbers of students with similar numbers of external delegates can be sufficient justification to offer such combined courses in only a few cases, and it is not financially a lucrative option. Presently there are few additional new stand-alone short courses now being developed or conceived.

One obvious difference from a semester long module to a week long delivery is that the latter needs more than one lecturer, four is typical. The interspersing of lectures with coursework or laboratory activities needs more staff that are ready to deliver an alternative form of teaching, and switching from one mode to another in a short space of time. In the semester long format fewer staff are involved, but the laboratory classes tend to be staggered and because of this more students can be registered on the module. In efficiency terms the longer format is perhaps better because of less restriction on numbers. The short course format, normally requiring

all participants to take the same lab or coursework element simultaneously, is restricted by physical room and equipment/software/computational limitations. In principle, one could envisage that parallel but different activities might be possible for a short course, but this has not been tried and would need more staff involvement/planning.

The combined course/module, if suitably planned, actually means that staff deliver both in a very effective use of their time, freeing up their teaching periods from other weeks and benefiting from the mixed cohort, who respond in a different way than the full time students. Ideally staff might contribute to only a few of these intensive formats, and they need to be distributed throughout the year. Scheduling the courses to have access to the teaching space is a problem in a university where the majority of the teaching is dedicated to full-time undergraduate teaching. Sometimes it is possible to use the vacations, as the full time MSc students will be available, or the university examination periods. The issue of restricted numbers is still applicable. One means to avoid too much restriction is the timetabling of additional lab sessions, etc., for the MSc attendees at other times or in later weeks. This should be a last resort. Often the continuity and additional complementary learning from such activities is invaluable, if not critical, for the cohort to maintain the same momentum and engagement with the material.

Examination of teaching load and efficiency drivers do benefit when external delegates attend the combined short course/module. Specialised modules and short courses separately might not warrant the staff involvement if either student numbers or delegates respectively are too few. The delivery of these have, to a large extent, also removed either the need or demand for staff to offer courses at external locations for external companies. In addition, the access to the additional funding generated by combining courses and modules has been fed back into the general teaching provision in the form of instrumentation, in some ways complementing the existing HEFCE sourced equipment funding rather than replacing it. The equipment can and should be both modern, preferably common in format/type for any parallel laboratory activities, and maintained in a good condition as a consequence.

7. Conclusions

Clearly the UK skills base needs to improve in both quality and numerical size. Postgraduate training/education is a necessity and although MSc degrees are available either work, financial commitments or time means that education at this level is not taken up by significant numbers. The alternative could be to combine training for working engineers with existing MSc programmes and the combined short modules/courses appear to be one possible answer. Notwithstanding the changed experience for the full-time masters students, the balance of a semester of long delivery modules followed by the short delivery modules appears to be a compromise well worth the investment in time and energy and educationally not particularly affected in a detrimental manner. The viability and choice of modules available are increased, funding and staff involvement is not an issue and the assessment can be tuned to be appropriate for the specified learning outcomes. Our experience is not unique, and recent experience indicates that the arrangement is worth further consideration.

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