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# Holistic Course Design: proposals for a short course on biosafety

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## Introduction

New infectious diseases continue to emerge and evolve while pathogens that cause known infections but whose incidence has increased significantly over the past three decades are 're-emerging' (NIAID 2004) and since 1973, more than 36 new infectious diseases have been identified. Strategies to control them calls for targeted research and training as well as enhancing in-country research capacity. In order to develop scientific research and expertise, especially in developing countries, training for working in specialised facilities with these infectious agents is crucial. Furthermore, several countries have embarked on international initiatives to strengthen emergency preparedness in response to terrorist activities ('bio-terrorism') by linking academic expertise to state and local health agency needs. These activities have in common the requirement for an increase in the number of people experienced and working in the field of 'biosafety'. This is one of the most recently-developed safety disciplines, the intention of which is to eliminate or prevent the risks related to the use of "biological agents" (Caucheteux and Mathot, 2005).

In the UK, the Advisory Committee on Dangerous Pathogens (ACDP, 2001) advises the Health and Safety agencies on all aspects of hazards and risks to workers and other individuals from exposure to 'biological agents. The Health and Safety Commission approves a typology of well-recognised pathogens in the form of an 'Approved List' of these agents (HSE, 2004) which are categorised into four hazard groups.

The number of the hazard group of a particular biological agent indicates the minimum level of containment under which it must be handled where 'containment' describes the way in which biological agents are managed in a laboratory environment so as to prevent or control the exposure of laboratory workers, other people and the outside environment to them. So, for example, Hazard group 3 biological agents require Containment Level 3 (CL3) procedures because that particular level involves working with agents (e.g. the Hepatitis B and C Viruses,

SARS, HIV and Salmonella typhi) which could cause severe human disease both within the laboratory and, if not contained, within the external community.

The most important element of containment is strict adherence to standard microbial practices and techniques and persons working with infectious agents or potentially infected material must be made aware of the potential hazards and be trained to the high level of proficiency required to handle such material safely. Yet, despite the urgent need for this kind of knowledge transfer and skill development, there was, at the time (the Summer of 2006) no existing provision within the UK. However, LondonMet, with its recently-commissioned, state-of-the-art Science Centre is in an ideal position to offer both the specialised CL3 facilities and staff skilled in their use in the required context. The short course described here was developed in the main as a response to the clear and demonstrated need but also as a way of generating national and international transfers of knowledge in the field and establishing LondonMet's credentials in this area of work.

## The process

The course design was based on a combination of the models proposed by Toohey (1999) and Moon (2001) using Biggs' (2003) concept of 'constructive alignment' as the 'glue' holding each of the elements together in a dynamic equilibrium. While the steps of that combined design shown in Figure 1 below are presented in a stepwise fashion, the short course process was in reality (once the need/demand was established as above) an iterative process where each step influenced the others - with some even running in parallel. This needs to be borne firmly in mind as although the sections below are presented as linear 'steps', each has, in fact, both discrete features and features which are relative to other sections.

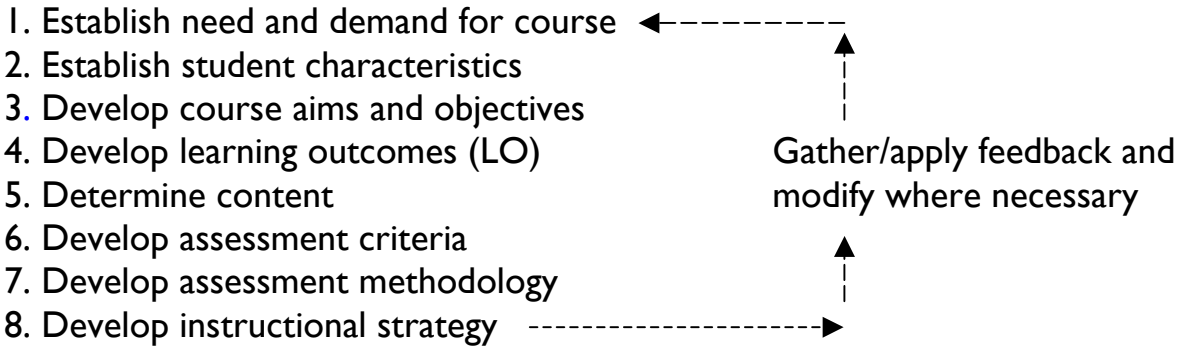


*Figure 1 – adapted from Toohey, (1999) and Moon (2001)*

*Context and General Aims*

The *general* course aim is to give potential and experienced researchers with an interest in infectious diseases, a firm grounding in the practical use of CL3 facilities. In particular, participants were to gain knowledge and practice in safe working at a CL3 level, to learn about the design and setting up of such laboratories, and obtain

accreditation in CL3 training. A further general aim, and one which figures prominently in the University's commitment to designing new courses (LondonMet new courses website), was to develop the course to meet the knowledge and skills demand within a niche market. The eventual format which is described below is that of a 5-day short course which will provide training to work in a CL3 facility, taking into account all the relevant legal, institutional, safety and laboratory requirements. Emphasis is to be placed on providing the course framework, practical experience and modelling the high standards expected of anyone working in a CL3 environment.

*Student characteristics*

So, having established the clear and urgent need for the course, the next step was to articulate the characteristics of the likely and intended participants. Initially, it was felt that the course should be aimed at those who have microbiology/virology experience, who may include, for example:

- Individuals from developing countries who want to engage in research in infectious diseases that are prevalent in their region
- Interested post-graduate students who have gained laboratory experience
- Medical doctors and medical researchers who wish to work in a CL3 environment.
- Current laboratory workers who wish to gain CL3 skills for career progression

Within this prospective 'audience' it was felt likely there would be a varied range of abilities, skills, personal, educational and employment backgrounds. In terms of work experience, it was believed that some participants would already have worked in CL1 or CL2 environments whereas others may only have routine laboratory experience. Still others, e.g. doctors, may have consulting experience in the field but have no experience in CL1-3 laboratories. Again, participants may be mature students, local, international students or students who do not have a good command of the English language. For all these reasons it is necessary that the course structure accommodate that diversity without compromising the expected learning outcomes. Finally, the intended small number of participants (6 - 8) working with two tutors should ensure the appropriate level and quality of participant-tutor interaction, especially for those requiring more support.

## Course Objectives and Approach

Course objectives were established from the above as follows:

- To address the training needs of those interested in infectious disease research for work in CL3
- To introduce students to major concepts, knowledge, techniques, practice and equipment relating to working in CL3

- To enhance the expertise of scientists in the CL3 environment for routine testing and research into biological agents of emerging and re-emerging diseases
- To serve as the basis to learn protocols relevant to other customised laboratories
- To serve as a 'springboard' to gain competency in their continuing work in customised CL3 environments at their places of employ

Given the nature of the context and the task as defined by the course aims, it seemed the best learning and teaching approach would be one based on Learning Outcomes (LOs) since not only is it essential to focus on what is important for participants to know it is also essential for prospective and actual students to know what they will be expected to do and what criteria will be used to assess them (Jackson et al, LTSN, 2004).

Other approaches to the design were contemplated but after having clearly articulated the key components and values, for example:-

- Participants will need to demonstrate progressive learning and skills development
- Practical skills will be weighted equally with theoretical knowledge and understanding
- There will be an emphasis on skills performance under various critical conditions
- Participants will be prepared for skilled, specialised employment

it was decided that an 'instructional systems' approach (and/or variations of it) would be the most appropriate framework for the course. In that kind of design, the formulation of precise objectives, careful pre-planning and regular testing of knowledge and understanding (with feedback) leads to the development of skills and changes in attitudes and behaviour of the kind required in this context. Again, because of the risk factors inherent in the subject matter it is important that participants progressively gain confidence to practise in such work environments. For that reason, clear expectations supplemented by regular feedback on performance and achievement will be a key course component (Toohey, 1999).

It is also important that participants on the course are able to add to this contextualised learning using their own experience and prior learning and thus beginning to construct their own meanings for, and master complex tasks in, specific situations. Nevertheless, because of the high-risk context, it was felt necessary to provide a 'base-level' for competent practice using the competency rubric 'those who pass are fit to practise.' First, a rigorous and comprehensive form of assessment covering the essential skills of the CL3 work is to be established and secondly, purpose-designed, simulated tasks will be employed in order to develop the kind of competence standards required for real-world situations. This will not only ensure that the essential content is covered it will also ensure the absolute currency of information, knowledge, processes and procedures.

Finally, the course design incorporates elements to encourage a deep approach to learning through 'active behaviour' by participants. Therefore, in addition to having access to an up-to-date, well-structured knowledge-base and engaging in the structured learning activities described above, participants will also take part in simulations, role-play and a variety of other learning-centred interactions with tutors, peers and others. Again, 'face to face teaching' and the small student number per class will encourage active participation, critical thinking, analysis, solving complex problems and assist in the creation of the kind of new knowledge essential to the development of the field..

## The learning and teaching strategy

As mentioned above, clear Learning Outcomes are central to this course design. They provide the central structure around which the content, the pre- and post-course material is built and they also influence the activities during preparation and delivery of the programme. As Houlden and Collier (1999) suggest, an explicit curriculum that informs tutors and learners from the outset, of the expectations and potential gain from the course is a prerequisite.

*The learning and teaching strategy*

The choice of learning and teaching strategies has been guided and informed by the LOs, the content, participants' backgrounds and resources in line with Biggs (1991). Several active learning strategies will be employed, including lectures, discussions, demonstrations, interactive sessions, role-playing and specific exercises where competence is both modelled and enabled. Again, the different learning styles of students, especially in classes where there is a diverse range of students abilities will be catered for. The daily assessments, especially those in the earlier part of the course will enable tutors to create differential and specific opportunities for learning for participants who may be more responsive to certain modes of delivery rather than others. For example, specific tools such as PowerPoint with audio may be used to help students who may not be so fluent in the medium of instruction or who require more time to understand particular concepts. Such students would then be able to revise the lecture in their own time.

Innovative teaching techniques to be employed include observation (modelling), guided and supported practice using Vygotskian notions of 'scaffolding' and the 'zone of proximal development' (Vygotsky, 1978). Articulation and reflective techniques are to be used to support learning and encourage the use of higher level cognitive processes and structured group activities will allow participants, with different skills and different levels of skill, to practice interacting within a socially organized unit designed to mirror research teams in the workplace. Similarly and as within scientific disciplines the keeping of an activity log is standard procedure, on this course, the log concept will be extended over the whole 5 days of the course. Responses to all the activities including the role-playing, and simulations and also the intended pre-

and post- feedback sessions will provide many opportunities for reflection and an analysis of how they will use their learning in their place of work.

*Assessment*

The assessment regime will include multiple choice questions and observational assessments based on work carried out on the previous day/s. This pattern will continue throughout the week and feedback will always be provided before the next assessment so that participants will have the opportunity to modify learning behaviour. In this way, participants will always be able to track their daily progress for particular events, e.g. BSU open-up/shut-down until they reach the required level of competency and skill. In addition, criterion-referenced assessment of all learning activities will be cognitive, affective and expressed in the learning outcomes and competencies.

*Gathering/applying feedback and modify where necessary*

Evaluation of the course by participants, employers and tutors will take place at the end of each session using information from

- participant/employer feedback questionnaires,
- assessment results and trends
- tutor feedback
- other (largely participant-generated) information e.g. levels of motivation, interest and participation.

Post-course feedback will link with the course objectives and the participants' intentions on completion of the course. It will also establish the participants' success in integrating the newly acquired knowledge and skills into their practices. A post-course follow-up with participants will also assist in determining vocational progression following completion of the course. This feedback will do much to extend the life of the course and direct improvements in course design. The design of the participant/employer feedback questionnaires will be guided by LondonMet's assessment guidelines.

## Conclusions

Given the current state of infectious disease levels in the world together with the associated need for infectious disease research and the threat of bio terrorism involving deliberate misuse of disease agents the course described will have significant real-world relevance for individuals, health departments, countries and nations. Such a course will not only create awareness and enable early 'identification' of potential agents or symptom manifestation, it can also aid public health measures, enhance emergency preparedness and help to minimise the risk of danger to life.

In order to realise these critical benefits, the design of the course *at every point* had to be equal to the nature of the subject – hence the title 'Holistic Course Design'

for any failure of that equivalence has a very high risk level attached, a risk that could have potentially disastrous and/or fatal consequences. Clearly, the course will grow and change as the evaluation and feedback regimes described begin to impact on the basic design and it should also be clear that 'bespoke' solutions are required for subject-matter of the kind described here. However, by placing that subject-matter at the heart of the design and by enlisting the support of tried and tested theory it was possible to develop a course that was not simply (to use a current cliché) 'fit for purpose' but one that represents the very best practice.

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