Developing Educational Courses in Nuclear Security: A Handbook

Dr Christopher Hobbs and Dr Matthew Moran[1]
King's College London, UK

March 2014

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[1] Dr Christopher Hobbs is Co-Director of the Centre for Science and Security Studies (CSSS) at King's College London (KCL) and Lecturer in Science and Security in the Department of War Studies. He co-ordinates an MA module on CBRN Terrorism and Counter-Terrorism and serves as external examiner for the University of Central Lancashire's (UCLAN) MSc. in Nuclear Security, Safety and Safeguards. He is Vice-Chair of the International Nuclear Security Education Network (INSEN). Dr Matthew Moran is Deputy Director of CSSS and Lecturer in International Security in the Department of War Studies at KCL. He coordinates modules on Current Issues in Science and Security and Proliferation and International Security.

Introduction

This handbook is designed to serve as a resource for educators interested in establishing academic courses, with either a technical or policy focus, in nuclear security. Its focus is on curriculum design and the identification of appropiate teaching and assessment methods for engendering student learning in this area. Recommendations are presented in general terms and it does not attempt to provide a detailed syllabus outlining how a course(s) in this area should be taught or actual teaching/assessment materials. In this sense it is designed to complement but not overlap with the International Atomic Energy Agency's (IAEA) Nuclear Security Series No. 12 'Educational Programme in Nuclear Security' and the work of the International Nuclear Security Education Network (INSEN).[2] Guidance is also given on how to establish a professional development course (PDC) for nuclear security educators, drawing on the experiences of King's College London (KCL) in this area.[3] For the purpose of this handbook 'nuclear security' is defined as applied by the International Atomic Energy Agency (IAEA):

> 'the prevention and detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear material, other radioactive substances or their associated facilities'.[4]

This relatively narrow definition means that course design, teaching and assessment methods in the areas of nuclear safety and safeguards are not directly addressed in this handbook. Although elements of some of the topics touched upon, for example, nuclear material accounting and control (NMAC) and nuclear forensics, the international nuclear regime etc. are also of relevance for nuclear safety and safeguards courses.

[2] 'Educational Programme in Nuclear Security', IAEA Nuclear Security Series No. 12, www-pub.iaea.org/MTCD/publications/PDF/Pub1439_web.pdf (2010)
[3] 'Preventing nuclear terrorism', Centre for Science and Security Studies, King's College London, http://www.kcl.ac.uk/sspp/departments/warstudies/research/groups/csss/research/preventing-nuc-terr.aspx (accessed March 2014).
[4] IAEA, 'Concepts and terms', http://www-ns.iaea.org/standards/concepts-terms.asp?s=11&l=90, (accessed March 2014).

Background - Strengthening Security Culture Through Education

Recent years have seen a surge of interest in nuclear security education (and training) courses driven by a growing international recognition of the importance of a strong nuclear security culture. This is demonstrated by its prominence in the IAEA Nuclear Security Series documents and the Communiqué from the 2012 Nuclear Security Summit in Seoul, which highlighted security culture as one of the thirteen key areas for progress in nuclear security, linking this with need for increased 'human resource development (HRD) through (new) education and training' programmes. [56] A study by the World Institute for Nuclear Security (WINS) identified approximately 230,000 professionals with some form of accountability for nuclear security worldwide, with current professional development courses only having the capacity to educate and train just over half of these individuals.[7] The report also highlighted the relatively small number of programmes offered by universities and related organisations in this area.[8]

In order to stimulate growth in academic programmes and address this nuclear security education gap the IAEA established in April 2010 the International Nuclear Security Education Network (INSEN), a partnership between the Agency, universities and research institutes and competent national authorities. Over the past four years INSEN members have worked collaboratively to support the development of new courses in the area of nuclear security through the production of teaching materials (textbooks, lecture slides and datasets) and the provision of opportunities for profession development for Lecturers and Professors. This handbook will further assist this process by focusing specifically on the concept of curriculum design and the selection of appropiate teaching and assessment methods for educational courses in nuclear security.

[5] Objective and Essential Elements of a State's Nuclear Security Regime, Nuclear Security Series No. 20, http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1590_web.pdf (2013)
[6] Seoul Communiqué at the 2012 Nuclear Security Summit, accessed via the Council on Foreign Relations, http://www.cfr.org/proliferation/seoul-communiqu-2012-nuclear-security-summit/p27735, 27th March 2012
[7] Global Needs Analysis for Nuclear Security Training, World Institute for Nuclear Security (WINS), https://www.wins.org/files/wins_white_paper_global_needs_analysis_web.pdf, pp. 4, 7, April 2013.
[8] Ibid. p.6.

Section 1: Principles of Teaching, Learning and Assessment

The development of a comprehensive nuclear security educational programme depends heavily on the availability and accessibility of the necessary resources, both intellectual and material. Issues such as nuclear forensics and radiation protection, for example, are complex ones that demand a high level of technical competency on the part of the instructor or teacher. Similarly, well-equipped laboratories and access to suitable learning materials within a university or training organisation should form a core part of the student learning experience.

This said, the latest research in pedagogy highlights the fact that material resources and subject matter expertise on the part of the instructor are not, by themselves, enough to create a productive learning environment for students. To design a successful programme of instruction that engages students and facilitates the development of critical thinkers and problem-solvers, it is also necessary to devote considerable attention to the manner in which the course is taught.

There is now considerable evidence to suggest that the traditional approach to teaching in higher education – the passive lecture-discussion format where faculty talk and students listen – fails, in many instances, to promote student learning. Current research argues that teachers must be proactive in their efforts to engage with different learning styles and draw on the considerable range of pedagogical tools and methods now available in order to create environments that are conducive to student learning. This shift is of particular relevance to educators attempting to design courses in the relatively new field of nuclear security.

1.1 The Changing Nature of Education

Traditionally, the dominant approach to teaching and learning in higher education has been based on what is termed the 'Instruction Paradigm'.[9] According to this approach, the goal of universities and other providers of higher education or advanced training is 'to provide instruction, to teach'.[10] This passive format typically consists of the subject matter expert delivering a lecture to a potentially very large group of students in a unilateral exchange of information and discussion. The focus here is on instruction rather than learning and the Instruction Paradigm is underpinned by the idea that a successful educational exchange occurs when high quality teachers transmit information to high quality students. Students are encouraged to assimilate a significant body of information, usually with a view to replicating this information, or parts of it, in an examination setting.

Yet despite its historical dominance in educational practice the Instruction Paradigm is problematic for a number of reasons. It is now widely accepted that 'the primary

[9] Robert B. Barr and John Tagg, 'From Teaching to Learning: A New Paradigm for Undergraduate Education', *Change: The Magazine of Higher Learning* (1995), Vol.27, No.6, p.13.
[10] Ibid., p.14.

learning environment for undergraduate students, the fairly passive lecture-discussion format where faculty talk and most students listen, is contrary to almost every principle of optimal settings for student learning'.[11] Some more specific examples of the problems associated with the Instruction Paradigm are set out below:

- First, the Instruction Paradigm assumes a certain uniformity across a class of students. Little acknowledgement is given to the range of experiences and competencies of which the student group may be comprised. Students in higher education range from those progressing straight from secondary education, to those re-entering education after a period (often considerable) in industry. This diversity of knowledge and experience can serve as an asset in the classroom – real-life experience can help ground abstract theory and description.

  Closely linked to this point is the fact that the Instruction Paradigm fails to recognise that students learn in different ways. The passive lecture format may suit some students but will certainly not suit all. Those who learn through experience and/or discussion, for example, may be marginalised by the lecture format of the Instruction Paradigm. Student learning will be discussed in more detail further on but it is important to note that failure to cater for different learning styles is a key characteristic of the Instruction Paradigm.

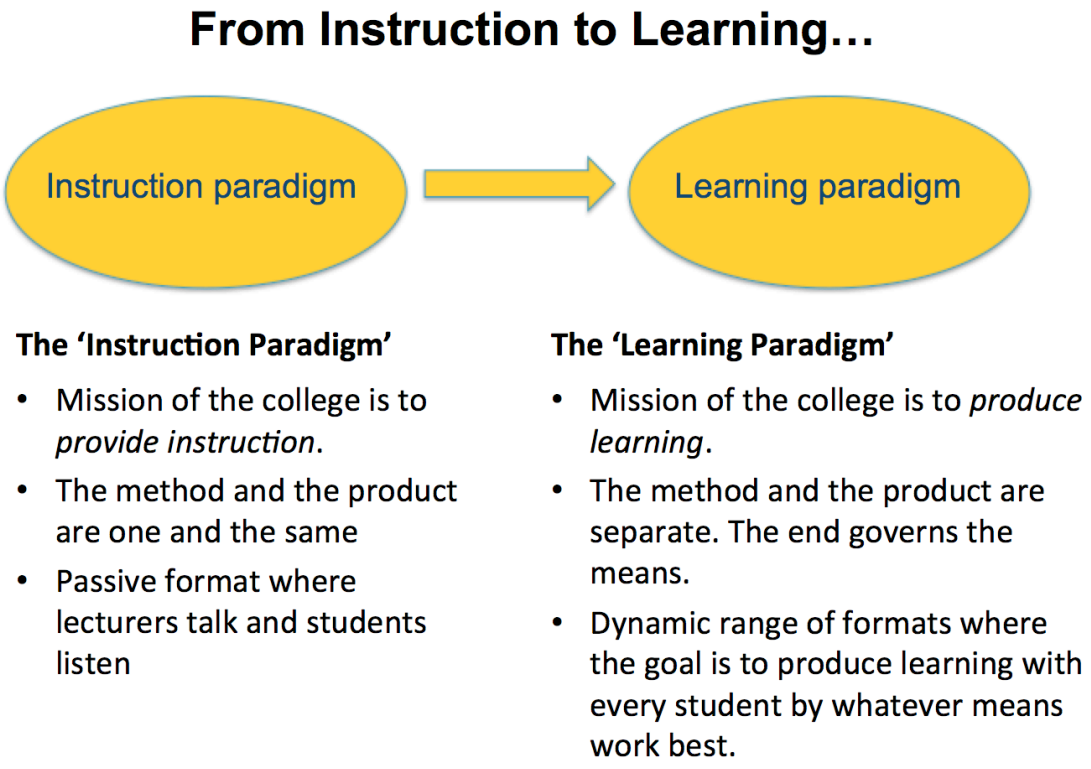
- Second, the Instruction Paradigm places emphasis on quality of resources rather than quality of learning. According to this approach, success is measured by revenue growth, recruitment of world-class and research-oriented faculty, student enrolment, and increased selectivity with regard to students (i.e. higher quality entering students). However, these indicators do not necessarily reflect a high-quality learning environment. For example, a lecturer may be the world's foremost expert in his/her subject area, with a long track record of research that is attractive to prospective students, yet these qualifications reveal nothing about the lecturer's ability to teach and promote learning in a class of students.

- Third, in the context of the Instruction Paradigm, assessment is primarily viewed as a means of gauging successful course completion, a means of ensuring that required course material has been covered by the teacher and taken on board by the student. However this view of assessment fails to recognise the formative benefits of assessment (particularly ongoing) and feedback, and how these can serve as learning tools.

As research on teaching and learning advanced, the limitations and problems associated with the Instruction Paradigm become evident. In this context, the past

[11] Alan E. Guskin, 'Reducing Student Costs & Enhancing Student Learning Part II: Restructuring The Role Of Faculty', *Change: The Magazine of Higher Learning* (1994), Vol.26, No.5, pp.16-25

two decades have seen a progressive shift towards what is termed the 'Learning Paradigm'.[12]



First proposed by Robert Barr and John Tagg in 1995, the Learning Paradigm places the student at the centre of the process of learning and teaching. Rather than proposing a fixed structure whereby a programme of lectures or instruction is provided and the student assumes complete responsibility for his/her learning, the Learning paradigm holds that responsibility for producing learning is shared between the teacher and the student. Crucially, in the Learning Paradigm, 'a college's purpose is not to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge for themselves'. This approach enables students to develop as critical thinkers with the ability to solve problems and make new discoveries.

The Learning Paradigm differs significantly from the Instruction Paradigm in that the Learning Paradigm advocates an approach whereby the goal is to produce learning by whatever means work best. This approach recognises that to produce learning, different students and different subjects will require different approaches, methods and tools. Some of these methods and tools will be discussed in the following sections in the specific context of nuclear security education.

Another significant difference between the two paradigms is to be found in perspectives on assessment. The Learning Paradigm attaches great importance to

[12] Barr and Tagg, p.17.

assessment and feedback as educational tools that should form part of the ongoing process of teaching and learning rather than simply being viewed in terms of a product, a means of verifying the accumulation of knowledge at the end of a programme of study.

Some of the key differences between the Instruction Paradigm and the Learning Paradigm are set out in the table below:

The Instruction Paradigm	The Learning Paradigm
Provide/deliver instruction	Produce learning
Transfer knowledge from faculty to students	Elicit student discovery and construction of knowledge
Faculty are primarily lecturers	Faculty are primarily designers of learning methods and environments
Any expert can teach	Empowering learning is challenging and complex
Learning is cumulative and linear	Learning is a nesting and interacting of frameworks
Learning is a nesting and interacting of frameworks	Fits learning how to ride a bicycle metaphor
Faculty and students act independently and in isolation	Faculty and students work in teams with each other and other staff
One teacher, one classroom	Whatever learning experience works
The classroom and learning are competitive and individualistic	Learning environments and learning are cooperative, collaborative, and supportive
Covering material	Specified learning results
50-minute lecture, 3-unit course	Learning environments
End-of-course assessment	Pre/during/post assessments

Table 1: Differences between the Instruction Paradigm and the Learning Paradigm Adapted from Barr and Tagg, 1995

In general terms, the Learning Paradigm represents a fluid and evolving system of education whereby teachers and institutions learn from every experience. In other words, this approach 'envisions the institution itself as a learner over time, it

continuously learns how to produce more learning with each graduating class, each entering student'.[13] This is in stark contrast to the Instruction Paradigm, a static and largely immutable system that that is resistant to change and does not adequately exploit the range of tools, methods and approaches that can contribute to a productive student learning environment.

This brief summary outlines the fundamental shift in approaches to teaching and learning that has occurred since the 1990s. This shift has radically altered perspectives on teaching in higher education, both by acknowledging shared responsibility for the production of learning (teacher/institution and student) and by recognising the need for innovation in teaching and curriculum design. In this context, the following subsections will take a closer look at issues of student learning, teaching methods, curriculum design and assessment. The goal here is to provide insights into the need for and availability of different tools and methods that can be used to support teaching and learning in nuclear security education.

1.2 How Students approach Learning

The shift from the Instruction Paradigm to the Learning Paradigm has seen 'learning and the learner become of central importance in the teaching/learning interaction - i.e. what the learner does has become more important for student learning than what the teacher does'.[14] The goal of the teacher and, on a larger scale, the institution, is to facilitate student development through the construction of appropriate learning environments.

In educational theory and practice, it is accepted that 'effective learning changes the way we see the world. The acquisition of information in itself does not bring about such a change, but the way we structure that information and think with it does. Thus, education is about conceptual change, not just the acquisition of information'.[15] To construct learning environments that facilitate this desired conceptual change, however, it is first necessary to understand both how students approach learning and how they learn, for this differs from student to student.

The literature on education identifies three distinct approaches to learning: surface learning; strategic learning; and deep learning. It should be noted that while these approaches are distinct, students frequently move between them. A student may, for example, move from a strategic learning approach to one based on deep learning.

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[13] Barr and Tagg, p.14.

[14] Jackie Lublin, 'Deep, surface and strategic approaches to learning', Centre for Teaching and Learning, 2003, http://www2.warwick.ac.uk/services/ldc/development/pga/introtandl/resources/2a_deep_surfacestrategic_approaches_to_learning.pdf, p.2.

[15] Jackie Lublin, 'Deep, surface and strategic approaches to learning', Centre for Teaching and Learning, 2003, http://www2.warwick.ac.uk/services/ldc/development/pga/introtandl/resources/2a_deep_surfacestrategic_approaches_to_learning.pdf, p.2.

1. Surface Learning

According to Biggs and Tang, 'the surface approach arises from an intention to get the task out of the way with minimum trouble, while appearing to meet course requirements. Low cognitive-level activities are used, when higher level activities are required to do the task properly'. [16] In an educational context, a good example of surface learning is when students simply memorise content without achieving any real understanding. Some of the characteristics of surface learning are:

- Memorising for the purpose of replication
- Failure to distinguish principles from examples
- Lack of comprehensive understanding
- Tendency to stick closely to the course requirements
- Often motivated by fear of failure

2. Deep Learning

This approach is characterised by a desire for comprehensive understanding. Students adopting this approach focus on underlying meanings, themes, principles and application. Some of the characteristics of deep learning are:

- Actively seeking to understand the subject
- Usually motivated by interest and curiosity
- Engaging fully with course content and material
- Taking a broad view and relating ideas to one another
- Building on previous knowledge with new ideas and concepts
- Tendency to read and study beyond the course requirements

3. Strategic Learning

Positioned between surface learning and deep learning is strategic learning. This is a results oriented approach to learning with students seeking to excel within the parameters of a programme of study. Students adopting a strategic approach realise that it is not enough to simply memorise information and regurgitate it in an exam setting. They know that some understanding is necessary, but their desire to understand is limited to what they need to achieve good results. Strategic learners go beyond surface learners in terms of understanding, but this more comprehensive understanding is simply a by-product of the desire to achieve good results. Some of the characteristics of strategic learning are:

- Desire to obtain high grades
- High level of organisation in terms of time and effort
- Ensuring that the conditions and materials for studying are appropriate

[16] John Biggs and Catherine Tang, *Teaching for Quality Learning at University – Third Edition* (Open University Press, 2007), p.22.

- Use of previous exam papers to anticipate questions
- Alert for cues and hints regarding examination questions
- Understanding tailored to the requirements of the course.

1.3 The Influence of Educators on Student Approaches to Learning

A deep learning approach facilitates comprehensive engagement with a subject and contributes to the development of students whose knowledge is matched by understanding. However, this approach is not always the starting point for students. The goal of teachers should therefore be to encourage and enable students to adopt a deep learning approach. In this context, there are a number of influencing factors within the teacher's control:

1. Passion for the subject: If a teacher does not appear too passionate about a subject, how can he/she provoke the interest and enthusiasm of students? It is important to remember that students are sensitive to the actions, attitude and approach of the teacher and a perceived lack of interest on the part of the teacher may well colour the student's perception of the subject.

2. Time stress and coverage: A key characteristic of the Instruction Paradigm was the idea of coverage, in other words, that there was a certain amount of material to be covered and therefore teaching had to proceed at pace and according to a strictly defined schedule. This frequently resulted in 'too many topics, each taught with equal emphasis'.[17] This approach is problematic, yet it still remains a feature of higher education, particularly in more technical subject areas.

3. Diversity of methods: The Learning Paradigm represented a break with traditional approaches to teaching and instruction, not least because it proposed a new system that prioritised the production of learning by whatever means work best. In terms of the teacher's contribution to learning, this is a key point. It is no longer sufficient to build a course around a simple lecture format; there are a range of tools and formats, from simulations to site visits, which can be incorporated into a programme of study. This diversity is necessary since students learn in different ways.

1.4 How Students Learn: Learning Styles

An understanding of how students approach learning is important in the context of the Learning Paradigm and student-centred learning. Equally important, however, is an understanding of how students learn. Since the 1950s, 'literature from both psychology and education has supported the proposition that learners of all ages have different yet consistent ways of responding in learning situations. These

[17] Biggs and Tang, Teaching for Quality Learning at University, p.40.

behaviours or predispositions to behave in a particular fashion have been termed learning styles'.[18]

In the literature, student learning styles are usually described or categorised in five distinct ways: aural, kinaesthetic, read/write, visual and multimodal. As the titles suggest, students in each category respond best to particular types of stimuli.

1. Visual Learners

Visual learners demonstrate a preference for 'graphical and symbolic ways of representing information'. [19] Examples here include maps, diagrams, charts, hierarchies and other visual forms of representing what could otherwise have been said in words.

2. Aural Learners

Aural learners respond particularly well to discussion, debate and the spoken word. Examples here include lectures, talks, group discussion and oral brainstorming. These types of learners often structure their thoughts and understanding by talking through issues and problems.

3. Read/Write Learners

Read/write learners demonstrate a preference for the written word. These students prefer to receive written instruction and may learn best from lists, definitions, handouts, textbooks, etc. As well as text-based input, read/write learners may also prefer text-based output such as essays and reports.

4. Kinesthetic Learners

This style of learning refers to the 'perceptual preference related to the use of experience and practice (simulated or real)'. Fleming and Mills describe a kinesthetic teaching experience as one in which all or any of the perceptual modes – sight, touch, taste, smell and hearing – 'are used to connect the student to reality, either through experience, example, practice, or simulation'.[20] This style of learning may draw on other styles but is distinct in that it prioritises the experience. Kinesthetic learners respond well to a hands-on approach, trial and error, and real-life examples. These students can benefit from lab work, practical tasks, field trips and site visits.

5. Multimodal Learners

Multimodal learners do not demonstrate clear preference for any of the above learning styles. Rather, these learners draw on a combination of styles. Multimodal learners are further divided into two types;

a. Some multimodal learners are flexible in their preferences and switch from style to style depending on the particular context. The style is chosen to suit the situation. For example, 'if they have to deal with legalities they will apply

[18] Neil D. Fleming and Colleen Mills, 'Not Another Inventory, Rather a Catalyst for Reflection', *To Improve the Academy* (1992), Vol.11, p.137.
[19] Fleming and Mills, p.140.
[20] Ibid., p.141.

the read/write preference', whereas 'if they are to watch and then replicate the demonstration of a technique in a laboratory setting' they will adopt the Kinesthetic style.[21]

b. Other multimodal learners 'are not satisfied until they have had input (or output) in all of their preferred modes. They take longer to gather information from each mode and, as a result, they often have a deeper and broader understanding. They may be seen as procrastinators or slow-deliverers but some may be merely gathering all the information before acting - and their decision making and learning may be better because of that breadth of understanding'.[22]

Research has shown that 'when a student's learning preference is accommodated, his or her level of motivation increases'.[23] Moreover, when a student has the opportunity to explore a particular subject in the context of his or her preferred learning style, this facilitates greater understanding on the part of the student.

In this context, limiting the range of teaching methods used in the classroom can place constraints on student learning potential. Ideally, then, a teacher should attempt to cater for different learning styles within a particular student group. Of course, it is 'simply not realistic to expect teachers to provide programs that accommodate the learning style diversity present in their classes, even if they can establish the nature and extent of that diversity'.[24] A more realistic approach involves both acknowledging and taking steps to cater for different learning styles, and 'empowering students through knowledge of their own learning styles to adjust their learning behaviour to the learning programs they encounter'.[25]

1.5 Assessment as Learning

Having considered the paradigm shift from instruction to learning, and explored some of the issues around student learning, this subsection will briefly consider the importance of assessment in the teaching and learning process.

Assessment is one area where new and innovative strategies hold the potential to make a significant contribution to student learning. Assessment is a necessary element of any programme of instruction since it serves as a means of gauging student competency in a particular subject or area. However, it is important to recognise that assessment has the potential to serve another function as a learning tool. Whereas in the past, assessment has been viewed 'primarily as a means to measure the achievement of goals, and thus for certification and selection, there is

[21] 'The VARK Modalities', VARK: A Guide to Learning Styles, http://www.vark-learn.com/english/page.asp?p=categories.
[22] Ibid.
[23] Kelli Allen, Jeanna Scheve and Vicki Nieter, *Understanding Learning Styles: Making a Difference for Diverse Learners* (Huntington Beach, CA: Shell Education, 2011), p.96.
[24] Fleming and Mills, p.138.
[25] Fleming and Mills, p.138.

now a belief that the potential goals of assessment are much wider and impinge on all stages of the learning process, and even beyond that'.[26]

Student approaches to learning, for example, are often driven by the assessment requirements of a particular course of study. In this context, it follows that approaches to learning, as well as depth and clarity of understanding, may be shaped by the choice of assessment methods. This notion is supported in the literature on teaching and learning in Higher Education. Numerous studies have highlighted the impact of assessment method upon depth of study. One study, for example, showed 'how the use of tests and multiple-choice questions promoted reproductive styles of learning, whereas projects and open-ended assessment promoted independence and deeper strategies of understanding'.[27]

There is also evidence to suggest that 'the use of problem-based approaches can promote deeper styles of learning. However, many students reject deeper approaches on the grounds that the assessment methods in their courses involve so much reproduction of material that developing deeper approaches in study methods is not worth the investment required'.[28] It should come as no surprise, then, that 'much of the literature on learning shows that undergraduate courses with a heavy load of subject content and a narrow range of topics are more likely to foster superficial learning methods and outcomes in students'.[29]

In general terms, then, the choice of assessment methods by teachers constitutes a key factor in efforts to construct a learning environment that favours deep learning and understanding on the part of students. Later sections will discuss particular assessment methods in more detail and relate these to the specific context of nuclear security education.

1.6 Conclusion

The above sections have set out, in general terms, some of the key principles of teaching and learning. An understanding of these principles and the thinking that underpins them can support the development of innovative and student centred programmes of instruction in the emerging context of nuclear security education. The following sections will move to focus on the application of these principles to nuclear security education. The handbook will offer practical advice with regard to curriculum design, the choice and application of particular teaching methods, and the question of assessment in nuclear security specific courses. Examples will be provided to illustrate the points made.

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[26] Sarah Gielen, Filip Dochyc, Patrick Onghenad, Katrien Struyvena and Stijn Smeetsa, 'Goals of peer assessment and their associated quality concepts', *Studies in Higher Education* (2011), Vol.36, No.6, pp.719-735.

[27] 'Assessment Handbook', University of Ulster, August 2013, http://www.ulster.ac.uk/academicoffice/download/Handbooks/Assessment%20Handbook.pdf.

[28] Ibid.

[29] Ibid.

Section 2: Curriculum Design in Nuclear Security Education

In higher education, educators are often subject matter experts whose focus is on the latest developments in their particular field of expertise. Little attention is given to educational research and the implications of advancements in this field. This is particularly true of curriculum design; Barnett, Parry and Coate point out that 'for all the discussion of the changes, often profound, that have taken place in contemporary higher education, the […] curriculum has commanded rather less attention than might be expected. Yet the curriculum remains one of the most important products that higher education institutions offer to their customers'.[30]

Although it is important to note that competing definitions exist, for the purpose of this handbook, curriculum may be understood as 'the planned interaction of pupils with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives'.[31]

Curriculum design poses particular challenges in the context of nuclear security education where the interdisciplinary nature of the subject area adds to the complexities associated with the design of an engaging and inclusive curriculum. What, then, are the key issues to bear in mind when designing a curriculum built around nuclear security?

2.1: Curriculum Design: A Four-Stage Process

Curriculum design is a complex and challenging process that must be tailored to the specific requirements of the course being constructed. The curriculum for a MSc module, for example, will differ considerably from the curriculum developed for a week-long professional development course.

In general terms, the design of a course or programme on nuclear security can be reduced to a four-stage process. The benefit of this approach lies in the fact that it can be used to inform the design of individual classes and stand-alone modules, as well as broader curricula in nuclear security education. It should be noted however, that while this approach aims to address many of the key issues and challenges faced by educators in curriculum design, it is not exhaustive and there is a considerable body of literature devoted to this area. The below approach should thus be considered a starting point for those wishing to explore curriculum design further.

1. Identify Learning Outcomes

[30] Ronald Barnett, Gareth Parry and Kelly Coate, 'Conceptualising Curriculum Change', *Teaching in Higher Education* (2001), Vol.6, No.4, p.435.
[31] Allan A. Glatthorn, Floyd Boschee, Bruce M. Whitehead and Bonni F. Boschee, *Curriculum Leadership: Strategies for development and Implementation. Third Edition* (Thousand Oaks: Sage, 2012), p.4.

The first stage in curriculum design involves the identification of appropriate learning outcomes. Since the late 1990s, outcome-based teaching and learning (OBTL) has been widely recognised as an innovative approach to teaching and learning. Essentially, outcome-based education 'is an approach to education in which decisions about the curriculum are driven by the outcomes the students should display by the end of the course. In outcome-based education, product defines process'.[32] OBTL is distinguished by two essential features:

- First, that educators state what the intended outcomes of a particular course or programme of study. It is important to note that 'an outcome statement is a statement of how we would recognize if or how well students have learned what is intended they should learn, not a prompt list of topics for teachers to 'cover' in a curriculum'.[33]

In this regard, OBTL is somewhat counter-intuitive in that it begins by considering the end point and working backwards. What sort of nuclear security expertise will students have at the end of the course? Will this expertise be focused on a particular area? What competencies will they possess? What skills, including personal transferable and communication skills, will the students have? How will these skills support or enhance the nuclear security expertise of the students?

On a larger scale, it is also important to consider issues such as how the proposed course fits within the broader programme of study being undertaken by the student. Moreover, how will a course on nuclear security support the employment prospects of students? Or, for those interested who have already embarked on a career in a relevant field, how will a course on nuclear security support professional development?

- Second, that 'teaching should be done in such a way as to increase the likelihood of most students achieving those outcomes'.[34] In other words, that teaching and assessment methods have been selected with a view to achieving the stated outcomes.

The aim here is to align the teaching, learning and assessment methods and activities with the intended learning outcomes. What methods of instruction will be used? What learning styles will be catered for? Will lectures be combined with laboratory work or field trips to working nuclear facilities for example? How will this combination of methods support the intended learning outcomes? What form will assessment take and why?

Outcome based teaching and learning provides educators with a more comprehensive approach to curriculum design. By working backwards from the

[32] R. M. Harden, J. R. Crosby and M. H. Davis, 'AMEE Guide No. 14: Outcome-based education: Part 1 - An introduction to outcome-based education', *Medical Teacher* (1999), Vol.21, No.1, p.8.
[33] John Biggs and Catherine Tang, *Teaching for Quality Learning at University. Third Edition* (Maidenhead: Open University Press, 2007), p.7.
[34] Ibid.

programme end point, educators can identify the methods and activities most suited to helping students achieve the intended learning outcomes.

2. Consider Background and Needs of Students

Closely linked to the first stage, the second stage involves considering the background and needs of the students likely to take the course. Given the multidisciplinary nature of nuclear security as a subject area, the student body may comprise students from a range of backgrounds, from technical to policy focused.

Student diversity in terms of background and experience can pose challenges for the educator, yet it also brings important benefits. Mature students, for example, may be returning to study after a period in industry. These students can form a valuable resource; their real-life experience can make a positive contribution to the learning environment and provide an important link between theory and practice. A student who has been employed at a nuclear facility, for example, could bring valuable perspective and add much to class discussions.

In terms of learning needs, while it may not be possible to cater for all the learning styles, such diversity must at least be considered and multiple teaching methods employed. A combination of lectures, oral presentations, written assignments, discussions and field trips, for example, will help make the course more accessible to a wider range of students. Teaching methods will be discussed in more detail further on.

It is also important to consider how feedback and assessment will be incorporated into the curriculum and how these tools will be used to support student learning needs. Ultimately, the goal here is to create a productive learning environment for students.

3. Identify Content and Teaching Methods Required to Achieve Learning Outcomes

The third stage involves identifying the content that will form the course syllabus and the methods that will be used to teach this content. For a course on insider threats, for example, materials might include international guidance on preventative and protective measures, case studies on actual incidents where nuclear material or information was stolen or facilities were sabotaged, or a table top exercise where students could apply conceptual knowledge to a hypothetical facility where students could identify vulnerabilities before suggesting security upgrades.

It is important to bear in mind that supporting materials for such a course, or indeed any nuclear security course, can incorporate a diverse range of sources. Traditional academic courses, for example, have been accompanied by a bibliography comprising a list of key academic works relating to the subject. Increasingly, however, educators are taking advantage of the full range of information sources that are now readily available online. In this context, supporting materials may include everything from textbooks to podcasts to video clips.

Furthermore, content and teaching methods need not be confined to the classroom. Many educators now use wikis, blogs and dedicated online learning platforms (many of which are freely available) to host course content and/or discussion. Through these vehicles, students have the opportunity to further explore topics in their own time and contribute to an online discussion that is not subject to time pressures.

It is important to maintain a certain level of flexibility with regard to both content and teaching methods since opportunities to update or alter the syllabus may arise during the course. For a course dealing with the threat form non-state actors, for example, new information on terrorist groups could make a valuable addition to an existing case study. This information may come in many forms, from an academic study that presents the findings of a long-standing project, or through media sources that offer an immediate insight and response to contemporary developments. Incorporating such material at short notice could help 'bring the subject to life' for the students.

4. Refining the Curriculum

The final stage of the curriculum design process involves refining the curriculum based on both student feedback and lessons learned by the educator through delivering the course. It is worth pointing out that while most courses undergo this process of refinement after the course has concluded, adjustments and improvements can (and should) be made at any point during the course in response to a perceived need or opportunity.

In terms of gathering student feedback on the course (structure, content and delivery), the first task for the educator is to decide *when* and *how* feedback will be gathered. For those wishing to engage in a continuous process of refinement, for example, structured feedback may be gathered from students at multiple points throughout the course. This will allow the course leader to keep abreast of any issues that may arise for students and address these issues in a timely fashion.

Alternatively, it may be more practical to obtain comprehensive feedback through an end of course evaluation process. This will highlight any significant issues that students have encountered during the course and these can then be addressed before the course is recommenced.

Educators must also consider how feedback will be gathered. Will feedback be gathered informally through discussions with students throughout the course? Will feedback be gathered formally through a structured course evaluation form (this is often a departmental requirement in the university setting)? Furthermore, if the educator is designing the feedback collection form, what questions will this form contain? What will be asked of students? A sample course evaluation form has been included in Annex 1.

Ultimately, a process of continuous feedback and refinement will result in a curriculum that remains relevant and up-to-date, offering students comprehensive and engaging insights into the subject area.

2.2: Key considerations when developing nuclear security curricula

Comprehensive frameworks for both MSc and Certificate level post-graduate programmes in nuclear security are outlined within the IAEA's technical guidance document, 'NSS 12: Educational Programme in Nuclear Security', which details 12 core and 10 elective courses.[35] For each course, information is provided on suggested learning objectives, main modules and recommended reading. Consequently this resource serves as a useful starting point for guiding the development of nuclear security curriculum. In the case of the European Masters in Nuclear Security, coordinated by Delft University of Technology in partnership with 5 other institutes, the 22-course framework outlined in NSS 12 was adopted in its entirety.

Although not all universities are seeking to launch full MSc programmes in nuclear security, they may nevertheless wish to draw on the information pertaining to individual courses contained within NSS 12, selecting courses to fit their particular programme needs. Here it should be noted that nuclear security students may come from technical, legal, policy or other backgrounds. Consequently not all the courses and materials within NSS 12 are directly relevant for individuals looking to improving their understanding of nuclear security in one of the aforementioned areas.

In terms of approaching curriculum design in this area, a common starting point is the threat posed by nuclear terrorism. An understanding of the nature, evolution and scale of the threat provides the necessary context within which the nuclear security 'response' at a range of levels may be understood. For example, at the international level, varying perceptions of threat across time (and geographical locations) have had a significant impact on the evolution of the patchwork of formal instruments and informal initiatives that form the international nuclear security architecture. At the other end of the spectrum, the nature and type of external and internal threats will directly impact the nuclear security measures employed at the practical, working level of a nuclear facility. Cleary, then, an understanding of the threat impacts at all levels and should thus form part of any nuclear security course.

How much time is spent on understanding the threat in relation to the response may vary considerably from course to course. On the policy-focused CBRN Terrorism and Counter-Terrorism course run at King's College London, approximately 50% of the course is spent analysing the threat, with the remaining 50% devoted to dissecting the response. However, for a technically focused course this ratio might be significantly different with, for example, a 20%/80% split in terms of threat/response and much greater emphasis placed on scientific and technical approaches to nuclear security.

[35] 'Educational Programme in Nuclear Security', IAEA Nuclear Security Series No. 12, www-pub.iaea.org/MTCD/publications/PDF/Pub1439_web.pdf (2010)

Time might also be allocated at the start of a nuclear security course (possibly as part of the treatment of the threat) to the unique properties of nuclear and radiological materials and the nuclear fuel cycle. Knowledge of these elements (even for policy students) is essential in understanding both the impact of a nuclear terrorist act and some of the unique challenges to designing nuclear security systems, such as the difficulty of detecting highly enriched uranium (HEU) outside of regulatory control, for example. These challenges and effects serve to make nuclear security a unique field of study, different from conventional counter-terrorism or chemical and biological security, although certain concepts and frameworks of analysis can certainly be drawn from these areas.

Turning to the nuclear security 'response', there are a wide range of topics that might be covered in a nuclear security course, ranging from the international nuclear security regime, to physical protection systems at a nuclear facility, to nuclear forensics and attribution. What topics are selected and how they are treated depend very much on the identified learning outcomes and the background and needs of the students. For law students for example, modules might be developed to focus on international treaties and conventions and national legal frameworks for regulating nuclear security. In contrast, for nuclear physics or engineering students, more appropiate modules might include: physical protection technologies and equipment; detection of nuclear and radiological material outside of regulatory control; nuclear forensics and attribution.

Once specific modules for a nuclear security course are selected attention turns to the identification of appropiate teaching and assessment methods (covered separately in the next two sections) and the development of appropiate reading lists and other learning resources. Although the nature of nuclear security as a relatively new area of study means that there are less reference materials available here than in other subject areas, such as nuclear non-proliferation, for example. However with significant international attention focused on nuclear security, magnified by the high profile Nuclear Security Summit Process, this situation is changing.

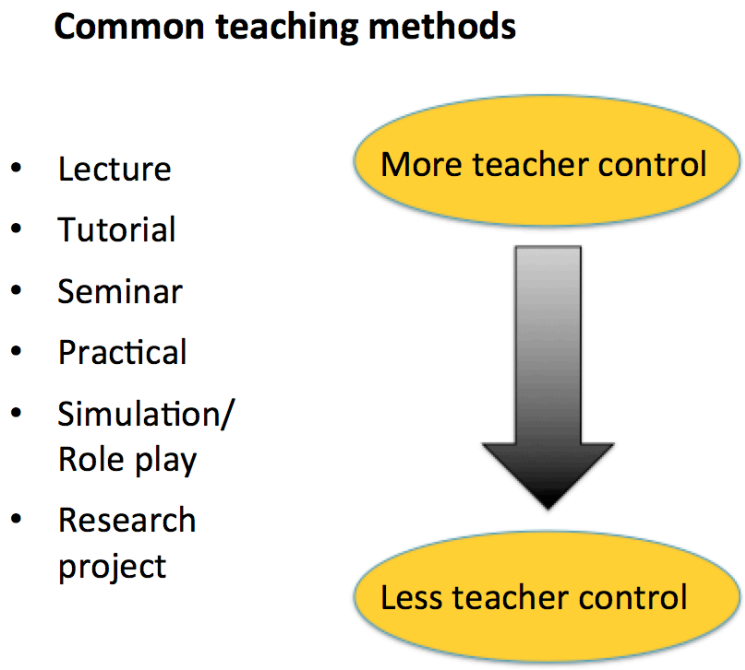
The IAEA has produced detailed guidance documents on a range of nuclear security topics for member states, and while perhaps most relevant for training courses, these provide useful background information on international standards and approaches.[36] The World Institute for Nuclear Security (WINS) also produces a range of best practice guides and other training-related documents for industry, which are also of relevance for educational courses.[37] There are also a number of specialist journals covering nuclear security among other issues, these include: the Nonproliferation Review; Arms Control Today; Bulletin of the Atomic Scientists; and Science and Global Security. [38] Together, these publications constitute a

[36] Nuclear Security Series, IAEA, www-ns.iaea.org/security/nuclear_security_series.htm
[37] World Institute for Nuclear Security (WINS) https://www.wins.org/
[38] Nonproliferation Review http://cns.miis.edu/npr/; Arms Control Today https://www.armscontrol.org/act/; Bulletin of the Atomic Scientists thebulletin.org/; Science and Global Security www.princeton.edu/sgs/publications/sgs/.

comprehensive source of academic articles that can form part of the reading list for a nuclear security course. In terms of more comprehensive resources, INSEN has at the time of writing developed and published three nuclear security textbooks with several more close to completion.

Section 3: Selecting Appropriate Teaching Methods

Having explored approaches to teaching in more general terms, and looked at a number of options in terms of the development of courses in nuclear security education, it is useful to discuss specific teaching methods and their value in different teaching contexts. As mentioned above, an important element of curriculum design involves the ability to select and apply appropriate teaching methods that will engage students and encourage deep learning.



The above image sets out a range of commonly used teaching methods. Clearly, these methods differ significantly in terms of structure and control of information flow and delivery. In the lecture format, for example, the teacher is very much in control of information – how it is delivered, how it is received. This is usually a passive learning format where information is transmitted directly to students.

At the other end of the spectrum is a research project where the educator offers guidance in terms of subject matter, scope and structure, but the student is free to pursue different avenues of enquiry. In this format, the student has much more independence in terms of how information is acquired and interpreted. This freedom, if managed appropriately, can facilitate deep learning as the student becomes immersed in a particular subject.

Of course, all teaching methods have particular benefits and drawbacks. It is important to be aware of these factors when selecting a particular method. The benefits and drawbacks of a number of teaching methods are discussed below. This list is not exhaustive, rather it is intended to highlight the importance of selecting appropriate teaching methods.

3.1 The Lecture Format

A lecture is best described as an oral presentation in which a speaker, usually a subject matter expert, conveys organised thoughts and ideas to students. This is perhaps the most widely used teaching format in higher and further education.

Benefits of the lecture format:

- The lecture constitutes an effective means of transmitting material to a large group of students
- Useful means of providing background information and basic ideas and concepts
- *Ideally* conveys factual/conceptual information in a clear and logical manner

Drawbacks of the lecture format:

- The lecture format allows for minimal participant involvement, particularly with large groups, with little opportunity to question or probe material
- Student concentration typically lapses after 15-20 minutes.[39] This poses problems in the context of lectures, which typically last at least one hour.
- The lecture format poses a risk of information overload
- The lack of opportunity for discussion means that it is difficult for the educator to gauge student understanding or identify problems.

The drawbacks mentioned above can be mitigated. Lectures can, for example, 'be punctuated with periodic activities'.[40] Short problem-solving activities or other forms of deliberate breaks help to break the cycle of passive learning and re-engage students. In a class on nuclear security culture, for example, it might be useful to ask students to discuss the similarities, differences and overlap between nuclear security culture and nuclear safety culture. Such an exercise promotes reflection and engagement on the part of students. This approach can also have benefits for the educator, providing valuable insights into student preconceptions and understanding of the subject matter.

Other means of facilitating student engagement during a lecture include incorporating audio and/or visual aids, drawing on real-life examples and analogies to 'bring the subject to life', and ensuring that the class follows a clear and logical structure which enables integrative links to be more easily made by students.

3.2 The Seminar Format

A seminar is best described as a form of small group teaching (SMG) led formally or informally by a tutor that encourages students to talk, think and share ideas on a

[39] For an influential article on this subject see Joan Middendorf and Alan Kalish, 'The "Change-Up" in Lectures', *The National Teaching and Learning Forum* (1996), Vol.5, No.2, pp.1-2.
[40] *Ibid*., p.1.

particular issue. Seminars typically involve a group of 15 or less students and the emphasis is placed firmly on communication and discussion.

Benefits of the seminar format:

- Provides greater opportunity for student participation through questions, discussion and debate.
- Facilitates collaborative learning as students probe an issue from multiple perspectives within a group.
- Contributes to the development of communication skills as students learn to make arguments and defend positions.
- Fosters critical thinking skills as students analyse and evaluate evidence.
- Offers educators an opportunity to gain insights into levels of understanding and interest of individual students.
- Provides for a less formal and more flexible learning environment.

Drawbacks of the seminar format:

- Dominant personalities can come to dominate discussion
- Differing levels of ability, motivation and confidence can serve as obstacles to discussion.
- Lapses in discussion can lead educators to resort to teacher-centred strategies and turn seminars into mini-lectures.

Despite the above drawbacks, small group teaching constitutes a format that is conducive to discussion, critical thinking and deep learning. This method can be particularly useful when discussing less technical issues where there is room for interpretation and criticism. The seminar format provides an environment where such questions can be explored and answered. Student (and instructor) preparation is key for ensuring a successful seminar, which will commonly start by either party giving a short presentation outlining the topics for debate.

3.2 The Simulation Format

The simulation format refers to instructional scenarios where students are immersed in a controlled and simulated learning environment. Students may be given guidelines, roles and even specific tasks. Crucially, however, the outcome is not determined; students are free to interpret the given information and determine their own course of action within the limits of the simulation.

Benefits of the simulation format:

- Allows students to engage with a subject 'in ways that traditional techniques like reading and lecturing do not'.[41]
- Place emphasis on real-world application of ideas and concepts.
- Can encourage new thinking and creativity.

[41] Stephen M. Shellman, and Kurstad Turan, 'Do Simulations Enhance Student Learning? An Empirical Evaluation of an IR Simulation', *Journal of Political Science Education* (2006), Vol.2, No.1, p.21.

- Can open 'alternative learning paths to participants who do not respond well to conventional lecturing approaches'.[42]
- Can help students retain information for longer periods of time

In general terms, the key benefit of the simulation approach lies in the fact that it attempts to 'bring to life' the complexities of real-world problems within the classroom setting. As such, simulations constitute a valuable learning tool. Shellman and Turan give a concise example of this: 'One can read about the strategic problems associated with the Cuban Missile Crisis, but until students are placed into strategic interactions of their own, in which they must take responsibility for their actions and connected consequences, they do not fully understand the associated quandaries'.[43]

Drawbacks of the simulation format:

- Requires significant amount of time and planning.
- Can be expensive, particularly if equipment, props or a site visit are requires.
- Without adequate preparation, there is a danger of oversimplification of complex and multifaceted issues.
- Assessment can be more complex than for other teaching methods since it can be difficult to evaluate individual contributions in an inherently collaborative context.

Simulations constitute a valuable pedagogical tool that can be used at the beginning, middle, or end of a course of study. Significantly, the simulation can serve different purposes depending on when in the course it is used. If used at the beginning, for example, a simulation 'can introduce students to major concepts or problems, provide them with a common experience [and] increase motivation to learn the subject matter'.[44] If used towards the end of a course, a simulation can consolidate learning and draw out links between different concepts.

The above paragraphs set out some of the key issues to bear in mind when selecting appropriate teaching methods for a particular educational course. Individual methods have their own merits but a comprehensive teaching strategy will likely incorporate multiple methods. A multi-method approach contributes to the construction of a productive learning environment that allows students to approach ideas, concepts and information from different perspectives. Other points to consider in selecting teaching methods include class size, amount of contact time and resources available.

[42] William W. Newmann and Judyth L. Twigg, 'Active Engagement of the Intro IR Student: A Simulation Approach', *Political Science and Politics* (2000), Vol.33, No.4, p.835.
[43] Shellman and Turan, p.21.
[44] Dean S. Dorn, Simulation Games: One More Tool on the Pedagogical Shelf', *Teaching Sociology* (1989), Vol.17, No.1, p.10.

3.3 Selecting Teaching Methods for Nuclear Security Courses

The interdisciplinary nature of nuclear security favours a range of teaching methods. Indeed, the diversity of topics that could potentially be included in a nuclear security course means that adopting different teaching methods is essential to the construction of a productive learning environment.

As is the case in the majority of undergraduate and post-graduate courses, lectures will likely form a core element of a course in nuclear security. Although a largely passive activity they are, nevertheless, a resource-efficient way of imparting information to a large group of students and can thus be used to introduce basic concepts and information. These basic concepts and ideas can then be further probed through other, more interactive formats.

In a nuclear security context lecturing can be used as an effective method to introduce any topic although is perhaps best suited to those where it is necessary to convey a significant amount of technical information. Such areas might include: properties of nuclear and radiological materials; the nuclear fuel cycle; effects of radiation; detection of nuclear and radiological material; physical protection technologies; IT/Cyber security; and nuclear forensics.

As highlighted above an instructor should make every effort to stimulate active student engagement during a lecture, through for example, posing a short question or a problem every 15-20 minutes – research indicates that student concentration typically begins to drop at this point. For the aforementioned topics questions might include: naming all fissile and fertile isotopes or radiological sources of most relevance for say a ‘dirty bomb’; identifying the most proliferation sensitive stages of the nuclear fuel cycle; discussing which technologies and systems are most effective at protecting against insider threats; outlining the difference between instrumentation and control (I&C) and information technology (IT) systems; and describing the different families of nuclear forensic techniques.

Building on this, seminars might be used to take forward the information introduced in lectures and explore topics where there are differences of opinion and approach, of which there are many in the area of nuclear security. For example, the seminar approach would be useful for a class on international nuclear security regime. Here the flexible, more informal format would allow students to probe the nature, influence and value of the various formal instruments and informal initiatives that make up the international nuclear security architecture. Furthermore, distilling into a single lecture the key elements of this broad and wide-ranging topic is no easy task and may leave students with a number of questions, which can be tackled more effectively in a seminar.

More generally seminars can be a useful way in which to introduce nuclear security case studies. On the threat side of the nuclear security equation this might include incidences where nuclear or radiological material has been stolen and/or used for malicious purposes, including the sabotage of nuclear facilities. In this context,

instructors should begin by clearly delimiting the parameters of the discussion or analysis. Students might, for example, be asked to identify and assess from the primary source literature key factors such as intent, capability, impact and security system weaknesses.

Nuclear security issues can also be explored in detail through the use of tabletop exercises and simulations and there are number of topics that lend themselves to this format. Tabletop exercises and simulations are used across a variety of sectors for developing a greater understanding of the threat environment through the use of red teaming whereby by participants play the role of the adversaries. In a nuclear context this can be done at a variety of different levels, such as through the design of a hypothetical nuclear facility containing a number of subtle security flaws, for example.

Here students could be tasked with playing the role of internal and external adversaries and devising ways to steal nuclear material and/or sabotage the facility. This approach would allow students to gain an appreciation of the different paths an adversary might take in terms of theft or sabotage, in addition to pinpointing the weaknesses in the existing system. Thinking more broadly, this could form the first part of a wider exercise in which the students would then be tasked with suggesting suitable security upgrades to minimise the aforementioned threats. Datasets for such an exercise have been developed by INSEN and are available for adaptation and use by its members.

At the other end of the spectrum tabletop exercises and simulations can also be used to help foster a detailed understanding of the response to a malicious act involving nuclear or radiological materials. Here students might play the role of government officials, first responders (police, medical personnel, fire fighters etc.), the media and the public immediately following an incident. This might take the form of an evolving scenario where the instructor would introduce a series of interjects as the exercise progresses.

The above paragraphs give some insights into how particular teaching methods might be applied in the context of nuclear security. It is important, to note, however, that these examples give a mere sample of the wide range of teaching strategies, methods and approaches that can be used to support educational efforts in this area. Moreover, many of these methods are complementary and may be used to greater effect in combinations.

Section 4: Assessment, Feedback and Cyclical Learning

Other key elements to consider in the context of nuclear security education and the development of course material (either for incorporation into existing courses or for a stand-alone course) are feedback and assessment.

4.1 The Importance of Feedback

Feedback is recognised as a core part of the educational process. Whether seen as 'external feedback given by tutors making a judgement on students' work, or as internal feedback generated by students as they reflect on their work in relation to a performance goal, feedback is considered essential to the process of learning'.[45]

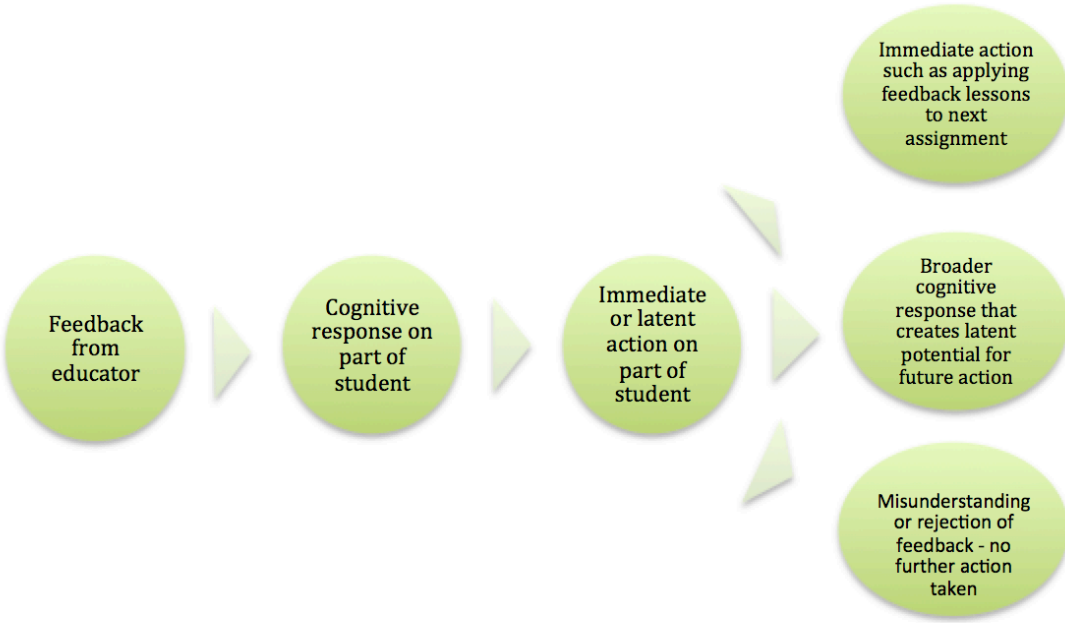
Feedback that is unduly negative or that fails to discuss flaws in a constructive manner can be demoralising and form a major obstacle to student learning and progress. It is therefore important to spend time considering how feedback will be managed in the context of the course being developed. There are also a number of strategies that may be adopted to promote constructive and successful feedback.

Characteristics of successful feedback:

- Feedback should be provided in a timely manner after assessments. This allows students to make links between feedback and assignments while material is fresh in their minds.
- Criticism should be delivered in a constructive manner. A common approach is the 'criticism sandwich': begin by pointing out a positive aspect of the work, follow this with constructive criticism, and finish with a positive comment. Overly negative feedback can leave students disillusioned and undermine motivation.
- Feedback should be clear and accessible. It is important to bear in mind that students are not subject matter experts and need explanations.
- Finally, everything about feedback matters. On a very basic level, for example, whether the feedback is legible/audible can give an indication of the importance accorded to the process by the educator.

The feedback process can provoke a number of different responses on the part of the student, from an immediate and visible response to a longer-term, latent response that manifests itself at a later point. It is important for educators to be aware of this range of responses so that expectations regarding feedback and the extent to which students respond to constructive criticism can be managed. The feedback process incorporating student responses is set out in the chart below:

[45] Margaret Price, Karen Handley and Jill Miller, 'Feedback: Focusing attention on engagement', *Studies in Higher Education* (2011), Vol.36, No.8, p.879.



The manner and format in which feedback will be delivered should be given considerable thought since this will vary according to course learning objectives and teaching methods used. The feedback given to students following a simulation, for example, will likely differ significantly from the feedback provided on an assessed essay. Moreover, as discussed below, the feedback process should be thought of as inextricably linked to the assessment process and course planning should reflect this link.

4.2 Approaching Course Assessment

Assessment forms a core element of any educational course and serves a number of useful functions. First and foremost, assessment serves as a means of judging whether students have met the objectives underpinning the course. This information is invaluable in terms of educators' efforts to refine course curricula. It also allows educators to reflect on the suitability of particular materials, methods and approaches.

Second, assessment can serve as a useful learning tool that provides students with valuable feedback. As mentioned earlier, assessment has traditionally been viewed in terms of a product, a simple test of received information. From a student perspective, this means that assessment is often viewed with apprehension. However, this should not and need not be the case. Under the Instruction Paradigm, assessment is viewed as a *process* rather than a *product.* That is to say, an element of the course that contributes to learning. Crucially, the value and role of assessment

must be explained clearly to the student. This is important if the notion of assessment as a learning tool is to be engaged with.

In planning for assessment, it is important to bear in mind that limiting assessment to any one method or approach may not be beneficial in terms of producing student learning. Where possible, it is preferable to adopt multiple methods since 'using a variety of assessments acknowledges the variety of prior knowledge, cultural experiences, and learning styles that students bring to the classroom'.[46]

Beyond the traditional, final summative assessment approach, assessment can take a number of forms:

Continuous Assessment usually involves a series of discrete assessments undertaken by students throughout the period of study. Such assessment may be formative, summative, or a mixture of both. Current thinking in educational research favours the use of continuous assessment for a number of reasons, not least because it allows the educator to gain insights into student learning in different conditions and across a particular time period. Moreover, continuous assessment 'allows candidates who do not perform well under examination conditions to demonstrate their true ability in a more relaxed atmosphere. [It] can also be used to assess those skills that cannot be measured or assessed in a written examination'.[47] Finally, continuous assessment provides an opportunity for the feedback process to take effect and this can have important developmental benefits for students.

Assessment based on reflective learning techniques aims to promote reflection and engagement with the subject matter on the part of the student. A move away from traditional forms of assessment, methods here might include, for example, a reflective journal in which students record short entries detailing positive and/or negative aspects of particular classes and subjects. This process can provide the educator with insights into what elements of the course students are engaging with as well as contributing to the development of the students' critical thinking abilities.

Peer assessment may be described as a collaborative process whereby students rate the work of their peers and provide feedback. Ideally, the process should be moderated by the class tutor and should take place according to a defined set of criteria designed to guide students in their critique.[48] The process of peer assessment holds many benefits: it promotes deep learning; encourages teacher and peer dialogue around learning, and contributes to the development of critical skills on the part of students. By exposing students to a new perspective (ie that of the

[46] Linda Suskie, *Assessing Student Learning: A Common Sense Guide* (San Francisco: Wiley, 2009), p.39.

[47] Cited in David Pennycuick, 'The introduction of continuous assessment systems at secondary level in developing countries', in Patricia Broadfoot, Roger Murphy and Harry Torrance, *Changing Educational Assessment: International Perspectives and Trends* (Abingdon: Routledge, 1990), p.111.

[48] For a comprehensive study of peer assessment see Meichun Lydia Wen, Chin-Chung Tsai and Chun-Yen Chang, 'Attitudes towards peer assessment: a comparison of the perspectives of pre-service and in-service teachers', *Innovations in Education and Teaching International* (2006), Vol.43, No.1, pp.83-92.

assessor), this form of assessment teaches students to view problems and how they are approached in different ways.

Of course, each of the above forms of assessment brings its own challenges. Continuous assessment, for example, is not best suited to short courses while time constraints may hamper the use of reflective assessment techniques. In this context, it is important to weigh up the benefits and drawbacks of particular methods at the curriculum design stage. On the whole, however, innovations in assessment can contribute to the construction of a more engaged and productive student learning environment.

4.3 Assessment and Feedback for Nuclear Security Courses

Due to the broad range of topics to be covered in a comprehensive nuclear security course there are a wide range of forms of, and approaches to, assessment that could be utilised. Specific types of assessment might include: research essays; dissertations; research projects (laboratory skill and final reports); contribution to in class discussions/tabletop exercises/simulations; and exams. Although their use will be dependent on the available teaching resources and specific assessment requirements of individual universities.

Assessment and feedback assume additional significance in nuclear security education, given the interdisciplinary nature of the subject area. Students in nuclear security come from a range of backgrounds and may be used to particular and differing approaches to feedback and assessment. In this context, there is a strong argument to be made for the use of continuous assessment in nuclear security courses. Continuous assessment, both formative and summative, and the feedback that this brings, allows students to gain insights into how their performance relates to course learning objectives. This approach also allows students to visibly chart their progress and helps them to identify any potential areas of concern. Continuous assessment also holds value for the educator, providing a window into student progress. Progress (or lack thereof) serves as an indicator of how particular teaching approaches and methods are impacting upon the students, both individually and as a group.

In the context of nuclear security, continuous assessment could be implemented through the use of short ‘reading-reactions’ as part of a seminar series, for example. In this approach, students might be divided into small groups, with each group asked to critique the reading for a particular class within a broader seminar series. This critique might then be presented by the group in the form of a brief, collaborative oral presentation. Equally, students might be asked to complete short reaction essays individually, with feedback provided by the instructor.

As discussed in the previous section, tabletop exercises and simulations can be highly effective, albeit time intensive, tools for promoting student learning across a range of nuclear security areas. However, it is important to note that these formats present a challenge for assessment, due to the relative importance of the process as

opposed to the final result. Indeed, in a well-planned simulation there are multiple potential answers, it is not possible to reduce the complexities involved to one 'right answer'. This is not to say that assessment of student activities during a simulation cannot take place; there a number of ways to offset this challenge. Assessment may, for example, be formative rather than summative and may be based on the instructor's observations according to a number of pre-agreed criteria – analytical contribution, communication skills, knowledge of the subject matter, etc.

In terms of summative assessment, individual student reports on decisions taken during the simulation, and their strengths and their weaknesses might serve as a useful means of assessment. This approach can both assess student learning during the simulation (as well as broader subject knowledge) and provide students with an opportunity to reflect on their contribution. As discussed previously, the success of the simulation approach, and assessment in this context, depends heavily on the level of instructor planning and preparation.

Section 5: Establishing a Professional Development Course for Nuclear Security Educators

Due to the broad scope of nuclear security most potential instructors are unlikely to have prior experience of teaching across all topic areas. Consequently, King's College London (KCL) supported by the INSEN network, launched a professional development course (PDC) for nuclear security educators at KCL in 2011 with the aim of increasing future educators' knowledge of major key topics, different teaching and assessment methods for promoting student learning and in supporting them with the design of curricula for new nuclear security courses specific to their own institutes. The below draws on lessons learnt from establishing and running the KCL nuclear security education PDC four times from 2011 to 2014. PDCs in this area have since been launched by Brandenburg University of Technology in Germany and the University of Witwatersrand (WITS) in South Africa, in the latter case in partnership with KCL.

5.1 Course content and structure

The very first step in the process of running a nuclear security education PDC is deciding on the necessary content and how it is to be covered. This can vary depending on whether the aim is to run a introductory course which covers all major aspects of nuclear security but not in great depth (such as the one at KCL) or a more focused course on a specific aspect of nuclear security (such as the one at Brandenberg University on IT/Cyber Security). Here NSS 12 provides a useful guide by outlining suggested sub-modules that might fit within a range of nuclear security courses. Once necessary content has been identified the course must be structured with consideration given to the balance between discussing key content and demonstrating how student learning can be promoted using different teaching and assessment methods. For the KCL course the balance was set at approximately 50/50, due to nuclear security being a relatively new area for the majority of participants. For an audience with a greater experience of working in the area of nuclear security a more appropiate ratio might be 20/80. Once the timetable has been set it is necessary to identify appropiate subject matter experts (SMEs) with teaching experience in each of the topic areas so they can effectively introduce the topics to the participants. Due to the relatively small number of educational courses in nuclear security this will likely be a mix of local and international SMEs drawn from academia, industry, the nuclear regulators and potentially international organisations such as the IAEA. The course outline for the two-week 'Introduction to Nuclear Security Education' PDC run at KCL is provided below:

Week 1

Monday	Tuesday	Wednesday	Thursday	Friday
9:15 - 9:30 Registration	9:00 - 10:30 NR Weapons	9:00 - 10:30 Counter Terrorism	9:00 - 10:30 Nuclear Security Framework (Formal and informal initiatives)	9:00 - 10:30 Participants to start work on assignments
9:30 - 10:00 Welcome & Introduction of course objectives				
10:00 - 10:30 Participant introductions				
10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break
11:00 - 12:30 Overview of Teaching Methods	11:00 - 12:30 Teaching: NR Weapons	11:00 - 12:30 Teaching: Counter Terrorism	11:00 - 12:30 Teaching: Nuclear Security Framework (Formal and informal initiatives)	11:00 - 12:30 UK Policy Round table discussion
12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break
13:30 - 15:00 Nuclear physics and technologies	13:30 - 15:00 Nuclear Threat by NSA	13:30 - 15:00 Assignments for participants (Curriculum Design & Introduction to Moodle Platform)	13:30 - 15:00 Planning Nuclear Security at the State Level	13:30 -14:30 Evaluation, wrap-up & time to work on group assignments
15:00 - 15:30 Break	15:00 - 15:30 Break	15:00 - 15:30 Break	15:00 - 15:30 Break	
15:30 - 17:00 Nuclear Fuel Cycle	15:30 - 17:00 Teaching: Nuclear Threat by NSA	15:30 - 17:00 Cultural Activity	15:30 - 17:00 Teaching: Planning Nuclear Security at the State Level	
Hospitality Event & Keynote Speaker				

Week 2

Monday	Tuesday	Wednesday	Thursday	Friday
8:45-9.00 Registration	9:00-10:30 Interrelationship between Safety, Security and Safeguards	9:00 - 10:30 Information Security	9:00 - 10:30 UK Nuclear Site Visit	9:00 -10:30 Security Culture - Concept and Model
9:00 - 9:15 Welcome and objectives				
9:15 - 10:30 Student presentations on individual assignments				
10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break	10:30 - 11:00 Coffee Break
11:00 - 12:30 Planning NS at the Facility Level	11:00 - 12:30 Teaching: Interrelationship between Safety, Security and Safeguards	11:00 - 12:30 Information Security	11:00 - 12:30 UK Nuclear Site Visit	11:00-12:30 Teaching: Security Culture - Concept and Model
12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break	12:30 - 13:30 Lunch Break
13:30 - 15:00 Teaching: Planning NS at the Facility Level	13:30 - 15:00 Transport security	13:30 - 15:00 Detection of unauthorised acts involving nuclear/radiological materials	13:30 - 15:00 Time to further refine course curriculum	13:30 - 15:00 Final Assignments, Evaluation and Wrap up
15:00 - 15:30 Break	15:00 - 15:30 Break	15:00 - 15:30 Break	15:00 - 15:30 Break	
15:30 - 17:00 Group presentations (1st half)	15:30 - 17:00 Teaching: Transport security	15:30 - 17:00 Teaching: Teaching: Detection of unauthorised acts involving nuclear/radiological materials	15:30 - 17:00 Group Presentations (2nd half)	
Hospitality Event & Keynote Speaker				

Due to the diversity of areas to be covered in an introductory course it was decided to have a dedicated session discussing and/or demonstrating different teaching/assessment methods after the delivery of substantive content for each nuclear security topic. In a more focused course it might make sense to have fewer but longer sessions that discussing teaching/assessment approaches across multiple topics.

One of the major goals of the PDC is to directly assist participants in designing their own courses in nuclear security. The major steps/processes for curriculum design were outlined during day one of the PDC. Participants were given time during weeks one and two to work either individually or in small groups under the guidance of the SMEs that have experience in developing academic courses in nuclear. Given the considerable time it takes to develop a detailed course outline participants were

tasked with taking this forward during the break (typically two months) between workshops and were incentivised to take this seriously by being required to deliver a presentation on their progress when they returned for week two of the PDC, at which point they were given further feedback by the SMEs and time later in the week to refine their curriculum.

Two other key parts of the PDC were the 'Policy Round Table' and the nuclear site visit. The first of these built on the international nuclear security regime session by focusing on nuclear security issues in the context of the Nuclear Security Summit Process. Here UK civil servants, responsible for formulating and implementing nuclear security policy, were asked to provide a short presentation on current priorities before moving into an interactive question and answer session. The site visit provided participants, many of whom had never been to a nuclear site, with an important practical perspective on the various issues discussed during the PDC.

5.2 Administrative process

Due consideration to the administrative aspects of a PDC involving international SMEs and participants and diverse activities including classroom sessions, site and cultural visits and hosted receptions/meals is essential to ensuring its success. In general terms administrative processes can be broken down into six basic steps:

5.2.1 Finances and projected costs

The breakdown and allocation of the PDC budget is one of the first administrative tasks that should be undertaken and will likely include the following items:

- International travel
- Domestic travel
- Venue hire
- Equipment hire (if applicable)
- Catering/refreshments and incidentals
- Admin (banners, folders, name badges)
- Lecturer, Course Organiser, Course Director and Course Coordinator fees (if applicable)
- Accommodation
- Ground transport
- Food expenses for lecturers/funded participants
- Site visit/excursion

Here it may be useful to add 10% to projected budget totals at the end of your calculations to be prepared for any travel cancelations, extra accommodation bookings or last minute changes. It is best to update the budget as you go and add in easy to use and understandable formulas.

5.2.2 Setting dates and publicising the course

The course dates should be set well in advance of the PDC and in the case of the KCL PDC should take place over two or more non-consecutive weeks in order to allow participants time to complete their assignments. Ideally this would be out of term time for the organising institutes with consideration given to the teaching commitments of potential SMEs and participants, although this can vary considerably for institutes in different countries. Once the dates have been set, a flyer for the course should be sent out to appropiate forums in order to advertise the course several months in advance of the scheduled start date. Fora for the promotion of the course should include INSEN and other international, regional and local nuclear education networks. A sample flyer from the KCL course is provided below:

Professional Development Course: Introduction to Nuclear Security

International Nuclear Security Education Network (INSEN) Workshop

The Centre for Science and Security (CSSS) in partnership with the International Atomic Energy Agency (IAEA) and its International Nuclear Security Educational Network (INSEN) will hold a Professional Development Course on Nuclear Security Education in 2013, which will consist of two workshop sessions and distance learning via the IAEA The course is modelled on the 'NS1 Introduction to Nuclear Security' module from the IAEA No 12 Educational Programme in Nuclear Security. The course is intended for faculty members from universities and research institutions planning to launch educational courses in nuclear security.

Subsistence and travel costs for participants will be covered by the IAEA.

The workshops will cover a variety of topics, ranging from basic nuclear physics to emerging threats from non-state actors. Sessions will be led by nuclear security experts and are intended to be highly interactive. The programme also includes a field trip to the UK's Springfields Fuel Fabrication Facility and a policy round table discussion involving relevant UK government departments.

Important Details:

Venue: King's College London & UCLAN, UK

1st Session: 23rd of September to 27th of September 2013

2nd Session: 6th of January to 10th of January 2014

First Workshop Programme:
- Nuclear Physics and Technologies
- Nuclear Fuel Cycle
- CBRN Weapons
- Nuclear Threats by NSA
- Counter Terrorism
- Nuclear Security Framework
- Teaching Methods
- Nuclear Security at the State Level

Second Workshop Programme:
- Safety, Security and Safeguards
- Planning Nuclear Security at the Facility Level
- Transport Security
- Detection of unauthorized acts
- Information Security
- Security Culture Concept and Models

About the CSSS

CSSS is a multi-disciplinary research group which brings together scientific experts with specialists in politics, international relations and history. CSSS conduct scholarly and policy-relevant research on weapons proliferation, non-proliferation, verification and disarmament and mass effect terrorism including the CBRN and runs two MA programmes 'Science and Security Studies' and 'Non-Proliferation and International Security

About INSEN

INSEN is a partnership between the IAEA and educational/research institutions, ensuring sustainable nuclear security education. Its goal is to enhance global security by developing and promoting excellence in nuclear security education through: the development of peer-reviewed textbooks, computer based teaching tools and instructional material; faculty assignment and development in the different areas of nuclear security; and outreach and promotion to industry.

CVs and nuclear security education plans should be requested from potential participants in order to assess who is most appropiate for selection, accompanied by a letter of support from their Head of Department/Section in order to ensure that there is a long term commitment to nuclear security education at their institution. Once these are received they should be organised with key information extracted into a file, such as an Excel spread sheet, so that participants can be assessed relative to one another. Typical information includes:

- Title
- Name
- Organisation
- Role and plan for nuclear security education
- Email address
- Tel number
- Passport/ID numbers

5.2.3 Recruiting participants

There is no one way to select participants for a PDC, for the case of KCL we decided to select individuals, where possible, from a range of backgrounds (technical and policy), geographical locations and levels of experience (emerging and established professionals) in order to ensure a group that could contribute a wide range of perspectives. Once participants are selected a letter of acceptance should be sent to them, which can also serve as a letter of support for those who are applying for a travel visa, see below for a blank sample letter:

KING'S College LONDON
University of London

Re: Nuclear Security Education Professional Development Course

DATE

This is to certify that XXXX

Organization:
Passport or ID number:
Date of Birth:
Place of Birth:
Date of Issue:
Date of Expiration:

is invited to the KCL professional development course (PDC) on nuclear security culture and information security, with workshops from the XXXX to the XXXX and the XXXX to the XXXX of XXXX. XXXX who is administrating the PDC will be in touch shortly with logistical details and background reading and other materials will be sent out a week before the start of the workshop.

Yours sincerely,

Dr Christopher Hobbs
Centre for Science and Security Studies (CSSS)
Department of War Studies
King's College London, UK

Once these letters have been sent, in the lead-up to the PDC, the course administrator will need to liaise with the participants regarding logistics, travel and accommodation.

5.2.4 Selecting the venue

Once participants have been selected an appropiate venue should be reserved in which to host the course to ensure that it creates a positive environment for the participants and the lecturers, in terms of quality, functionality, space, access, comfort and location. This may involve viewing the venue before booking it or requesting pictures if the course is taking place outside the usual teaching environment or abroad.

The venue must have good AV facilities with a projector, extension cable and good light as well as comfortable seating and enough space to move around and stand during breaks. It may also be useful to book one or more break out room depending on the various exercises that are to be attempted. Depending on the venue's policy, this breakout room could also be used to serve the lunch or refreshments during breaks. If a hotel is chosen at the venue it may be a good idea to accommodate participants and lecturers in the same hotel to decrease travelling costs and time. Do check the hotel policy and flexibility on cancelations and late minute bookings. Check on payment requirements with the hotel and ask for an invoice before arrival to avoid any guests being asked to pay for their rooms (for a fully-funded course). Some guests may be driving so it may prove useful to check that the hotel has parking and can provide parking vouchers. If the hotel or conference venue provides a shuttle service or car service to and from the airport or train station, it may be useful to use this service and request that the costs be added to the final invoice.

It is important to arrange catering with the venue early on so that they are able to cater for a large group. Always check dietary requirements with the delegates once you have finalised your participant list.

5.2.5 Setting up the PDC e-learning platform

In organising and delivering the KCL PDC the Moodle e-learning platform offered by the IAEA through their LMS system was utilised. This was used to share the presentations (avoiding printing costs) and served as a forum through which participants and instructors could communicate and comment on the completed course assignments.

<u>What is Moodle?</u>
Moodle is a free software e-learning platform used by thousands of universities and colleges around the world. Some free Moodle hosting providers allow educators to create Moodle-based online classes without installation or server knowledge. Some paid Moodle hosting providers also provide value-added services like customisation and content development.

Registering and organising your Moodle Course

Once you have your list of delegate names and email addresses you should send this to your Moodle developer (in the case of KCL the IAEA) so that they are able to create the course on the platform. You may be able to do this yourself, depending on which version of Moodle you have opted to use. Instructors and participants should then receive an email with log in details once the course has been created.

Before you begin to add resources and activities to a new Moodle course, it is advisable to make some decisions about the structure and the layout of your Moodle course. You can organise your course chronologically by week, by topics or around a discussion forum.

Moodle has a summary setting that allows you to provide a brief description of the course. We have found that organising the course by week and topic is the most effective method allowing you to add resources/presentations under each relevant topic and section. Under each section there is an edit icon that can be used to write a summary. This section can also be used to introduce students to the course.

Adding, moving, hiding and deleting blocks

Blocks are the separate squares in the left and right columns of the Moodle course. These Blocks can be moved around, hidden from students view and deleted. Other Blocks can also be added with the Blocks tool, which will become visible at the bottom of the right column when you turn editing on.

5.2.7 Certificates

Following the second week of the course certificates of completion should be awarded to participants, assuming they have attended all sessions and completed their assignments. In the case of KCL these carried an official university logo and were signed by the course director. These were presented to the students on the last day of the course and serve to certify the authenticity of the course and the participants attendance on it.

5.2.8 Overseeing the course

Below is a list of key jobs to be performed directly before, during and after the course in order to ensure that the course runs smoothly.

Before the Course

- Send learners confirmation of their place on the course with basic details- dates, venue, address, meeting point, start and finish times.
- Provide a telephone number to delegates in case of emergencies before the start of the course.

During the Course

- Ensure that the venue is ready for the delegates arrival on each day of the course and that all the equipment and AV is set up and working properly.
- Ensure the conference room is locked when delegates leave the room to avoid personal belongings going missing.
- Bring a USB stick with you each day in case a lecturer has not sent their presentation through before their teaching slot. By doing this, you are also able to upload the presentation onto Moodle during the lecture for all students to access.
- Welcome the delegates, along with the Course Director and Course Coordinator each day and try to be present before the start time.
- The Course Coordinator should act as the main point of contact for participants throughout the course and assist them with any questions about the logistics of the venue, Moodle and the course agenda.

After the Course

- Give out certificates of attendance (on last day of the course or by mail)
- Pay the venue (if you haven't already done so)
- Pay lecturer and organisers expense claims (taxis, food etc.)
- Remember to evidence all transactions with invoices and receipts.
- Finalise budget

5.2.7 Specific roles for the organising team

In accomplishing the above tasks it may make sense to divide them between a Course Director and a Course Coordinator/Administrator. In running the KCL PDC duties were split as follows:

Course Director:

- Develops the course timetable and content
- Chooses appropiate SMEs and participants
- Decides location, dates and venue for the course
- Responsible for all the delivery and technical aspects of the course including quality of SMEs and sessions
    - Making sure all SMEs are aware of the aims of the course and have developed their presentations to reflect this by reviewing all presentations before they are delivered to the class
- Attends every course session, introducing topics and SMEs
- Responsible (in collaboration with the SMEs) for assessing the participants assignments

Course Coordinator/Administrator:

- Responsible for overseeing the effective organisation and management of the course and supporting the Course Director with all aspects of the course
- Sending out course invitations
- Collating CV's of interested participants and sending to Course Director
- Sending out course invites to selected participants
- Booking flights for international SMEs and participants
- Booking the venue and ensuring that all the necessary equipment and facilities are provided
- Keeping an up to date budget
- Keeping relevant receipts and invoices for payments or expense reimbursement (if applicable)
- Updating the online resources on Moodle
- Arranging catering at the venue
- Arranging name badges, course folders and a banner for advertising and guiding participants on arrival
- Organising parking at the venue and sending directions to participants before the commencement of the course
- Collating lecture presentations before the start of the course to add them to Moodle

5.2.8. Overview of Administration Process

Here is a breakdown of the steps involved in organising a course.

Task	**When**
Calculate the costs	Before the start/at least 3 months before the start
Set the dates	As soon as possible, 2/3 months before the start date
Book the venue and catering	1/2 months before the start date
Send out flyer/advertise course	1/2 moths before the start date
Recruit learners and send out invitation letters	1/2 months before the start date
Create course on Moodle /add presentations	1 month before the start date
Book travel and Accommodation (if applicable)	1 month before the start date
Ensure venue is ready to use/equipment is set up	Day before (earlier if possible)
Welcome, course delivery, course wrap up, handing out of certificates to delegates and updating Moodle each day	During the course/last day of the course

Course Director /lecturers to mark assignments	After deadline/before second part of the course
Reimburse expenses, give out certificates, pay venue and finalise budget	After course

Annex 1: Sample Course Evaluation Form

As part of our efforts to improve this course, we would appreciate your feedback on the module. Please tick the box that best represents to your views. Any additional comments can be added in the spaces to the right. All feedback is anonymous

Course Title: *Date*:

	Additional Comments
1. The learning objectives of the course were achieved. Strongly agree ☐ ☐ ☐ ☐ ☐ Disagree strongly	
2. Classes were generally well-prepared and organised Strongly agree ☐ ☐ ☐ ☐ ☐ Disagree strongly	
3. The lecturer was helpful and approachable Strongly agree ☐ ☐ ☐ ☐ ☐ Disagree strongly	
4. The pace of the module was Far too slow ☐ ☐ ☐ ☐ ☐ Far too fast	
5. The course work was Far too easy ☐ ☐ ☐ ☐ ☐ Far too difficult	
6. The amount of course work required was Far too little ☐ ☐ ☐ ☐ ☐ Far too much	
7. Feedback on progress was Excellent ☐ ☐ ☐ ☐ ☐ Non-existent	

8. Library resources were Excellent ☐ ☐ ☐ ☐ ☐ Extremely poor	
9. IT resources were Excellent ☐ ☐ ☐ ☐ ☐ Extremely poor	
10. Overall, the module was Very interesting ☐ ☐ ☐ ☐ ☐ Extremely boring	

Please use the space below to expand on any of your comments, or to add any other observations you think would be useful.

Your feedback is very useful, thank you for your co-operation