



# SCALE-UP Handbook

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## About this guide

This guide is to support NTU colleagues who are interested in SCALE-UP.

You might be:

- Teaching in a SCALE-UP room for the first time;
- An experienced SCALE-UP tutor who would like some useful ideas or reminders of key principles of the approach;
- Interested to learn more about how SCALE-UP works (perhaps with a view to joining the SCALE-UP community in the future);
- Interested in adapting some of the transferable principles and practices for use in a regular (GPT) teaching environment;
- Managing or supporting a colleague who is using SCALE-UP.

This guide includes pedagogical guidance and practical information about learning spaces, equipment and tools.

Centre for Academic Development and  
Quality

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## Introduction to SCALE-UP

SCALE-UP—Student-Centred Active Learning Environment with Upside-down Pedagogies—is an active mode of learning which offers an alternative to traditional lectures. In a SCALE-UP class, rather than predominately listening to their lecturers, students learn through solving problems, sharing ideas, giving and receiving feedback, and teaching each other.

SCALE-UP was originally developed by Robert Beichner, Professor of Physics at North Carolina State University (NCSU). In the mid-2000s, Beichner and his colleagues began experimenting with a hands-on approach to learning that dissolved barriers between theory and practice. Their aim was to develop a model of teaching that could improve students' conceptual understanding more effectively than a 'traditional' model of separate lectures and seminars/labs (Beichner *et al* 2007). Over several years, they explored and evaluated how changes to the physical classroom environment can work in tandem with active learning pedagogies to promote engagement and deep learning, gradually refining their model into the distinctive SCALE-UP approach.<sup>1</sup> The model has since been adopted globally in a wide variety of disciplines.

In SCALE-UP, lectures are replaced by problem-solving and enquiry-based activities carried out in strategically-assigned groups. To foster collaborative learning, the re-designed classroom environment incorporates bespoke circular tables, shared laptops, and mirroring technology for students to share their work with the class. Flipcharts and whiteboards function as additional Public Thinking Spaces (Beichner 2014). These physical aspects are supported by a threefold 'upside-down pedagogy' comprising 'backwards design'—the curriculum is designed 'backwards' from the learning outcomes; 'students as teachers'; and flipped learning, where 'content' may be encountered outside class and sessions are devoted to applying ideas. The shift away from lectures frees up class time for students to focus on difficult aspects of the material, to work at their own pace, and to receive on-the-spot feedback on their work from peers and the tutor.



<sup>1</sup> To watch a video introducing Professor Beichner's work on SCALE-UP, click here: <https://youtu.be/MdymI61hLPY?list=PLE8C54256779B374D>

### **A SCALE-UP session**

While there is no 'typical class', interactivity is a key feature of SCALE-UP learning. A SCALE-UP session is likely to involve students working on tasks together; groups assisting or giving feedback to other groups; and teams presenting their work to others. Tutors will be interacting at different times with individuals, small and large groups, and with the class as a whole. There will be many discussions, questions and debates, often going on simultaneously and creating a buzz in the room.

This TiPS (Teaching in Practice Series) video from a Social Work and Professional Practice module shows a lively SCALE-UP class in progress:

<http://bit.ly/1ITxqDr>

### **Benefits of SCALE-UP**

SCALE-UP has many benefits for student learning, as demonstrated through evaluation by Beichner and other SCALE-UP adopters (Beichner 2014). Generating a range of data on many cohorts at NCSU (N=16,000), Beichner was able to document improvements in both student engagement and achievement. In particular, Beichner *et al* (2007) reported the following benefits:

- Conceptual understanding increased
- Ability to solve problems improved
- Attitudes and attendance improved
- Failure rates were significantly reduced
- "At-risk" students did better in later modules

While SCALE-UP was originally designed to enhance teaching and student engagement in large groups, it has been found to work equally well with smaller class sizes (CADQ 2013).

### **SCALE-UP at NTU: staff and student responses**

NTU is the first UK university to introduce SCALE-UP across an extensive range of subjects. In 2013-14, thirty-three module leads from diverse disciplines including Physics, Sociology, Marketing, and Law volunteered to pilot SCALE-UP teaching in bespoke rooms in the Boots and Clifton libraries. Some module leaders chose to adopt SCALE-UP pedagogy across the whole module, while others opted to start smaller, initially targeting specific aspects of their modules which they felt would adapt easily to and benefit from the approach. The following year, over fifty modules— involving twenty-six discrete subjects across seven Schools—adopted SCALE-UP.

In an evaluation of the NTU SCALE-UP pilot modules in 2013-14 (CADQ 2013), teaching staff reported greater student engagement with materials and more interaction between peers and the tutor, leading to increased conceptual understanding.

SCALE-UP also seems to have impacted positively on student grades: one tutor commented, “the work of the students [has] improved through a combination of flipped learning strategies and the group work enabled through the SCALE-UP environment.” Both tutors and students felt that the regular collaborative activities had improved problem solving ability and teamwork skills. EvaSys scores—showing a mean of 4.37 out of 5—indicated a high level of student satisfaction with modules (CADQ 2013).

*“[Students] understand the concepts more..., they have a broader knowledge of issues than they would have had, had I put things in the lecture slides and talked through it.”*

*NTU SCALE-UP tutor*

A further benefit, as with any active learning approach, is that SCALE-UP offers regular opportunities for tutors to monitor learning and understanding, observe progress, and identify and address difficulties as they arise.

Following the overwhelmingly positive response to the NTU pilot, and increased demand among teaching staff, the University has invested in additional bespoke teaching rooms to allow more students and academics access to the benefits of SCALE-UP. Sector interest in SCALE-UP has been considerable and we have promoted the approach widely, for example through invited keynotes at interested institutions and a national SCALE-UP conference, which NTU hosted in 2014.<sup>2</sup>

*Table 1 Findings from NCSU and NTU SCALE-UP evaluations*

Aspect	NCSU	NTU pilot modules
Problem-solving	Improved	Positive signs
Conceptual understanding	Improved	Improved
Expectations	Improved	Students largely positive; Module satisfaction high
Attendance	Improved	No effect
Failure rates	Significantly reduced	Inconclusive on failure; Positive impact on grades

(Beichner *et al* 2007; CADQ 2013)

<sup>2</sup> Details of NTU SCALE-UP rooms can be found on the CADQ web pages:

<http://bit.ly/1L8HTAp>.

Materials from the SCALE-UP UK conference can be found here: <http://bit.ly/1YU8Iye>.

## Inside the SCALE-UP classroom

A SCALE-UP classroom incorporates features specifically designed to promote active, collaborative and problem-based/enquiry-based learning. These features include a range of digital and non-digital equipment. While furniture and equipment in a SCALE-UP classroom are carefully calibrated to maximise student interaction, it should be noted that a number of principles and practices described in this guide—for example, those associated with flipped learning or group work—can be applied in other teaching spaces, including lecture theatres.



Boots Library SCALE-UP room

Beichner (2007) notes that the most important piece of technology in the SCALE-UP room is the round table, which naturally facilitates interaction and enables collaborative group learning. After experimenting with different shapes and sizes, Beichner found that seven foot round tables are optimal: these provide students with sufficient space to work without being so large as to hinder group discussion. Circulation space between tables is also vital, as this facilitates tutors' access to groups working on activities. Beichner and his colleagues (Gaffney *et al* 2008), as well as several NTU SCALE-UP tutors, have found that the studio-like—or even restaurant-like—environment created by these round tables generates a more relaxed atmosphere which seems to contribute positively to SCALE-UP's social learning ethos:

*“One of the strongest reasons that students give for preferring a SCALE-UP class is the ability to work and get to know each other in the class.”*

*Beichner et al 2007, p. 28*

In addition to the round tables, several other digital and non-digital technologies help students to work together, engage in discussions, share their work and receive feedback from peers and the tutor. These include:

- A MacBook or laptop for every group of three students
- Portable whiteboards for student group work
- Multiple data projector screens in larger rooms to allow viewing from anywhere in the room
- Mirroring software such as Apple TV or Miracast for sharing student work from individual MacBooks/laptops on data projector screens

- Microphones in rooms with 70+ capacities: a lapel mic for tutors and a roving mic to facilitate student questions, presentations and feedback.

At NTU we have been experimenting with and refining this model; individual SCALE-UP rooms therefore have differing capacities and IT operating systems. Details can be found on the CADQ web pages.<sup>3</sup>



Clifton Library SCALE-UP room before and after renovation

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<sup>3</sup> For more details regarding all the NTU SCALE-UP teaching rooms, please visit: <http://bit.ly/1LS2SrN>.

## Learning design for SCALE-UP

SCALE-UP can offer excellent opportunities to energise and transform student learning, particularly for academics seeking a viable and interesting alternative to lecturing. Indeed, its teaching philosophy was the most commonly cited motivation among NTU teaching staff for adopting SCALE-UP during the pilot year (CADQ 2013). In order to benefit from the SCALE-UP setting, many of these tutors went through a process of module re-design to promote active learning. Several noted that preparing to teach using SCALE-UP took longer than usual as it required the rethinking of module content and a re-design of several activities and resources. Module leads interviewed for the NTU pilot evaluation found this initial investment worthwhile and felt that the process itself was hugely rewarding.

The sections below outline in more detail four key aspects of learning design for SCALE-UP: 'backward' curriculum design, student-centred design, flipped learning, and collaborative in-class activities. A tabular resource to help module leads think through some of the details of module design for SCALE-UP can be found in [Appendix B](#).

### **'Backward' curriculum design**

NTU SCALE-UP module leads reported that before embarking on any curricular re-design it was important to have a clear sense of what they aimed to achieve by switching to the SCALE-UP approach. For many, the aims included creating a curriculum that supports the learning outcomes for the module or course. This echoes the original motivation that led Beichner and colleagues to develop SCALE-UP, namely: to promote students' understanding of the subject and to cultivate related practical skills. Adapting Wiggins and McTighe's (2005) 'backwards design' model, Beichner identified Performance Outcomes (similar to learning outcomes) and worked back from those—deciding how each should be evidenced in student learning—to create assessment tasks. From those, he then worked back again to design learning activities which practised and developed the requisite skills and understanding. This 'backwards' view of the curriculum can be a useful way of thinking about constructive alignment (as described by Biggs and Tang 2007) and can be employed in any module, SCALE-UP or not.<sup>4</sup>

An example of detail for Beichner's Performance Outcome 'students should develop expert-like problem-solving skills' is provided here:

*Students should begin developing expert-like problem solving skills. They should be able to:*

*A. satisfactorily solve standard textbook exercises*

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<sup>4</sup> For support with constructive alignment in general, see CPLD resource Principles of Course Design on NOW in the learning room *Teaching and Supporting Learning*.

B. apply all or part(s) of the GOAL expert problem-solving protocol (Gather information; Organize your approach; Analyse the problem; Learn from your efforts) in any context

C. solve more challenging problems, including:

1. context-rich ("Real World") problems
2. estimation problems
3. multi-step problems
4. multi-concept problems
5. problems requiring qualitative reasoning

D. evaluate other people's written solutions and solution plans

**Example of Performance Outcomes (Beichner)**

Chapter 22 Patterns of Field in Space	
2	<b>Define</b> electric flux, both in words and with a mathematical expression.
	<b>Articulate</b> the role of each of the following: direction of electric field with respect to the outward-going normal, the magnitude of the electric field, and the surface area.
3	<b>State</b> Gauss's Law
	<b>Explain</b> the role of a Gaussian surface evaluating Gauss's Law.
4	<b>Identify</b> and <b>explain</b> specific situations where Gauss's Law can be useful (an where it is not helpful)
	<b>Use</b> Gauss's Law to find the electric field due to a point charge
	<b>Use</b> Gauss's Law to find the electric field due to a uniformly charged plate, sphere, or cylinder.

Beichner then mapped more detailed Performance Outcomes to each segment of the Physics module, to enumerate exactly what students are expected to do by the completion of each learning segment. An example of this more detailed breakdown is given for the module segment 'Patterns of field in space'. Each outcome uses a specific verb, to indicate what is expected of students. These verbs also suggest the kinds of activity students will engage in during teaching sessions, for self-study, and for their assessment. For full details of this example from Physics at NCSU, see Beichner's PowerPoint (no date) *Developing Learning Activities*.

It is not usually necessary to develop new module learning outcomes for SCALE-UP. Rather, as this approach promotes active learning through a collaborative, enquiry-based approach, it may offer creative ways to help students meet existing learning outcomes, particularly those involving problem-solving, teamwork, and practical skills, as well as those related to demonstrating knowledge and understanding. Several tutors at NTU have reported finding it easier to measure students' achievement of existing learning outcomes through the SCALE-UP approach. Furthermore, SCALE-

UP's emphasis on practical in-class work allows tutors to check on student learning and progress in every session on the module, rather than waiting for (summative) assessment points when it may be too late to address misconceptions or skills gaps.

### **Student-centred design**

When designing a SCALE-UP curriculum, it is helpful to take into consideration how students' background and prior experience might affect their expectations and the way they experience learning in the SCALE-UP model. Both Beichner and NTU SCALE-UP tutors have emphasised the importance of knowing one's students when planning SCALE-UP teaching.

#### ***Students' background***

In his work on design for learning, Graham Gibbs (2003) suggests several factors which learning designers will find useful to think through, including students' demographic and educational background, and their level of study. Some comments are provided below to suggest how the factors identified by Gibbs might apply to learning design in a SCALE-UP context:

- **Students' demographic and educational background:** In SCALE-UP, the need to consider students' diverse starting points might be greater than for other approaches to learning and teaching. Students from different educational backgrounds will likely have vastly differing experiences of active learning, collaborative learning, flipped learning and technology enhanced learning. For example, some prior knowledge of students' technological capabilities can help shape decisions around task design, framing, level of difficulty, and scaffolding. Cultural factors may also come into play: for example, international students from some cultures might find the collaborative approach to learning challenging as it disrupts the notion of the tutor as the sole authority figure.
- **Level of study:** The level of study at which a SCALE-UP module sits is a crucial factor to consider as it relates to students' expectations and prior experience of active, collaborative and flipped learning at NTU or elsewhere. Tutor and student feedback at NTU indicates that students are likely to be more open to this new approach in Level 4 and Level 5 rather than Level 6. At any level, it is helpful to design activities with very careful consideration of students' prior experience of active, collaborative and flipped learning, and, where possible, to incorporate elements which will feel familiar to them.

#### ***Cohort size***

Cohort size is another important factor to consider in SCALE-UP planning. While SCALE-UP is designed to engage large cohorts in active learning, it is not intentionally designed for teaching more students with fewer staff. It is intended as a more effective use of resources, rather than a use of

fewer resources. The ideal ratio of staff to students is comparable to that of a typical seminar group or practical session (Beichner 2007). Where the group is larger than thirty, two approaches appear to be effective: team teaching and cohort splitting.

In team teaching, more than one tutor is present in the room. All tutors circulate to facilitate discussion and to provide students with timely feedback. Tutors at NTU have found that one tutor per four tables of nine is the maximum number viable to support group work effectively. Where team teaching is not practicable, colleagues have found it useful to divide the cohort into smaller classes and repeat sessions with different groups. Due to the dynamic nature of SCALE-UP classes, it is likely that the 'same' session will feel different and interesting to the teacher even in multiple iterations. Both these solutions may have implications for timetabling and tutor time allocation which will need to be discussed with Academic Team Leaders.

### **Flipped learning**



Students in a SCALE-UP class learn largely inductively, carrying out carefully-designed group activities through which they construct knowledge for themselves, with the tutor acting as facilitator and guide. For colleagues used to teaching via extended lectures, this may mean finding new ways of introducing 'content' to students. Many SCALE-UP tutors integrate a flipped approach, curating resources for students to engage with outside class. Flipped learning—a term popularised by Bergmann and Sams (2012)—'flips' the traditional lecture-homework model in that lecture content is covered outside class and activities previously set for self-study are now carried out in class. For Beichner, flipped learning is a key element of 'upside-down pedagogies'. Moving 'content delivery' out of class frees up the in-session contact time for the more challenging activities of collaborative investigation, application and creation. In addition, the use of online resources—such as videos and interactive quizzes—can encourage students to engage with content in ways which are not possible in a lecture.

## **Content chunking**

When moving to a SCALE-UP approach, module leads may need to devote some time and thought to how content is currently transmitted and how best to transmit it in a flipped format. Beichner (2007) and other flipped learning practitioners advise against replacing an in-person lecture with a full-length online video lecture, both for reasons of practicality (Lancaster 2014) and because students tend not to engage with lengthy

videos outside class (Morris and Chikwa 2013). Instead, they suggest dividing content into shorter segments, sometimes known as 'chunks', and making these available online. The use of 'chunks' can promote student engagement and can encourage depth over breadth of learning.

Many content elements lend themselves well to 'chunking'. Examples will depend on the subject, but might include: explanation of a key concept; lecturer's insights into a particular topic; new or additional knowledge to supplement text book content; addressing a common misconception about the material; answering a frequently-asked question; pointing out a likely common error in a forthcoming piece of work; recapping key information; demonstrating a technique; performing a calculation, and so on. These can be provided in a variety of formats—short videos, podcasts and excerpted readings and have been shown to work particularly well.<sup>5</sup> Ten-minute mini-lectures, delivered in class at relevant points between activities, can also function as effective content chunks.

*"Think about what you want your students to know, and work backwards from there when planning your content. It's much better to have a few short, succinct videos that explain concepts clearly than long, meandering videos that may be intimidating to students."*

*Flipped Institute no date*

### **Example of content chunking**

Simon Lancaster's approach brings together concept chunking and student-authored content (Lancaster 2014). His students use screencasting software to create 'vignettes', each one explaining a key point from the module. Students have the opportunity to provide and act on peer feedback to improve their vignettes. At the end of the module, the vignettes are all available to the whole class and function as a revision aid for exam preparation.

A Prezi with example vignettes for a Chemistry module can be viewed at this link: <http://bit.ly/1NR84Oq>

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<sup>5</sup> The Flipped Institute has some useful guides on creating learning videos: <http://flippedinstitute.org/files/practical-guide.pdf>.

### ***Encouraging student engagement with out-of-class work***

Technologies used for flipped learning can enable students to take ownership of their learning: for example, they can access online materials at their convenience and re-visit them as many times as they need to. With audio and video materials, they can also pause, rewind, fast-forward and review at their own pace. However, as Bergmann and Sams (2012) point out, simply making content available online is not enough to ensure that students will engage with it. At a minimum, some discussion and prompted reflection around the advantages of online content for learners may encourage them to engage. Setting preparation activities can also promote student engagement with out-of-class materials. A question to answer or short task can help focus students' response to materials. A pre-class online quiz, where students can check for themselves how well they have understood the content, is often popular with students as well as useful for tutors to check student learning.

Clear links between pre-session and in-session activities are a vital element of effective flipped learning. A brief peer discussion of questions relating to preparatory materials can help re-engage students with the content at the start of a session. Clicker quizzes are another method for in-class warmer activities which link to pre-class preparation materials. Colleagues at NTU also recommend putting some thought into how in-session activities will work if some students have not undertaken the preparatory work. There may be good opportunities here to incorporate some peer teaching: having students explain concepts and activities to each other can help them identify and fill gaps in their own understanding in a low-risk setting.

Clarity of instructions and expectations can also contribute to encouraging student engagement with out-of-class materials and tasks, as can explicit links to assessment. The example from an NTU Law module provided here shows students clearly what is expected of them before and during each session.

### **Example of student preparation tasks—Law**

An outline of each workshop is provided on NOW, which students are able to see before their first SCALE-UP session. This outline clearly indicates to students what preparation they are required to carry out in order to participate meaningfully in the workshop activities. They can also see how the tasks relate to specific Module Learning Outcomes.

*Table 2 A snapshot of a Law module's session outline*

<b>Workshop</b>	<b>Intended learning outcomes</b>	<b>Activities</b>
NTU wk 10 Introduction to Trusts	1,2,4,5,9	<u>Preparation</u> Watch AV presentations in NOW Required reading: <ul style="list-style-type: none"> <li>• Guidance text introduction</li> <li>• The Earl of Oxford's case in Chancery (1615) 21 ER 485 (via Westlaw for full text)</li> </ul> Diagnostic assessment: <ul style="list-style-type: none"> <li>• Complete online MCQs to test understanding of concepts</li> </ul>
		<u>Workshop</u> Registration Learning outcomes and overview of sessions
	1,2,3,5,9	<u>Activity 1: Hunt the Trust</u> Activity to identify a range of trusts in Lexport
	1,2,4,5,8-11	<u>Activity 2: Modern Use of Trusts</u> Research an allocated trust from Activity 1 and present oral report

In this TiPS video, Pamela Henderson (from Law) describes her own flipped learning strategies: <http://bit.ly/1PiBlip>

[Appendix C](#) contains some example of tools and applications which may be useful to support flipped learning. More ideas on flipped learning in higher education, including how to engage students with online materials, are collected on this Scoop.it site: [www.scoop.it/t/fliplearn-ntu](http://www.scoop.it/t/fliplearn-ntu).

## Collaborative in-class activities

In a SCALE-UP class, lectures are replaced by collaborative problem-solving and enquiry-based learning activities. The role of the tutor, then, is a facilitative one: not to transmit information, but to plan and support activities which will foster students' own creation and acquisition of relevant knowledge. There is no set model for such activities: every class will look different depending on the subject, the students' learning preferences, and the tutor's teaching style.

*"As more and more instruction is handled virtually via the web, taking advantage of the relationship-building capability of the real people in brick and mortar universities becomes even more important."*

*NCSU no date. 2*

This list, while not intended as prescriptive or exhaustive, includes some typical activities which SCALE-UP tutors at NTU and beyond have found useful:

- Activities to test or consolidate students' comprehension of preparatory work, such as an online poll or a brief small-group discussion
- A substantial problem or investigation, divided into 10-15 minute tasks
- Group activities in smaller and larger groups to summarise and present key ideas
- Online investigations into key topics
- 10-minute tutor mini-lectures to supplement group work, confirm key concepts, address misconceptions, etc.
- Presentation of student work in plenary, with plenty of opportunity for questions and peer and tutor feedback
- 5-minute session summaries
- Group and individual reflection on learning and group effectiveness
- Any activity requiring individuals or groups to teach what they have learned to others.

Law colleagues teaching on the Statute module have created tasks for SCALE-UP sessions in which students identify relevant legal issues, apply appropriate language, analyse the situation, apply the analysis to a real-world scenario and justify the choice(s) made. This activity requires them to make an informed choice vis-à-vis the given scenario and has enhanced the breadth and depth of knowledge that students develop on the module. In Sociology, the module team for Service Learning found that switching to SCALE-UP enhanced the active learning approach already taken on the module. Pre-placement group activities, formerly set for homework, have been moved into the classroom, enabling students to practice relevant skills with the tutor present to assist. This arrangement better supports students to achieve the learning outcomes and allows the tutor to monitor their progress towards achieving them.

Colleagues teaching on SCALE-UP modules in the NTU pilot found it helpful to plan the in-session activities carefully in advance, thinking through how they would work in practice (CADQ 2013). Module leaders also mentioned the additional time needed to prepare for SCALE-UP teaching, which was often more than initially anticipated. As one tutor commented: "I had to spend a day per week working intensively to prepare activities."

Not all SCALE-UP learning activities need to be designed and developed from scratch. Existing problem-solving or enquiry-based group activities might be easily adapted for the SCALE-UP environment. This might involve adding an online research element to take advantage of the laptops, for example, or using Beichner's group roles (discussed in detail under Group work below) to add a new dimension to existing group activities. NTU tutors in the SCALE-UP pilot also advised using a variety of tasks to keep students interested: "Design sets of activities, whatever you do, don't do the same activities every week. Make them stimulating and varied." Design of group tasks and strategies and tools to facilitate these are discussed in more detail in [SCALE-UP style collaborative learning](#).

### **SCALE-UP module design: two examples from NTU**

Module teams at NTU have found that the switch to SCALE-UP enables them to consider various aspects of the module holistically in order to enhance student learning. In the following two examples from NTU, modules have been re-designed to enhance the mode of delivery, the organisation of topics, and the assessment, all of which can be beneficial for student learning.

#### ***Example of module re-design—Physics***

**Module:** Advanced Experimental Techniques (Physics)

**Module leader:** Dr. David Fairhurst

**Cohort:** Large (70+)

**Year group:** Final year

#### **Intended Learning Outcomes:**

- Develop your appreciation of good experimental design
- Enhance your familiarity and understanding of physical phenomena through practical work
- Give you an insight into a wide range of *experimental techniques* through both theoretical and *practical work*
- Develop your ability to *produce journal style reports*

**Assessment** for the module is comprised of:

- |  |     |
|--|-----|
| • 4 × 1-hour in-class examination        | 60% |
| • 2 × 9-hour Laboratory notebook entries | 30% |
| • 2 × short journal-style articles       | 10% |

The core aim for this module is for students to develop their understanding of a range of modern Physics techniques and to be able to work with the data produced by using these techniques. In its previous form, the

module's combination of lectures and labs often left students unprepared to engage effectively with equipment and techniques in the lab. Furthermore, when it came to the exam at the end of the module, students struggled with topics covered during the early stages of the module.

To ensure students engage with the module content and achieve good results in their assessment, David and his team have re-designed this module, replacing lectures with two-hour SCALE-UP workshops, grouping topics into units and changing the end-of-year examination to four in-class examinations throughout the year.

In its SCALE-UP form, the module has more coherence and flow. Within each block of sessions, students engage with the flipped learning approach—reading and watching videos (created by the course team and their students<sup>6</sup>) on particular techniques and practices before coming to class. In class, they work on tasks to build up understanding progressively. Rather than listening to a lecture about data sets, groups of students now work with those data sets hands-on. Tutors circulate around the room, observing student problem-solving approaches, answering questions promptly and giving timely feedback. A particular advantage of SCALE-UP workshops is that tutors now are able to identify areas in which students are struggling and direct them to correct their mistakes appropriately.

At the end of each content block, students are tested on the topic area they have engaged with intensively for the past two weeks. This motivates them to engage with each topic, as they can see the result of their learning almost immediately.

Date	Subject
29 Sept	Introduction
6 Oct	Rheology
13 Oct	Rheology
20 Oct	Rheology test
27 Oct	Contact angles
3 Nov	Contact angles
10 Nov	Contact angles test
17 Nov	Network analysis
24 Nov	Network analysis
1 Dec	Network analysis test
5 Jan	Space weather
12 Jan	Space weather
19 Jan	Space weather test
26 Jan	Lasers
2 Feb	Lasers
9 Feb	Lasers test

In this TiPS (Teaching in Practice Series) video, David describe the process by which he and his module team used 'backward design' principles to guide them through the re-structuring and re-design of this module:

<http://bit.ly/1NWjzRg>.

### ***Example of collaborative module re-design—Law***

The move to a SCALE-UP approach can create opportunities for creative curricular re-design: for example, colleagues in Law have used SCALE-UP to focus a cluster of modules around a virtual town. The modules are Legal Method (level 4) and two level 5 modules: Criminal Law and Law of Trusts. The module teams have used SCALE-UP to incorporate more flipped and

<sup>6</sup> As part of a SPUR (Scholarship Projects for Undergraduate Researchers) project, a Level 5 student helped to prepare information videos for Physics students on using lab equipment. An example can be viewed here: <http://bit.ly/1UAFHo0>

problem-based learning on the modules. To do this, they have developed the virtual environment of Lexport, a fictitious town with its own infrastructure, law firms, justice system, police force and an abundance of rogues and villains (Huxley-Binns, Boylan-Kemp and Henderson 2014).

In SCALE-UP modules, students access Lexport online to tackle realistic legal issues, developing their legal knowledge and honing problem-solving and teamwork skills in the process. For example, in Trusts, they might navigate the paperwork associated with the creation of a trust. In Criminal Law they might analyse a scenario to determine the charge(s) in an assault/theft/robbery case. For each learning experience, they start to gain the 'knowledge' in advance by watching selected YouTube mini lectures or lecture nuggets on PowerPoint. For example, in Criminal Law, students might be introduced to a case involving Lexport's notorious Mitchell family of bandits, rogues and villains. Before the session they listen to a recording of a police interview with members of the family, and consider what charge the prosecution might successfully bring. Students then bring their suggestion to class for sharing and discussion with peers.



Identifying Trusts in Lexport City

A flipped learning approach, then, enables an emphasis on active and collaborative learning in face-to-face contact time. Lexport has so far elicited a high level of student engagement in and beyond the classroom (Huxley-Binns *et al* 2014).

### Moving to a SCALE-UP model

Depending on the module and cohort, it might be that the move to a SCALE-UP setting is a completely new experience for both students and tutors. Generally speaking the more 'new' aspects, the more adaptation and preparation time will be required, and potentially, the more exciting the end result. It is important to consider all of this so that support can be sought where necessary and so that SCALE-UP can be framed and introduced to students in a way which will encourage more successful outcomes.

Where the SCALE-UP approach is very new to both tutor and students, some teaching staff have found it useful to introduce the approach gradually, starting with sections of the module that can more easily be adapted in the first instance, and introducing more SCALE-UP elements in the module's second iteration. Another useful exercise can be trialling a SCALE-UP session on some willing participants—perhaps colleagues—before running it with students. This can help to garner different

perspectives on the activities and identify possible adjustments or training needs. Members of the CADQ SCALE-UP support team are very willing to be guinea pigs and offer feedback and support: contact [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk).

See [Appendix B](#) for a resource bringing together diverse aspects for consideration when (re-)designing a module to get the most from the SCALE-UP approach.

If you are in the process of moving to a SCALE-UP model, you may also find the sections on [Introducing SCALE-UP to students](#) and [Consideration for managers and Academic Team Leaders](#) to be of interest.



## SCALE-UP style collaborative learning

Collaborative group work is a fundamental aspect of the SCALE-UP approach. In addition to enhancing students' subject knowledge and intellectual capacity, SCALE-UP emphasises group work in a deliberate endeavour to foster teamwork and communication skills—attributes which employers widely identify as desirable (Beichner 2014). Drawing on Astin's (1993) findings that the quality of tutor-student and student-student relationships is paramount for student learning, Beichner developed both a pedagogy and a physical environment which promote peer and tutor-student interaction. Key aspects of the SCALE-UP approach to collaborative learning discussed in this chapter include group formation, group roles, collaborative activities and reflection on group functioning.

### ***Five characteristics of successful group-based interaction***

According to Beichner *et al* (2007), to ensure that students benefit from SCALE-UP style collaborative learning, tutors need to incorporate the five critical aspects of group design (Johnson, Johnson and Smith, 1991):

- Individual accountability: each member is responsible for doing their share of the work and for mastering the material
- Positive interdependence: team members have to rely on each other
- Face-to-face interaction: some or all of the group effort must involve working together in person
- Interpersonal skills: members learn about and practice leadership, decision-making, communication and conflict management
- Regular self-assessment of group functioning: groups evaluate how well their team is functioning, where they could improve, and what they should do differently in future.

In their reflections on and evaluations of SCALE-UP at NCSU, Beichner and Jeffrey (2003) found that “not incorporating all these aspects is a recipe for failure, at least as far as group functioning is concerned” (p.3).

### **Benefits of learning in groups**

Group work can encourage students to share problems and solutions with peers, which some are more likely to do than ask questions of a tutor.<sup>7</sup> Beichner (2014) found that where individual students are likely to get stuck and give up during an activity, this does not happen as often or as early in group work, as groups share resources and tend to perceive alternative strategies that they might not see when working alone.

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<sup>7</sup> Recent research at NTU for the UKES survey 2014 revealed that a quarter of NTU students felt reluctant about asking a lecturer for help or advice.

Furthermore, working in groups facilitates the student-as-teacher model, which Beichner (2014) describes as “Cognitive Rehearsal: students learn more when they teach others (just like us).”

The benefits of learning in groups are well documented and include the following:

#### Social benefits

- Creates social support network for learners
- Builds positive heterogeneous relationships and promotes diverse understanding amongst students and staff
- Establishes a positive environment for modelling and practising cooperation
- Develops learning communities

#### Psychological benefits

- Builds students' self-esteem through student-centred instruction
- Reduces classroom anxiety through cooperation
- Develops positive attitude amongst learners towards teachers

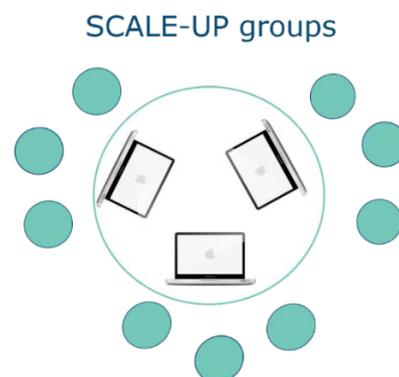
#### Academic benefits

- Promotes higher level thinking skills
- Involves students actively in the learning process
- Classroom results are improved
- Models appropriate student problem-solving techniques
- Can be used to personalise large lecture classes

(Adapted from Laal and Ghodsi 2012)

### SCALE-UP style groups

The basic unit in a SCALE-UP class is the group of three students. Each table seats three groups of three, and a laptop and power socket are available for each group. To suit different activity types, and to keep the session interesting, Beichner recommends varying between work in threes, in whole tables (of nine), and in other configurations such as whole-class: *“Students readily work in their own teams of three as well as in table-sized groups of nine ... Students particularly enjoy having each table to work on a problem and then sharing their efforts with the rest of the class”* (Beichner *et al* 2007, p. 28).



#### Group formation

A distinctive feature of SCALE-UP is the organisation of students into mixed-ability groups. To achieve this across the cohort, Beichner looks at his students' prior attainment and—without telling the students—assigns a

student from the top, the middle and the bottom third to each group (Beichner *et al* 2007). He has found that using this strategy enhances the work of the whole team: students from the top band benefit in particular as their learning is enhanced through ‘teaching’ difficult concepts to peers who may be struggling.

Students work in these groups for several weeks and are then re-allocated before they become so comfortable as a unit that their level of effort drops. Beichner and his colleagues (2007) found that switching groups three or four times per semester was most effective, whereas “changing groups only once in the middle of the semester is traumatic because the students have formed strong friendship bonds that are now severed.”

There are many existing approaches to group formation within and outside SCALE-UP; tutors may already use strategies which would transfer well to SCALE-UP, and may wish to tailor their approach according to the needs and make-up of particular cohorts. Other considerations that might come into play are gender balance, international mix, educational background, and competence with relevant equipment (such as the MacBooks in some NTU SCALE-UP rooms). Knowing the students, or having access to some background information about them, can be very helpful here.

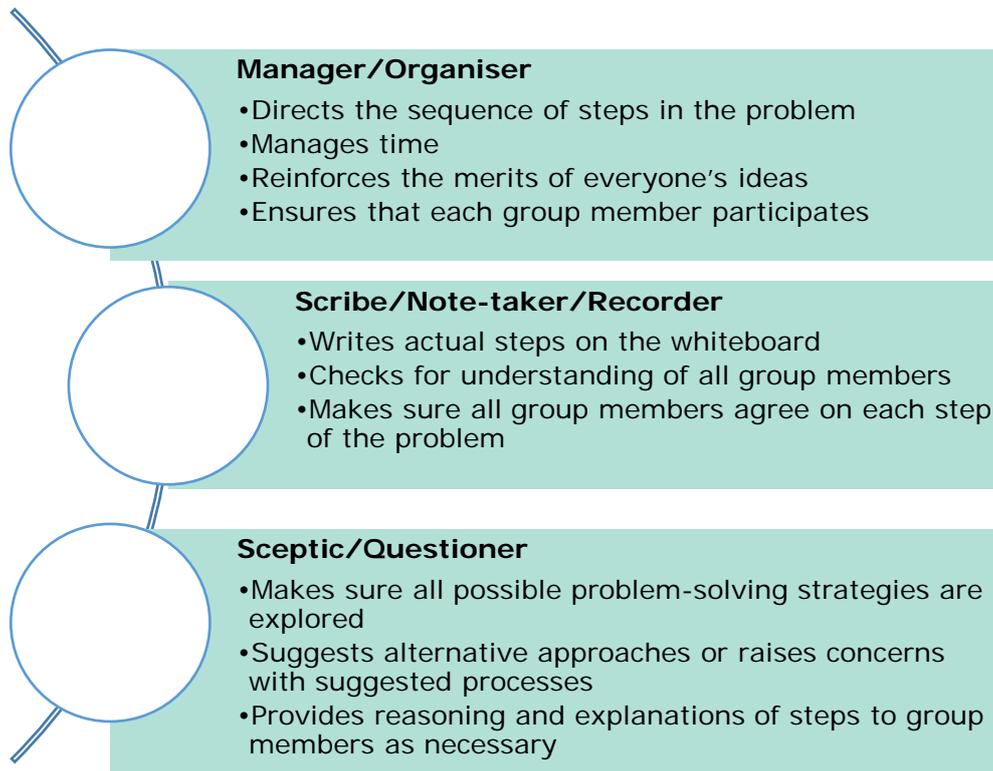
*Tutors in the NTU pilot evaluation found that mixed-ability, teacher-allocated student groups performed better than friendship groups.*

*CADQ 2013*



### **Group roles**

Another distinctive element of SCALE-UP style collaborative learning is the use of group roles. Each group member takes on, at various times, the roles of manager, scribe and sceptic. They keep these roles for an appropriate period of time: perhaps one teaching session, perhaps several weeks for a larger project. These three roles—described in more detail by Heller and Heller (1999)—are summarised here:



Beichner suggests that if a group has a fourth member, for example on occasions where the cohort does not divide neatly into threes, this student should act as *summariser*, i.e. to summarise solutions and the steps the group took towards finding these, and also to maintain the group's energy through encouragement, humour, enthusiasm, etc.

To ensure the group roles are used effectively, Beichner and his colleagues recommend scheduling some brief training in group functioning early in the module (Beichner *et al* 2007). Regular, structured reflection on group roles and functioning is also vital. It is useful to devote some class time to this or to set follow-up tasks where students reflect then produce an action plan for further development. This kind of reflection supports not only students' development of effective group work skills but also their self-efficacy. Furthermore, reflection on group functioning following carefully selected prompts can allow students to give and receive constructive feedback, a valuable skill in itself.

A periodic requirement to switch roles affords students opportunities to play to their strengths in roles where they feel comfortable, and to be challenged in roles which would they would not naturally choose. Knowing the roles will be rotated, students can proceed on the basis that there is a finite end to a role they are finding challenging; they are also able to observe and learn from how their peers perform the various roles, so that the group as a whole has the opportunity to adapt and continually raise the standard of collaboration.

Roles such as manager, scribe and sceptic can also be employed in a non-SCALE-UP learning environment to help foster social cohesion, effective team work, employability skills and personal development.

Table 3 Example of SCALE-UP group roles in action

ROLE	Sounds like
<b>Scribe or Recorder</b>	<ul style="list-style-type: none"> <li>• “Do we agree that this drawing is accurate?”</li> <li>• “I’m hearing more than one idea. I’m not sure what to write. Can we agree on how to proceed?”</li> <li>• “Does everyone agree with the lab report?”</li> <li>• “How can I use an updated form of velocity in the code?”</li> </ul>
<b>Sceptic or Questioner</b>	<ul style="list-style-type: none"> <li>• “Can we visualize this problem differently?”</li> <li>• “It feels like we’re spinning our wheels. Let’s take another look at this previous step.”</li> <li>• “Are we accounting for all factors?”</li> <li>• “Are we using the correct units?”</li> </ul>
<b>Manager or Organiser</b>	<ul style="list-style-type: none"> <li>• “Does anyone have an idea what approach we could take for this problem?”</li> <li>• “Henry, why don’t you monitor the data display while Sue and I initiate the experiment?”</li> <li>• “We have to move on. If we have time, we’ll come back to this discussion later.”</li> </ul>
<b>Summariser (Optional 4<sup>th</sup> role)</b>	<ul style="list-style-type: none"> <li>• “So, we started with the fundamental principle of momentum, and proceeded to...”</li> <li>• “You have a very insightful idea.”</li> <li>• “So, here’s what we’ve decided on the layout of the code...”</li> <li>• “Let’s become rocket scientists!”</li> </ul>

(Based on NCSU no date 1)

### Group activities for the SCALE-UP classroom

SCALE-UP activities vary in length and form, and are carefully structured to maximise opportunities for collaboration, peer teaching, student-lecturer interaction, discussion and feedback. When planning group activities, it can be helpful to consider different types of task, as well as ways in which technology can support the group work itself and enable groups to share the process and results of that work with others.

#### **SCALE-UP in-session activities**

Beichner thinks of his SCALE-UP activities as “tangibles” (short hands-on activities), “ponderables” (interesting questions to consider) and “visibles” (images, equations, demonstrations, simulations, artefacts etc. to explore). This taxonomy was developed through teaching calculus to Physics students and may be more appropriate for some subjects than others. Activities particularly suited to group work in many subjects include: brainstorming, problem-solving and decision-making, role-play, simulations, games, making comparisons, and justifying stances.

As SCALE-UP is closely related to enquiry-based learning, it may be useful to talk through some specific problem-solving strategies with students, especially if they are new to this kind of work. Many tutors, and indeed students, will already have their preferred strategies, and these may

transfer well to a SCALE-UP setting. For example, Beichner encourages his students to use the GOAL framework (adapted from Polya 1973) when solving real world problems in Physics:

### **Gather information**

- Look for key phrases in the question
- Get a “big picture” view of the situation
- Estimate the final answer, etc.

### **Organise your approach**

- Classify the problem
- Agree on a plan of action

### **Analyse the problem**

- Calculate
- Note answers

### **Learn from your efforts**

- Reflect on what worked/didn't work
- Consider how to approach a similar problem next time

(Adapted from Beichner *et al* 2007)

## **Tools to facilitate group work**

To facilitate in-session group work SCALE-UP rooms are equipped with whiteboards and a laptop or MacBook for every group of three students. The latter can be connected to the Internet via wi-fi or a network cable, so that students can access NOW, search engines and databases, Internet content and online tools.

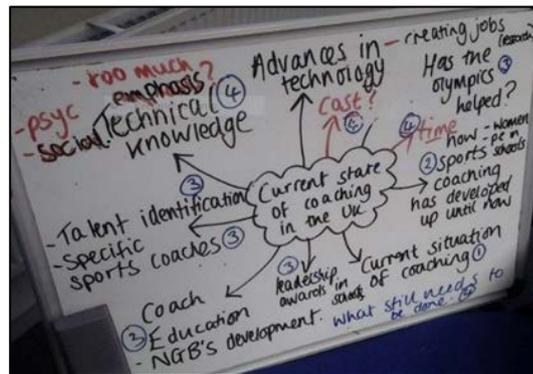
Staff in the NTU pilot noted that group work is most successful when the group is asked to produce something: for example, a mind map, a written paragraph, a resource for others, a poster (physical or digital), a video or podcast. Opportunities to create materials can help students think through key concepts while also practising a range of communication and presentation skills. One online tool that might be worth exploring to this end is Google docs, which can be used by groups of students to collaborate on a document, table or spreadsheet. While there are many creative collaborative tools available online, the MacBooks and laptops also have Microsoft Office suite including Excel, Word and PowerPoint, so that students can use familiar software where appropriate.

Groups undertaking substantive projects may find online project management tools useful, such as those provided in the Microsoft Office 365 suite: these include group calendars (Outlook), collaborative document editing (OneDrive) and group communication and polling (Yammer). There are a range of similar tools available and tutors and students may already have their own preferences. [Appendix C](#) outlines a small selection of online tools to support various aspects of SCALE-UP including group work.

## Tools for sharing student work

A great advantage of the SCALE-UP approach is that it renders visible the enquiry process: that is, the paths students take to solve a problem, explore a question, analyse a scenario, understand a phenomenon, or create a digital or physical artefact. In a traditional lecture setting, this process generally takes place outside class, making the 'workings-out' invisible. In a SCALE-UP setting, however, tutors can observe and coach students during the enquiry process, offering guidance and identifying sticking points in terms of skills or application of knowledge. This visibility of the enquiry process can also enable peers to learn from each other's successes, and to give and receive timely feedback.

The facility for students to share their work during sessions is therefore a significant aspect of SCALE-UP for both work-in-progress and more polished pieces. Most SCALE-UP rooms at NTU are equipped with mini whiteboards and/or writeable walls for this purpose. These Public Thinking Spaces (Beichner 2014) enable thought processes such as mind maps or flowcharts to be seen, compared, and commented on.



A SCALE-UP mind map by Sports Coaching students

Digital technologies are also available in a SCALE-UP room to enable sharing of work. Mirroring via Apple TV and/or Miracast (Screen Beam in Chaucer) allows students to project work from the laptops to the large screen(s) for comment and discussion. In many cases, students can also project from their own Apple devices via Apple TV and/or their own Windows/Android devices via Miracast. In larger SCALE-UP rooms, multiple screens are available to enable easy viewing for students wherever they are sitting. In some rooms, the screens can function independently: a feature which can be used, for example, to allow students to compare and critique the work of multiple groups. Work can also be directly shared from one MacBook to another via AirPlay. The facility to share work in progress encourages students to view the environment as a safe place to make and learn from mistakes. It also enables students to teach peers through sharing knowledge they have gained during the enquiry process, and provides regular opportunities for them to practice producing and applying feedback.

### ***Example of a versatile collaborative tool—Padlet***

Padlet is a virtual wall that allows easy collaboration on a common topic. It works like an online pin board where contributors can click anywhere on the screen to add content such as images, videos, documents, or text. Multiple contributors can 'post' on the wall at the same time from any device, and can see each other's contributions in real time.

Padlet has been used by NTU SCALE-UP tutors in a range of ways to facilitate students' learning. Some examples are summarised here:

- In Social Care, tutors use Padlet during sessions as a collaborative working space and for sharing resources. Visit <http://padlet.com/jchall00/8y1bias6ive2> for an example.
- In Psychology, Padlet is used during class for groups to post their work for presentations. Visit [http://padlet.com/andy\\_grayson/dcd3](http://padlet.com/andy_grayson/dcd3) for an example.
- Students can use a Padlet wall to post ideas or questions for the tutor to address in the session or afterwards. This can be particularly useful in a busy session with a large group. This TiPS video discusses Padlet use in a SCALE-UP class: <http://bit.ly/1GjS8fJ>
- Padlet can also be used for students to post questions anonymously, particularly where they might be hesitant to raise these in person. Tutors have overall control of the Padlet wall and can moderate or delete comments where necessary.
- Outside the classroom, tutors can use Padlet to provide students with collections of resources for pre-class content learning. Several NTU tutors have recommended linking to specific Padlet walls from the module's NOW learning room for easy access.
- Padlet can be a useful revision aid: students can be encouraged to re-visit Padlet wall links to recall their knowledge about a specific topic.

Because a Padlet wall can be viewed and used from multiple devices simultaneously, it can also be accessed from students' own devices in any general purpose teaching room to create a sharing opportunity somewhat similar to the mirroring function in SCALE-UP rooms.

For more ideas about using Padlet, visit:

<http://padlet.com/elearningntu1/cas> created by the Elearning Development Team (CADQ). To create a free Padlet account, visit <https://padlet.com/>

## Strategies for facilitating and managing group work

There are many strategies for facilitating group work, and tutors will likely already have a range of these at their disposal. These may include—but are not limited to—the following suggestions:

**Before the task:** To ensure group activities are successful, give explicit instructions verbally and/or in writing. After instructions are given, ‘what’ and ‘how’ questions can be useful to check task understanding before work begins. Beichner *et al* (2007) ask Physics students both before and after the task to consider the questions “what am I supposed to learn from this?” and “why are we doing this?”

**During the task:** The SCALE-UP environment is designed so that tutors can monitor group progress by circulating between the tables. In this way they can address common misconceptions, identify effective approaches and answers, and provide feedback. Where the latter is concerned, Beichner recommends that, rather

*“Coach the students during activities by assisting them in answering their own questions and by letting students present their results to the class for review by instructors and peers as opposed to just telling students the answer.”*

*Beichner et al 2007*

than telling students the right answer, tutors encourage them to help each other: for example, groups who finish a task early can help groups who are struggling. Indeed, cross-fertilisation of ideas may happen organically as the SCALE-UP room is designed to facilitate cross-table discussions. To ensure group activities keep to time—especially with a larger class—it may be useful to have a timer displaying the remaining time for an activity; otherwise, activities can tend to expand beyond the time planned.

**To conclude the task:** Groups may use what they have learned from the activity to teach other groups or present to the class. Groups can project to large screens from the laptops, or write on the whiteboards to display their work and obtain feedback in plenary. Beichner recommends using a randomised strategy such as dice to determine which groups feed back to the whole class.

Follow-up questions can be used to push students’ thinking further and to link to the next activity. For Beichner *et al* (2007) a vital element of SCALE-UP is taking a few minutes as a class to reflect on the ‘what’ and

*“At the end of a task, we will often stop class for a minute or two while students add comments to [a classmate’s] notes that specifically address the questions “what am I supposed to learn from this?” and “why are we doing this?” Requiring them to write these notes for their neighbors ensures they put careful thought into their work.”*

*Beichner et al 2007, p. 15*

'how' questions that were asked before the task. Students may write notes summarising the central point of an activity, and then pass these to a peer for comment and annotation. This encourages students to reflect on what they are doing, lets them praise each other for high quality academic work, and requires them to identify the main ideas for themselves, rather than listening to the instructor do it.

### ***Strategies for large cohort group work***

SCALE-UP was originally developed in order to engage a large cohort of students with active learning. Facilitating active and collaborative tasks with large groups of students can be a challenge: the diverse learning needs and expectations of students necessitates a considered approach to activity design and group management. SCALE-UP tutors need strategies to:

- facilitate discussion and focus the group's attention on relevant tasks at different points
- observe students' learning and provide timely feedback to individuals and groups
- allow students to share their work and thoughts across a large classroom.

In a larger NTU SCALE-UP room, some tutors have found their students reluctant to address a hundred peers in order to share work or ask a question. Although a roving microphone is provided, this may increase some students' anxiety about speaking. An NTU SCALE-UP tutor with a large cohort group has been exploring alternative ways of harnessing small group outputs to share with the class for feedback, and these are shared here:

- Groups create short answers and put them into a NOW Dropbox—the tutor then pulls these up on screen for demonstration and discussion.
- Portable whiteboards are prepared by students and talked through by the lecturer—these can be photographed as a record.
- When team teaching, a second lecturer roams whilst students describe their work to them; the lecturer then summarises for the class using the mic.
- A NOW learning room is used to capture class work which can then be formally submitted by all groups at class end for tutor feedback.
- A Padlet 'wall' is created for a particular session, or a separate 'wall' created for each issue discussed in the session. Students contribute via the laptops and can easily see each other's contributions or questions (more information on Padlet is provided in [tools for sharing student work](#)).
- A 'car park' board is identified somewhere in the room for students to record questions on post-its and 'park' them for later. This is a useful strategy for dealing with questions that are slightly off-topic, without distracting from the main activity.

The module re-design framework in [Appendix B](#) includes suggested considerations for various aspects of SCALE-UP style group work.

## Assessment design in SCALE-UP

As described in '[Backward' curriculum design](#), SCALE-UP takes a 'backwards' approach to curriculum design in that desired performance outcomes are considered first and assessment and instruction developed thereafter to enable these outcomes (Beichner 2014). A switch to SCALE-UP may therefore provide significant opportunities to adapt or re-design assessment.

An advantage of the SCALE-UP approach is that it provides ample opportunity for formative activities and feedback during teaching sessions, enabling students to explore themes and practise skills which will later be summatively assessed (Beichner 2014). NTU SCALE-UP tutors have taken advantage of these possibilities to adjust the ways that they assess learning (CADQ 2013) as well as the ways they incorporate feedback opportunities into the module. Two examples are provided here: the first shows how SCALE-UP can provide opportunities for formative peer assessment; the second describes an assessment which was adapted to align more closely with the types of learning enabled by SCALE-UP sessions.

### ***Example of a SCALE-UP assessment—Fashion Marketing & Branding***

The summative assessment for this Level 5 core module is an individual strategy and communication report. Formative assessments building towards this are: a team presentation on brand strategy; an individual communication report and presentation; and a written executive summary. The fifteen-week module is divided into three five-week blocks, each culminating in a formative assessment component.

To help students see the benefits of peer learning, and to help build the skills and knowledge required for developing and presenting marketing and branding in the fashion industry, the module leader selected team work, report writing and presentation as key assessment elements. For example, although the summative assessment is an individual report, a formative group presentation supports students to understand the relevance of collaborative work in their industry.

One strategy to promote collaborative learning is peer formative feedback. As part of the formative presentation assessment, students are asked to evaluate the work of other groups. They then give a presentation on their evaluation of the other team's work, focussing on how well developed the strategy was and offering an alternative plan for the other group's brands.

In this video, a module lead explains her approach to formative assessment in the SCALE-UP setting: <http://bit.ly/1J9NZBs>

Aspects worth considering when making changes to assessment and incorporating more formative activities and feedback might include the timing of feedback (e.g. before, during and after an activity), who produces feedback (self, peer, tutor) and the forms it will take (written, visual, oral etc.) It may also be helpful to consider how students are supported to recognise, produce and apply feedback effectively.

### **Example of a SCALE-UP assessment—Law of Trusts**

This is a Level 5 core module with a summative exam assessment (100% weighting). The module team felt that the existing unseen exam without books did not align well with learning outcomes involving students' development of skills as lawyers. In particular, it did not adequately assess students' ability to apply wider research and practical experience in order to solve a problem.

To take full advantage of the SCALE-UP setting, the unseen exam was made into a three-hour seen exam in which students are required to address two scenarios. The cases presented are similar to the cases students have worked on within their SCALE-UP sessions. For example:

*“Simon Hammond died recently. His will appoints Paul and Alice Taylor as his Executors. Since Simon died, the Executors have learned that he may have attempted to set up a trust. They have found some correspondence and spoken to the apparent trustees. A copy of all relevant paperwork is set out on pages 3 onwards. Advise the Executors as to how Simon's estate should be distributed.”*

Instead of a clear problem to solve, students are presented with the documentation (such as a will), and are required to work through it to identify the issues it raises, and decide for themselves what they need to research. Such an assessment mirrors expectations in the workplace in that it calls for students to use a range of complex skills beyond pure legal knowledge.

In this TiPS video, the module leader explains her approach to assessing meaningfully the kind of learning carried out in the SCALE-UP module within the constraints of the module specification:

<http://bit.ly/1IWqfdR>.

Consideration should be taken during any module re-design of the policies and requirements regarding changes to assessment. At the time of writing, “modifications to existing modules up to an annual limit of 40 credits in a level” require approval by the course committee and SASQC. These modifications include assessment methods as well as module title, level, credit value, aims and outcomes.<sup>8</sup> The exam change described in the second example here did not require a major change process.

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<sup>8</sup> More details can be found in [Quality Handbook Supplement 5B: Making changing to courses](#).

## Introducing SCALE-UP to students

SCALE-UP requires careful framing with students, particularly at the start of a module. As with any shift to a more active learning approach, the SCALE-UP experience may challenge students' expectations about learning and may feel different to other modules on the course. It can be useful to explain the potential benefits of SCALE-UP to students. These include increased feedback opportunities, tutor observation of sticking points in student understanding, and group work for personal and professional development.

### ***Framing collaborative learning with students***

As part of the introductory session to a SCALE-UP module in Education, Sarah Davies and Alison Hardy use some of Beichner's ideas to introduce SCALE-UP style collaborative learning to students. First, as an ice-breaker activity, students create a personalised name badge to place on their table. In this way, no student is anonymous. Next, students are shown the differences between learning in collaborative classrooms and traditional classrooms as outlined by MacGregor (1990) and are asked to discuss these differences in relation to their own experience and expectations. To model the SCALE-UP approach, they discuss in groups of three and some groups then share their key points with the rest of the class. This table is adapted from MacGregor's outline:

<b><i>Traditional classroom— Students shift from:</i></b>	<b><i>Collaborative classroom— to:</i></b>
Listener, observer, and note taker	Active problem solver, contributor, discussant
Low or moderate expectations of preparation for class	Higher expectations of preparation for class
Private presence in the classroom	Public presence with many risks
Attendance dictated by personal choice	Attendance dictated by community expectation
Competition with peers	Collaborative work with peers
Responsibilities and self-definition associated with learning independently	Responsibilities and self-definition associated with learning interdependently
Seeing teachers and tests as the sole sources of authority and knowledge	Seeing peers, self and the community as additional and important sources of authority and knowledge

For SCALE-UP to work, students must understand what is expected of them: for example, pre-session preparation and active participation in class. It is also vital that reflection time and reflective activities be built into the module so that students can observe and articulate the benefits of the SCALE-UP setting for their learning. A resource to help introduce SCALE-UP to students can be downloaded from the CADQ web pages here: [http://ntu.ac.uk/adq/teaching/scale\\_up/support\\_resources/index.html](http://ntu.ac.uk/adq/teaching/scale_up/support_resources/index.html)

### ***Example of an introduction to SCALE-UP for students—Physics***

For the first Advanced Experimental Techniques session, students are put into their SCALE-UP groups to carry out an engaging activity on correlations and causations while familiarising themselves with the collaborative style of learning that will be used throughout the module.

Using the online resource 'Spurious Correlations' (<http://www.tylervigen.com/discover>), students are first asked to identify the relationship between various interesting facts (e.g. 'Per capita consumption of cheese' and 'Physical copies of video games sold in the UK'). They then:

- Present their correlations to other teams at their table
- Pass on both their correlations to the team on their left
- Invent possible, and sometimes amusing, explanations for the correlations they have identified (e.g. 'people consume more cheese when they play video games because they are too gripped by the game to get up and make a meal')
- Vote for a table favourite explanation
- Share the table's favourite with the entire room.

During this time, students are also given a task sheet to help them learn to use the MacBooks, as the technology may be unfamiliar to them. Example prompts include:

- *What is the Mac equivalent of My Computer for navigating folders and files?*
- *How do you open, close, minimise and move windows?*
- *Investigate gestures. These are various ways of using the swipe pad with several fingers for scrolling, zooming, navigating... Copy into your PowerPoint a link to the best webpages which explain how to use the trackpad.*
- *Project your screen onto one of the projectors in the room*
- *Send your word file to your H:\ drive.*

A complete version of this worksheet can be found in [Appendix D](#). David Fairhurst has kindly made this activity available for SCALE-UP tutors to download from the SCALE-UP SharePoint site or directly via this URL: <http://bit.ly/1RktJgx>.

## Supporting SCALE-UP colleagues—considerations for course leaders and course teams

SCALE-UP—Student-Centred Active Learning Environment with Upside-down Pedagogies—is an active mode of learning which offers an alternative to traditional lectures. In a SCALE-UP class students learn through solving problems, sharing ideas, giving and receiving feedback, and teaching each other. This approach is supported by a bespoke, technology-rich classroom environment. As with any shift to a more active learning approach, the SCALE-UP experience may challenge students' expectations and feel different to learning activities elsewhere on the course. Some planning and discussion across the course team can help smooth the transition for staff and students, build coherence across the course, and ensure that the benefits of SCALE-UP are available beyond a single module. The suggestions below may be useful for course teams and course leaders to consider when tutors on the course are using the SCALE-UP approach.

### ***A single SCALE-UP module on a course***

Where one or two modules are involved in SCALE-UP, as is often the case, it may be useful for course teams to discuss how other modules can both support and benefit from SCALE-UP learning. If approaches such as collaborative group work and enquiry-based learning are already prevalent on the course, the transition to SCALE-UP is likely to be easier for students. Where these approaches are not in common use, it may be easier to introduce SCALE-UP in the first year when students are potentially more open to different learning experiences. However, it is also worth considering where aspects of SCALE-UP such as [collaborative activities](#), [SCALE-UP group roles](#), and [flipped learning](#) could be incorporated into other modules: this can both help familiarise students with these approaches and have a positive effect on student engagement and learning across the course.

### ***Linking multiple SCALE-UP modules on a course***

While SCALE-UP can work very well on a single module, some colleagues at NTU have had great success by introducing the approach across a suite of modules. This strategy has several advantages: it shares out the module re-design work among colleagues; it normalises SCALE-UP for students in that they encounter it on multiple modules; and it makes the benefits of SCALE-UP available to a wider group of students and staff. In Law, for example, colleagues leading three discrete modules have collaborated to create the virtual town of Lexport. Students 'visit' Lexport to explore realistic legal issues related to the relevant module, honing their analytical and problem-solving skills in the process. For more detail, see [Example of collaborative module re-design for SCALE-UP—Law](#).

### ***Supporting course colleagues and students involved in SCALE-UP***

Because SCALE-UP may feel different to other learning experiences, it requires careful framing with students. For this reason, other teaching and support staff involved with the course may find it helpful to have some knowledge about the benefits of SCALE-UP as well as the ways in which students may find it different or challenging. A resource called *SCALE-UP—Information for Students* is available on the [CADO website](#) to give to students and staff as relevant. Some knowledge of how SCALE-UP works may also help local Timetabling staff support colleagues wishing to teach in these rooms. Teaching staff might get involved in supporting colleagues doing SCALE-UP via peer review of materials, or in-class peer observation of learning facilitation. This kind of 'critical friendship' can become a reciprocal arrangement benefitting both parties, and can feed into discussions and enhancement at course team level.



## **SCALE-UP—considerations for managers and Academic Team Leaders**

SCALE-UP combines active learning strategies with bespoke, technology-rich classroom design to energise and transform student learning. Its benefits—outlined in more detail in [Benefits of SCALE-UP](#)—include greater student engagement with the subject matter and more social learning, leading to increased conceptual understanding. The incorporation of regular collaborative activities can also improve problem solving ability and teamwork skills—qualities highly prized by employers. SCALE-UP modules at NTU have been associated with good student attainment and high EvaSys scores for student satisfaction. The switch to a SCALE-UP approach can also help address module-specific problems: for example, Beichner (2014) found it improved attendance and reduced failure rates on his Physics modules.

The introduction of any new teaching approach necessarily requires planning and support and in this respect, SCALE-UP is no different. The suggestions below may be useful for managers or Academic Team Leaders to consider when one or more tutors in the team is embarking on SCALE-UP.

### ***Rooms and timetabling***

Bespoke SCALE-UP classrooms are available at both City and Clifton. Module leads who wish to teach in a SCALE-UP setting are advised to discuss their plans with their ATL in the first instance. ATLs can then liaise with school timetabling coordinators or key academic contacts to support rooming as appropriate.

While SCALE-UP is designed to engage large cohorts in active learning, it is not designed for teaching more students with fewer staff. It works best with a tutor-student ratio similar to that of a typical seminar or practical session. Where the group is larger than thirty, two approaches are common at NTU: team teaching and cohort splitting. Team teaching usually takes place in one of the larger SCALE-UP rooms and involves having more than one tutor present during sessions to facilitate group work and answer questions. Cohort splitting involves dividing the group into two or more smaller groups and repeating the teaching session as many times as necessary. In both instances, extra attention may need to be paid to timetabling, tutor time allocation, and module cohort management.

### ***Time allocation***

The evaluation of pilot modules at NTU found that preparing to teach using SCALE-UP could take longer than usual as it required some rethinking of module content and re-design of activities and resources. Depending on the learning and teaching approaches already used on a module, this kind of re-design might call for a larger allocation of hours within MAW during a module's first iteration in SCALE-UP mode. The benefits of SCALE-UP for

student learning and satisfaction make this initial time investment very worthwhile.

### ***Framing with students***

SCALE-UP replaces lectures with active learning and therefore—as with any shift to a more active learning approach—it may challenge students' expectations about learning and feel different to other module activities. Academic colleagues and their students may need to be supported through this transition period, while students are adjusting and beginning to see benefits. A resource called *SCALE-UP—Information for Students* is available on the [CADO website](#) to give to students and staff as relevant.



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## Appendix A: Key contacts

Central liaison for all SCALE-UP related issues: [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)

### In-session support

- Tech or A/V support during a session (e.g. can't connect to AppleTV/Miracast, laptop/MacBook won't turn on, error message that inhibits device use, audio problems):
  - City & Clifton: 88500 or +44 (0)115 848 8500
  - Clifton (Heart of Campus): 83400 or +44 (0)115 848-3400
- Emergency partition movement (Boots library only) - **Estates 82211**

Please let [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk) know about any issues you identify.

### Non-urgent in-session issues

- Ongoing technical or A/V issues (e.g. slow laptops/MacBooks: **log a ticket with IS** and cc [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk))
- Issues with room dividers, tables etc: Email [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk) or contact Facilities/Badger and cc [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)

### Timetabling

Timetabling: To be timetabled into a SCALE-UP room contact your ATL and inform [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)

For timetabling information and support contact your local Timetabling team.

For room booking requests (e.g. for one-off sessions), contact: [REG Room Requests](#) or your usual contact for non-timetabled sessions.

### Ongoing support

For support with all other aspects of SCALE-UP e.g. module (re-)design, active learning strategies, SCALE-UP theory and practice, Elearning tools advice, equipment familiarisation etc. contact:

SCALE-UP Support team (CADQ): [NTUSCALEUP@ntu.ac.uk](mailto:NTUSCALEUP@ntu.ac.uk)

Individual contacts:

[helen.puntha@ntu.ac.uk](mailto:helen.puntha@ntu.ac.uk) / 0115 84 (88128)  
[ellie.kennedy@ntu.ac.uk](mailto:ellie.kennedy@ntu.ac.uk) / 0115 84 (82243)  
[wendy.oneill@ntu.ac.uk](mailto:wendy.oneill@ntu.ac.uk) / 0115 84 (88190)  
[michaela.borg@ntu.ac.uk](mailto:michaela.borg@ntu.ac.uk) / 0115 84 (88204)

## Appendix B: Framework for SCALE-UP module re-design

The effective implementation of a SCALE-UP approach will likely require some re-design of learning materials and activities. The table below offers suggestions to frame thinking about three key elements of SCALE-UP, and may be particularly useful to colleagues preparing to teach a module in SCALE-UP for the first time. It is not intended to be an exhaustive guide to SCALE-UP planning but rather a series of useful prompts to be used by an individual tutor or module team. To request an electronic copy, email [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk).

For more ideas, see resources available at: [http://ntu.ac.uk/adq/teaching/scale\\_up/support\\_resources/index.html](http://ntu.ac.uk/adq/teaching/scale_up/support_resources/index.html)

Aspect of SCALE-UP approach	Ideas for where/how it could be used on the module	How it might fit with students' prior learning experiences
<p><b>Upside-down pedagogies (flipped learning)</b></p> <ul style="list-style-type: none"><li>• Content delivery happens outside/before class</li><li>• Content is 'chunked', i.e. divided into segments such as short videos, short readings and podcasts</li><li>• Materials are made available online</li><li>• A focus question or task is set to encourage student engagement with the content outside class</li><li>• Student understanding of the content is checked, e.g. via an online quiz</li></ul> <p>See Section on <a href="#">Flipped Learning</a> for more ideas</p>		

<p><b>Active/interactive learning</b></p> <ul style="list-style-type: none"> <li>• The majority of a SCALE-UP session comprises active learning through group activities</li> <li>• Group activities are problem-based/enquiry-based</li> <li>• Activities might include Beichner’s ‘tangibles’, ‘ponderables’ or ‘visibles’</li> <li>• Beichner recommends the GOAL framework for problem-solving</li> <li>• A MacBook/laptop per group of 3 students is available to support group work</li> </ul> <p>See sections on <a href="#">SCALE-UP style collaborative learning</a>, <a href="#">in-class activities</a> and <a href="#">‘backward’ curriculum design</a></p>		
<p><b>Group organisation</b></p> <ul style="list-style-type: none"> <li>• Mixed-ability, teacher-allocated groups work better than friendship groups</li> <li>• Beichner recommends using group roles: organiser, scribe, sceptic</li> <li>• The basic SCALE-UP unit is the group of 3. These can be combined—for example into tables of 9—for activities suited to larger groups</li> <li>• Regular, structured reflection helps students develop effective group work skills</li> </ul> <p>See section on <a href="#">SCALE-UP style groups</a></p>		

## Appendix C: Some useful tools and apps

It may be useful initially to limit the number of tools or applications so as not to distract from learning. The following free tools may be useful to start with, depending on subject and task.

Tool/Application	What is it	Ideas for use on a SCALE-UP module
<b>NTU Online Workspace</b> 	NTU's Virtual Learning Environment (VLE) available to all NTU staff and students	<ul style="list-style-type: none"> <li>• Managing and sharing resources (e.g. setting availability dates)</li> <li>• Communicating with students</li> <li>• Collaborative student workspace (Groups tool, Shared Files area)</li> <li>• Feedback (Assessment, Self-Assessment and Discussion tools)</li> </ul>
<b>Padlet</b> <a href="http://Padlet.com">http://Padlet.com</a> 	Virtual walls for sharing resources and ideas. See <a href="#">Tools for sharing student work</a>	<ul style="list-style-type: none"> <li>• Sharing resources with students</li> <li>• Collaborative student workspace</li> <li>• NB it is useful for tutors to create a free Padlet account in order to manage Padlet walls (students can access and contribute to these without creating an account)</li> </ul>
<b>Screencast-O-Matic</b> <a href="http://www.screencast-o-matic.com/">http://www.screencast-o-matic.com/</a> 	A screencasting tool for capturing what is shown on the screen (moving or still), along with audio narration	<ul style="list-style-type: none"> <li>• Creating flipped resource 'chunks'</li> <li>• Providing feedback, e.g. cohort feedback to address common mistakes</li> <li>• Explaining, clarifying and reinforcing key ideas and concepts</li> </ul>

<p><b>Polleverywhere</b>  <a href="https://www.polleverywhere.com/">https://www.polleverywhere.com/</a>  </p>	<p>A Polling and Audience Response System (ARS)</p>	<ul style="list-style-type: none"> <li>• Testing and confirming understanding of content</li> <li>• Reinforcing key points and concepts</li> <li>• Questioning, quizzing and general polling</li> </ul>
<p><b>Office 365</b>  </p>	<p>Online version of Microsoft Office tools &amp; applications available to all NTU staff and students. See also <a href="#">Tools to facilitate group work</a></p>	<ul style="list-style-type: none"> <li>• File exchange and document sharing (Yammer, One Drive)</li> <li>• Collaborative multiuser document editing (OneDrive)</li> <li>• Resource and file storage (OneDrive)</li> <li>• Group communication and polling (Yammer)</li> <li>• Manage a group calendar (Outlook)</li> </ul>
<p><b>Google Docs</b>  <a href="https://www.google.co.uk/docs/about/">https://www.google.co.uk/docs/about/</a>  </p>	<p>An application for creating, editing and storing documents and spreadsheets</p>	<ul style="list-style-type: none"> <li>• File exchange and document sharing</li> <li>• Collaborative multiuser document editing</li> <li>• NB students need to have a Google account</li> </ul>

## Appendix D: Example SCALE-UP tech familiarisation session (MacBooks) for Physics students

Today's session will give you more confidence to use the Mac Books and the projectors in the room.

### **Task 1: The Mac Operating System**

Familiarise yourself with the Mac operating system. There are online guides that you can use. For example:

What is the Mac equivalent of My Computer for navigating folders and files?

How do you open, close, minimise and move windows?

Can you search for content or applications?

Can you open a browser window? Excel? Word? Try to put a shortcut to one of these applications on the desktop.

Create a file in Word and save it to the desktop. Make a copy of this file and copy it somewhere else.

How can you take a screenshot? Do this and copy it into your Word file.

### **Task 2: The Mac Book keyboard and trackpad**

You will have noticed that the keyboard and trackpad are a bit different to what you are used to on a Windows machine. Investigate the following:

What are the function of any keys on the keyboard that you do not recognise? Make a list in a PowerPoint file, with images for the keys (taken from the internet)

How do you right click using the single button mouse pad?

Investigate gestures. These are various ways of using the swipe pad with several fingers for scrolling, zooming, navigating...Copy into your PowerPoint a link to the best webpages which explain how to use the trackpad.

### **Task 3: Sharing files in the SCALE-UP room**

One of the ideas of the SCALE-UP approach is to be able to share your work with others. Have a go at the following activities:

Project your screen onto one of the projectors in the room

Send your word file to your H:\ drive

Share your word file with others around your table

### **Task 4: Using Excel**

Several of the weekly exercises will require you to use Excel on the MacBook. The software is almost identical to the Windows version, but the keystrokes and mouse gestures may be different. To familiarise yourself, try the following activities:

Find some interesting data on the internet. It would be anything you want as long as there are two sets of data you can plot against each other. Maybe you can find historical temperature data going back thousands of years, population data, goals scored in the Premiership, the average starting salary for a Physics undergraduate, the rate of deforestation, the popularity of YouTube...

Copy the data into two columns in Excel, Plot the data in a well formatted chart. Label the axes and add a heading.

Fit a meaningful trendline to some section of the curve, and create an equation for the curve.

Copy the chart into your PowerPoint presentation.

Make a short presentation to the rest of the room about what you have discovered.

## Appendix E: How to join SCALE-UP

→ Colleagues who would like to teach in a SCALE-UP setting next year:

**Spring/early summer**, module lead approaches their **ATL** and:

⇒ Explains what they would like to achieve by moving the module to SCALE-UP and

→ ⇒ Requests to be timetabled into a SCALE-UP room

**Spring/early summer**, module lead contacts [NTUSCALE-UP@ntu.ac.uk](mailto:NTUSCALE-UP@ntu.ac.uk). Colleagues in CADQ arrange a conversation about how the particular module and cohort could benefit from SCALE-UP and what work might be needed in order to adapt the module for a SCALE-UP setting.

**Over the summer**, module team begins module re-design. This process can also continue during the course of the year. CADQ can support the team with decisions about priorities and process.

**Before term starts**, module team attends a SCALE-UP Workshop, or arranges some 1:1 support from CADQ via [NTUSCALEUP](mailto:NTUSCALEUP).

**Before term starts**, module team attends a familiarisation session on care and use of the equipment in the room.

**Beginning of term**, tutors on the module team explain the purpose of the SCALE-UP room and approach to students.

**ATL** contacts Timetabling regarding the necessary room requirements

### Colleagues finding themselves timetabled into a SCALE-UP room:

Any group timetabled into a SCALE-UP room can already access much of the equipment provided there to promote active learning, such as round tables, student whiteboards, and mirroring technology. Academics wishing to learn more about the SCALE-UP approach and interested in adapting their module to get the most out of the setting can contact [NTUSCALEUP@ntu.ac.uk](mailto:NTUSCALEUP@ntu.ac.uk) for discussion and support. SCALE-UP techniques can be introduced gradually throughout the course of the module.



### Support available from CADQ

- Support for curriculum redesign
- Inductions
- Technology familiarisation sessions—run in conjunction with IS
- Targeted in-session support
- Elearning advice
- Networking opportunities with fellow SCALE-UPpers
- Workshops on active learning pedagogies

Email: [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)

CADQ SCALE-UP web pages:

[http://ntu.ac.uk/adq/teaching/scale\\_up/index.html](http://ntu.ac.uk/adq/teaching/scale_up/index.html)

### Who to contact

- Central liaison for all SCALE-UP related issues: [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)
- Tech or A/V support during a session:
  - City & Clifton: 88500 or +44 (0)115 848 8500
  - Clifton (Heart of Campus): 83400 or +44 (0)115 848-3400
- Ongoing technical or A/V issues: log a ticket with IS and cc [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)
- Issues with room dividers, tables etc: Email [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk) or contact Facilities/Badger and cc [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)
- Timetabling: To be timetabled into a SCALE-UP room contact your ATL and inform [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)
- Module (re-)design, active learning strategies, SCALE-UP theory and practice, Elearning tools advice, SCALE-UP orientation: Email [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk) (or contact a member of the SCALE-UP support team
  - Ellie Kennedy: 82243
  - Helen Puntha: 88128
  - Wendy O'Neill: 88190

Each SCALE-UP room contains an information binder with instructions for using the equipment. Instructions are also available to download via the [SCALE-UP SharePoint site](#) or on request from [ntuscaleup@ntu.ac.uk](mailto:ntuscaleup@ntu.ac.uk)



