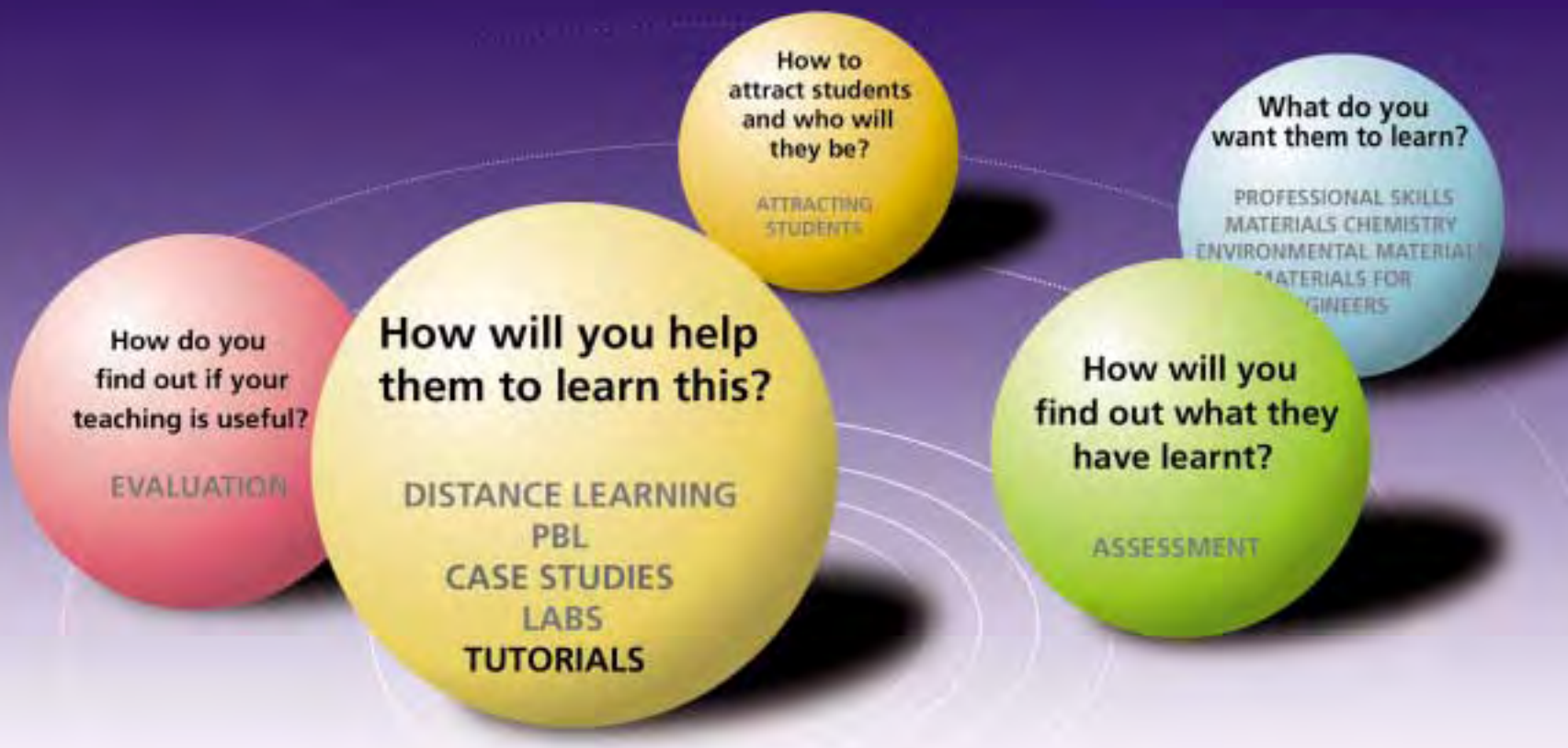
Tutoring Materials

Adam Mannis and Shanaka Katuwawala



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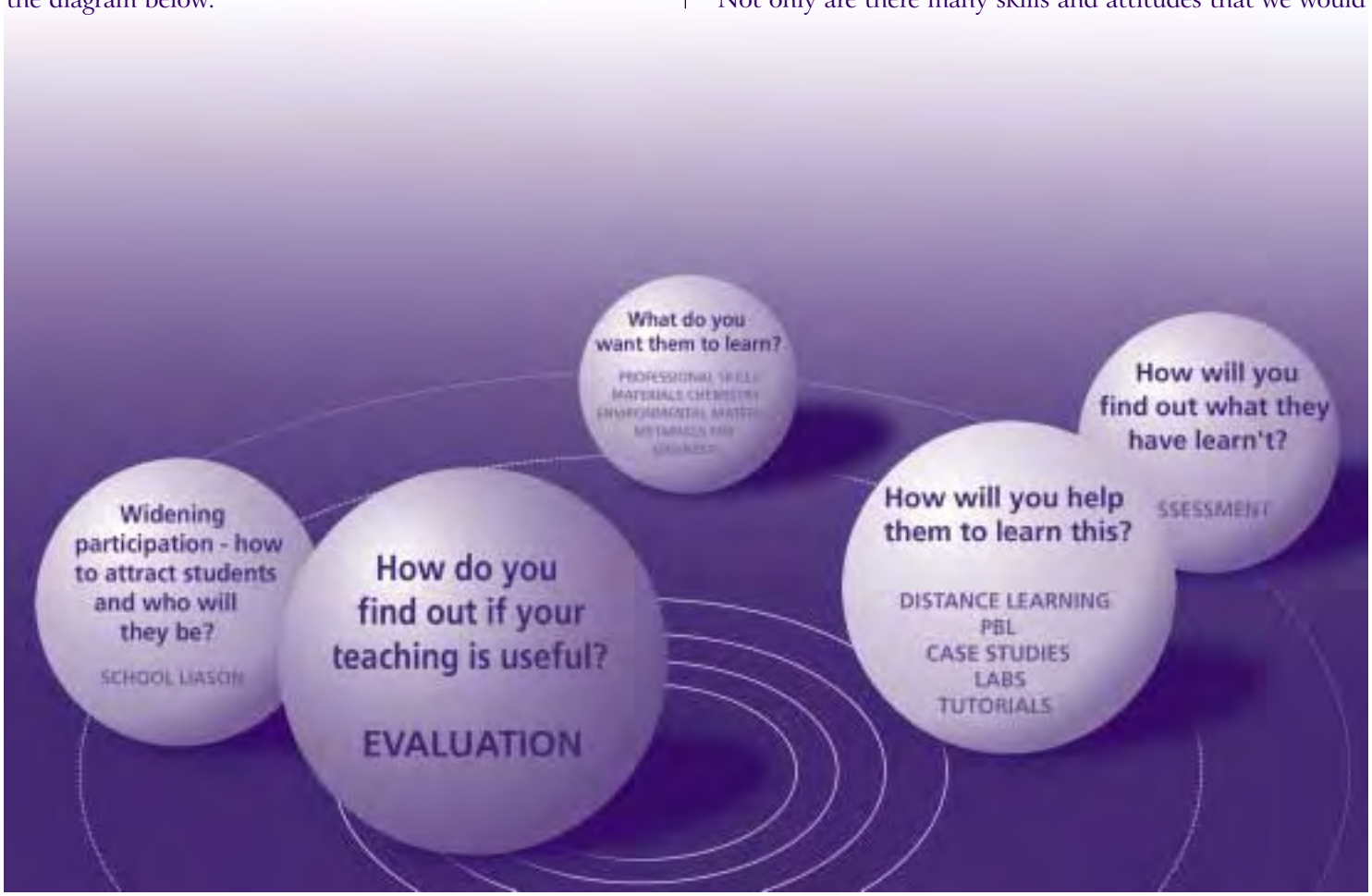
Tutorial Environment

INTRODUCTION

Many of our community, lecturers in the disciplines of and relating to Materials Science and Engineering, have expressed interest in simple-to-use guides to support the workshops we run on learning and teaching. As part of our 'Thematic Groups' scheme, we have established 12 themes for this special focussed support, each of which is led by a 'Thematic Group Leader'. During the first two years of the scheme, workshops have been held on these themes and this has enabled the leaders to further explore relevant issues with lecturers and feed the results into this series of booklets.

Learning and teaching is a continuous cycle represented in the diagram below:

We can start at any point around the cycle. If we are in the business of teaching it certainly helps if there is someone to teach! Not such a funny joke in the current climate with reducing numbers of students in technical disciplines. Hence one of our main concerns is how can we approach schools and work with school students to attract them into Materials areas. 'Attracting Materials Students' by Cheryl Anderson explores how we can work with schools and the wider community to ensure a diverse and inclusive group of able students on our courses. Once we have a class to teach, what would we like to teach them? The first reaction to such a question is to make a list of topics or knowledge. However, this is only a beginning, and a very limited one. Not only are there many skills and attitudes that we would



like them to develop, but learning is more complex than simply the what. It also involves the how. 'Developing Professional Skills' by John Wilcox explores the approach to empowering students to track their own skills development as they progress. 'Materials for Engineers' by Mike Bramhall, 'Materials Chemistry' by Stephen Skinner and 'Environmental Materials' by Cris Arnold, focus on what we might like to include in a specialised curriculum, for targeted students. The knowledge, skills and attitudes or learning objectives identified for each course must be assessed if we are going to give credit to students for learning what we want them to learn. 'Assessing Materials Students' by Lewis Elton gives support to the development of assessments and assignments that do in fact give marks for those things we want to acknowledge, rather than those aspects that are simply easy to assess!

Believe it or not it is only at this stage that we can really consider how we should teach the students to learn these things. We all know about lectures but will we use in addition or instead: tutorials ('Tutoring Materials' by Adam Mannis and Shanaka Katuwawala), labs ('Teaching Materials Lab Classes' by Caroline Baillie), case studies ('Teaching Materials Using Case Studies' by Claire Davis and Elizabeth Wilcock), problem based learning ('Learning Materials in a Problem Based Course' by James Busfield and Ton Peijs) or even learning at a distance ('Learning Materials at a Distance' by Mark Endean)?

The final stage before we start all over again is to see if we have done what we intended to do. We may have already found out whether, and how effectively, the students learnt what we wanted them to (i.e. if the assessment matched the learning objectives and if our teaching methods suited the students' learning approaches). If this has not proved to be as ideal a scenario as we would have wished we will need further input to analyse what has happened. 'Were the course objectives inappropriate?' 'Am I sure that the assessment did not force my students into taking a surface approach? ' Did the students take on surface approaches to learning because of my teaching?' Ivan Moore's 'Evaluating a Materials Course' will give you the tools of the trade to conduct your own thorough evaluation and enable you to develop an improved course for next year's cohort. Which brings us back to the beginning of the cycle. 'Are we attracting students with appropriate abilities for this course?' And on it goes ….

In writing these booklets, and running the workshops we have had a lot of fun and we hope that you catch the flavour of this in using them. Stay in touch and give us feedback about your ideas in implementing any of the suggestions. As a community we can learn most from each other.

Caroline Baillie and Leone Burton
Editors

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WHY USE THIS BOOKLET?

Materials Technology, or Materials Science & Engineering, is a subject that crosses many boundaries. It draws on the fields of physics, chemistry and maths and applies them to all different applications in engineering. It bears its own unique qualities and difficulties as a result of this diversity in thinking styles bringing about the possibilities of deep approaches to learning. However, students have little understanding of what they will meet on the course, often they have little awareness of Materials Technology and have entered the course as their second or third choice.

The QAA Subject overview report (1999) suggests that most institutions:

are experiencing 'considerable difficulties in recruiting suitably qualified entrants',

and that there is 'a tension between the desire for access and student numbers and high rates of progression'.

This is considered a cause for concern especially in the first year of the programmes and:

'there is scope for improvement in progression and completion rates in many institutions'.

Despite this concern, overall the outcomes were considered encouraging and many institutions received very high ratings in all categories. Student support and guidance was the strongest contributor to the stated aims and objectives and particular note was made of the tutorial pastoral care and the good staff student relations. This is made easier by the relatively small size of the classes in materials (average 30 students). However, there seems to be a significant problem if the level of support and tutorial mechanism is considered good and yet there is still a concern for student progression and completion rates in many institutions.

It is clear that with such small class sizes, the scope for teaching in small groups, or tutorials, is much higher than in other subject areas. It is also well known that small group teaching is ideal for dealing with learning difficulties associated with multiple learning styles, diverse cultural and academic backgrounds as well as motivation levels, all of which are potential reasons for the lower progression rates associated with lowering access standards. It may,

therefore, be the case that the tutorial approach is not optimal and opportunities for learning are being lost. It has been stated in the Subject overview report:

> ***'there is still an "over-reliance" on traditional methods in some instances'.***

It should be noted that recently the Materials community has been in a period of flux, with a growing number of Materials staff in the UK now being in broader Engineering Departments, due to recent changes in which many dedicated Materials Departments have been integrated within Engineering/Technology Schools. The current situation is as follows:

- Materials programmes are taught in a small number of dedicated Materials Departments
- Large numbers of Materials degrees are taught in Engineering Schools
- Many Materials modules are taught as part of common 1st years in Engineering programmes
- Certain new Materials degrees are now emerging as niche specialisations in specific fields, such as Materials combined with Chemistry, or Sports Science, or Medicine

As such, there is a new range of issues relating to the teaching of Materials within a broad Engineering context that Materials staff must now deal with. Also, what works in some contexts and is considered best practice will not work in others, and as such the UK Materials community needs to develop and share their experiences.

PERSPECTIVE ADOPTED IN THE BOOKLET?

This booklet aims to reflect upon good practice in tutorial teaching within Materials programmes, and to disseminate this with all providers. Guidelines drawn from the study highlight strategies in tutorial systems to improve progression rates in all institutions, as well as enhancing employment prospects.

WHAT IS MEANT BY 'TUTORIALS'?

'Tutorials' can mean anything from a group of four students to a group of approximately thirty students, depending on the context. What you can do with the students largely depends on the size of the group.

WHY USE TUTORIALS IN TEACHING? Addressing Student Diversity in Tutorials

When considering the diverse population of students, we need to be aware of and take account of differences in expectations, in academic ability, in age and maturity, in work related experience, in mathematical and physical science background knowledge and skill, in personality, spatial ability, cognitive type, learning style, cultural and language background, as well as gender. We need to be aware of what approach students take, because of their different experiences and filters of perception (Marton and Booth, 1997).

We must also assess the accessibility of various tutoring approaches for disabled students. Parker (1999) discuss some important issues relating to visually impaired students, deaf and hard of hearing students, students with medical conditions, students with physical disabilities, students with language and speech difficulties, students with learning difficulties (including dyslexia) etc. All of these disabilities may prevent students from learning in certain conditions and rooms.

Tutorial Environment

Addressing Student Employability in Tutorials

Tutorials are very important for encouraging students to think – to compare ideas, give expressions to their understanding of a subject, help students to help each other, share and compare ideas, encourage active learning and exchange of ideas, evaluate and develop personal and professional values. Additionally, tutorials can be employed to acquire and practise important professional skills of team working, leadership and communication skills. Through their active involvement, students are encouraged to monitor their own learning and gain a degree of self-direction. Two main factors are to be considered: content of the educational session, and the characteristics of the learning and teaching process. Both depend on the purpose (i.e. educational aims and objectives) of the session.

Materials scientists and engineers will usually work in teams, solving problems, particularly associated with the development of new materials for given applications. Analysis, critique, assessment of selection criteria, redefining problems or problem finding, as well as creative thinking are all essential elements of their jobs. Students need to develop these skills as well as enhance their ability to communicate their creative ideas and their finished work or innovation to an audience (customer, designer, etc.) (Dewulf and Baillie, 1999).

WHERE ARE TUTORIALS USED IN TEACHING?

The specific purpose of tutorials can be any, or all, of the following three; subject or course academic support, skills development, or personal tutorials (mentoring).

Academic tutorials – subject oriented

The academic tutorial 'is concerned with the development of the student's powers of thought' (Jacques, 1991) within a subject or course. It is, in general, aimed at one to six students – in a one-to-one tutorial the tutor may focus completely on work completed by the student. In some situations, classwork sessions of between twenty to thirty students are also called tutorials, as their main aim is interaction with students, and for the students to work and think during the session.

Skills development

Some tutorials or small group work is designed to promote certain personal transferable or professional 'key' skills. Schemes are increasingly introduced into degree programmes to improve students' skills in teamwork, communication (oral and written), leadership, creativity, etc (Dewulf and Baillie, 1999). These might be 'add on' sessions with the whole class, in small groups, or as part of the academic or personal tutoring system. They might also be integrated throughout the degree programme.

Specific attempts are made in the first year in many universities for students to learn how to learn (Baillie, 1999). There has been a move in recent years away from the 'study skills' approach of telling students how to study, and towards the idea of helping students develop a responsibility towards learning which motivates them to understand rather than reproduce (deep rather than surface approach) (Ramsden, 1991).

Personal tutorials or mentoring

In most UK universities lecturers are allocated one or more personal tutees who they are asked to 'monitor' during their time of study. This practice is very ad-hoc, with some academics taking their role more seriously than others. Some personal tutors see their students once every two weeks at least for the first year. Some never see their tutees, but students at least know they are there. This can be less than satisfactory in some instances where lack of support was found to be the main cause of student dropout. Personal tutors are rarely trained for their job, and neither student nor lecturer fully understands the boundaries of their role. It is obvious that they cannot be a 'counsellor', and yet this is often the term used to describe their role.

WHO CAN TEACH TUTORIALS?

Staff tutors

In the UK it is common for lecturers to take tutorials, both academic and personal. In some Universities lecturers are trained in small group teaching techniques as part of their initial induction, but less are trained in personal tutoring/mentoring skills. Senior tutors oversee the system in many UK Universities, who are responsible for the personal or sometimes the academic tutorial schemes of Departments. Therefore, the effectiveness of tutorials in different Departments often relies on the Senior Tutor's capabilities and responsibility.

Peer tutors

Peer tutoring schemes have been successfully implemented in many Universities worldwide to promote student learning (Magin and Churches, 1997). Peer tutors help

younger students to learn by holding group sessions in which certain topics are discussed. The aim of the scheme is not to provide textbook answers to set problems or even to provide formal supplementary teaching, rather it is the peer tutor's role to act as a focus for the group and thereby make it work for itself. More specifically, the group provides a supportive environment for new students:

- to test out their understanding of difficult concepts introduced in lectures
- gain confidence in dealing with the volume of and complexity of material
- use the staff-run tutorial system effectively
- take more responsibility for their own learning
- encourage cooperative problem-solving methods
- promote a deeper approach to learning

In the Department of Materials at Imperial College London a peer tutoring scheme was established in October 1997 for the first year crystallography students, focused on the learning of crystallography (Baillie and Grimes 1999). This has proved very popular over the years with at least 60% voluntary attendance.

Tutor training

In many Universities training of staff is a compulsory part of their induction. Small group teaching may or may not be included in the workshops that staff have to take as part of their training. However, mid career staff may never have been trained in small group techniques and have little understanding as to their role and function, nor any experience of facilitating rather than teaching or lecturing. Mentors are rarely trained unless an optional course is provided which a handful of interested staff will take. Senior tutors are rarely trained. Postgraduate tutors are less often trained. Peer tutors are always trained, and this is an imperative and very effective part of the peer tutoring schemes that are run. The training is often seen as so useful that some lecturers could also profit from such a course.

Interaction, both learner-to-learner and learner-to-tutor, is another powerful method of ensuring learners maintain an appropriate pace, and judicious intervention by tutors can help motivate and encourage learners to keep going. The role of the tutor in distance learning is a subject in its own right and I recommend you consult one of the sources listed under 'Further reading' if you wish to pursue this further.

HOW CAN TUTORIALS BE TAUGHT?

Motivating students of mixed abilities and backgrounds

(a) Key Issues:

'Materials for Engineers' classes often consist of students of mixed abilities and backgrounds, with and without chemistry or maths. The class may even be from different disciplines or branches of Engineering. Therefore, tutors have to teach students the same core Materials information – so how can they deal with this, and motivate the students?

- Tutors can learn from motivation literature about what to do with students in groups, to help them realise that Materials is not just something to be swallowed whole and regurgitated in an exam i.e. staff should help develop a deep approach to learning in students
- Tutors could teach general principles in lectures and apply these to different contexts (e.g. different problems for different branches of Engineering) in associated tutorials
- It is important that tutors understand and appreciate how to teach to different backgrounds; e.g. so as not to lose the well prepared students through boredom, and the less experienced ones by moving too fast

- When teaching in a generic context, tutors can help to make Materials appreciated as a subject in its own right and not the poor relation, or seen as something else like Chemistry.

(b) Increasing student motivation for studying Materials:

Engineers often see Materials as a subsidiary subject. Only when Materials failure occurs does the importance of Material selection become apparent. What can tutors do to encourage motivation for studying Materials?

1) Tutors need to appreciate where the first year student is 'at':

- They need to adjust to the diverse intellectual levels and styles of learning of their students
- Often, they are not thinking of what the student is receiving

2) Students need to have the fundamentals of Materials in place very early on, and the cross disciplinary aspects of Materials need emphasizing:

- Stress the importance of concepts rather than details
- Encourage linking of concepts across modules, so curriculum design is extremely important

3) Tutors must continually emphasize the relevance of studying Materials to students:

- Justify the importance of Materials to society
- Continually impress on students, what is the point of doing this?
- Materials selection, manufacture and design challenge is intrinsically rewarding
- Stress the wide range of career opportunities that the study of Materials affords
- Use graduate profiles to remind students that the course is worthwhile

4) Giving realistic feedback to students is crucial to motivating students:

- A good personal tutor system can make a significant contribution here
- Use assessment to check for understanding not rote learning

5) Interactive teaching helps increase motivation:

- Introduce fun things to do and real examples of Materials to students
- Group work can help motivate students, as can hands-on lab experiences

Implementing teaching & learning innovations for better student understanding

(a) Key Issues:

How do tutors stimulate students to develop a 'feel' for a Material and a mental picture of how a Material behaves? What teaching and learning innovations help address the changing skills base of Engineering students?

- It is very important that tutors help students gain an appreciation of Materials, especially when they don't get to feel the Materials
- Tutors should ensure that there is an adequate balance of theory and practice, and that students see subject relevance
- Tutors need to carefully consider assessment to make sure that Materials is not assessed by memory-only exam-style questions, which can be the case for relatively less mathematical subjects. Even in the first year concept-based questions are necessary

(b) Implementing an innovation – the case for PBL (Problem Based Learning):

1) PBL involves students working in teams on case studies in which realistic industrial problems are solved, the aim being:

- to integrate knowledge and skills (multidisciplinary)
- to acquire knowledge through self-study (learning to learn)
- to teach students to work in groups
- to improve communication skills
- to improve problem solving ability

2) Every student is part of a small team (of approx six), supervised by a tutor.

- Important that the tutor does not impose their own knowledge and standards on the students, but instead helps them to find their own way in solving the case study

3) Since students work in small teams and only individually cover one aspect of the problem, tutors need to ensure individual students learn all topics in the case study. This can be achieved by:

- Having a case study mark (individual and group), but also have an exam that covers all case studies
- Students submitting an individual report on part of the problem, but the group combining reports and each student having to write an abstract, introduction and conclusions

4) Important for tutors to ensure that all students contribute and learn all skills.

- Rotate the chair and minute-taker roles that students adopt in weekly team meetings
- Ensure a balance of students in each team; i.e. natural leaders, team workers, etc.

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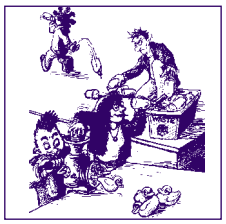
Other Booklets In the Series:

Attracting Materials Students – Cheryl Anderson

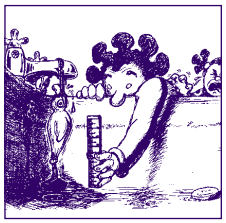


Environmental Materials – Cris Arnold

Teaching Materials Using Case Studies – Claire Davis and Elizabeth Wilcock

Developing Professional Skills – John Wilcox

Assessing Materials Students – Lewis Elton



Learning Materials at a Distance – Mark Endean

Materials for Engineers – Mike Bramhall

Tutoring Materials – Adam Mannis and Shanaka Katuwawala

Learning Materials in a Problem Based Course – James Busfield and Ton Peijs

Materials Chemistry – Stephen Skinner

Teaching Materials Lab Classes – Caroline Baillie

Evaluating a Materials Course – Ivan Moore

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