Journals based on applications: An attempt to improve students' learning about composite materials

Summary

Staffan Lundström
Department of polymeric materials
Chalmers university of technology

Shirley Booth
Centre for educational development
Chalmers university of technology

1. Introduction

This work considers a course on fibre reinforced composite materials, given to students in their fourth and final year of a Masters degree in mechanical engineering. The teaching form and the examination for the course were rather traditional, with lectures, tutorials and practicals. Students who successfully carry out the practicals and obtain a certain amount of marks on a written exam pass the course. The course was seen to need a new approach because on the one hand the field of fibre reinforced composite materials is growing with respect to application and manufacturing methods, as well as theoretical aspects, and on the other hand there were certain shortcomings seen in the students' learning on the course.

2. The problem

The course in focus can roughly be divided into five areas, and from earlier course evaluations it is clear that some students have difficulties in finding connections between them. This has resulted in their being somewhat frustrated and their losing interest in the course. The most probable reason is that each area is treated in detail in the course: the students were quite simply studying five sub-courses and not seeking links between them, or the underlying principles. The students were therefore much too focused on the details without really knowing why they are important. The goal for the students therefore becomes to learn something just for the sake of passing the exam, which appeared like five sub-exams.

Hence, tools are required which the students can use to find connections between the sections of the course. One such tool is the central subject in this report namely: Journals based on applications.

3. Method

The first idea for an alteration in the composite materials course was to include projects carried out in groups. The projects would be handed in as reports and presented at a compulsory seminar. At this seminar the different projects were also to be graded by the lecturers and, if possible, by a representative from the industry. This, it was believed, would lead to a greater synthesis of the parts of the course, but it proved too costly in students' and teachers' time.

The second idea, inspired by a story related by another teacher (November, 1997), was to have each student write her/his own journal in which the theory and practical knowledge currently being treated would be related to a given application. This, it was felt, would support the students in relating the parts of the course to one another and even relating the theory and practice to their own experience of applications in everyday life. It was this tool that was finally developed.

Other advantages of students writing journals were believed to be that:

1. They will help us to understand how the students, collectively and as individuals, think about the subject of composite materials and how they learn the subject.
2. Each student must take responsibility for her/his journal.
3. The discussions on the course material between the students would probably increase due to the journals, since there is a concrete task to relate to.

One potential risk with students keeping a written journal is, however, that of copying from one another, and the way of dealing with this without prohibiting the students from discussing the journals was to make each journal unique in some way. Thus each student was allotted a unique application on which the journal could be based.

Each of the students was required to write their own journal with well-motivated reflections on the course content, lectures, practicals and/or literature. The reflections had to be considered with respect to an application such as a tennis racket, a boat hull or an outer panel of a car. The students were instructed to hand in the journals three times during the course, and they received feedback a short while later. In the first year, each proper hand-in was awarded with some bonus-marks to be added to the results on the written exam. In the second year the hand-in was graded according to criteria developed during the first year. These comments were dealt with in a final hand-in, which was compulsory and did not give any extra marks on the exam.

The journals did not take too much time for students or for the teachers. In the first year a turn round of about a week was maintained; in the second year this was improved because of better routines and clear criteria for grading.

4. Results

The e-mailed journal entries have been collected and analysed. The first year led to a set of criteria for grading, in which the character of good entries and poor entries are discerned. The first and second year entries are being analysed to cast light on the ways in which students understand the composite materials they are learning about and the ways they go about learning, using a phenomenographic approach (Marton & Booth, 1997). These results will be presented in a more complete paper.

One set of results are the criteria devised for the quality of the hand-in, described further in the discussion section.

The main practical results are:

- The students are generally positive to the journals and they have the impression that the journals help them in their learning of the course material. An illustrative quote is,
 - The things you learn in the journals, these are things you remember throughout your entire life, while the things you learn for the exam you will soon forget.
- The general trend is that the students who write good journals also do well on the exam, which strengthens their motivation to spend time on them, and strengthens the teachers'

decision to continue with them. (Figure 1). There are, however, some anomalies which deserve further attention

An overall better communication with the students was achieved, which was a prerequisite for the rest of the practical results.

- The applications provide a starting point for student-led discussions during the lectures, for instance:
 - I have a propeller as application and I was thinking about choosing a ductile material, (in this case a thermoplastic material). It is, however, more difficult to manufacture a part with such a material, or is it?
 - My application is a panel for a truck. Should I use short fibres?
- The students came to see the limits of their knowledge and understanding, and how they developed. For example, at the first hand-in some of the students felt that they did not have enough information to design their part, and complained to the teacher. This was perfectly all right, since that should be the case at this stage of the course, and they could be reassured.
- The students got early feed-back if they, for instance, had misinterpreted central conceptions.

4. Discussion

What constitutes a good journal?

The first years' journals were commented and handed back, without grades being given. However, they led to the development of two criteria for a good journal and two for a poor journal, which were applied for our own use in the first year and handed out in the second.

A good journal is characterised by i) the student demonstrating connections between the course material and the application and ii) a worthwhile discussion on the course material. An example of the first, where "book work" is in plain text and connections are in italics, is:

”Except from being the constituent that stiffens up the composite, it is essential, that the fibres have a low cost. *Hence, glass fibres seem to be a good alternative for my application....* Coupling agents may be used to chemically bind the fibres and matrix together. *This is an important issue for my application, since there might be a scratch on its surface resulting in the fibres being exposed to water.*”

The second case contains some analysis, such as the following, where analytical considerations are in italics:

”Fibres are in general much stronger in tensile load than in compression load. *This must be remembered, when the part is manufactured. If the surfaces are strongly curled, the fibres must be bend in order to follow the surface and hence broken by too high compression forces.* The flexibility varies between different sorts of fibres.”

The journals were given a low grade for one of the following reasons: i) reflections on one or more themes are missing without comment, and ii) the main focus in the journal is the application, each topic being dealt with only in passing.

5. The way forward

The journal writing has now been implemented twice, and there are three things to work further with:

- analysis of the ways in which the students understand composite materials, in particular how they synthesise the parts into some sort of whole, and how they go about their studies in connection with the journal
- simplified web-based maintenance of journal writing and hand-in
- making better use of the journals in group discussion

6. References

Marton, F. & Booth, S. (1997). *Learning and Awareness*. Mahwah: Lawrence Erlbaum Ass.

November, P. (1997). *Learning to teach experientially: a pilgrim's progress*. Studies in higher education, 22, 3, pp 289-299