Lecturers’ perceptions of students’ learning needs in geo-engineering in Spain

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ABSTRACT: Results from a study on university lecturers’ approaches to teaching and lecturers’ perceptions of students’ learning needs in Spain are presented in this paper. A total of 27 lecturers of geotechnical engineering and engineering geology were selected for the study. Participants were asked to complete the Trigwell & Prosser’s Approaches to Teaching Inventory and a second Inventory developed by the last author of this paper. The first inventory gave an indication of lecturers’ approaches to teaching, whereas the second provided data on perceptions of students’ learning needs. Results showed how a content-focused approach is favoured by 67% of participants. Time management, critical thinking, problem solving skills, ability to make sound judgments, and ability to apply knowledge in practice, were all identified as key students’ learning needs; whereas ability to give oral presentations and research skills came last in the list. A number of comments regarding education of geotechnical engineers and engineering geologists in Spain are included in the paper.

1 INTRODUCTION

Changes to higher education introduced by the Bologna Process are affecting the way civil engineering in general, and geo-engineering in particular, is being taught in universities throughout Spain. The most significant change to date has been the substitution of the alternative three-year or five-year undergraduate degree for a four-year undergraduate course followed by an optional one or two-year postgraduate qualification.

Not only has the format of the degree changed, but also the number of institutions offering civil engineering courses in Spain has increased dramatically over the past few years. Whereas before only a reduced number of public universities offered the longer (and more exclusive) undergraduate degree, now there is an increasing number of institutions – both public and private – offering the old and about to start offering the new degrees.

The above changes call for a re-evaluation of the teaching and learning process with takes place in institutions offering civil engineering degrees in Spain.

Research in higher education on the topics of lecturers’ approaches to teaching, their conception of teaching, and the relationship between these two areas, has highlighted differences between alternative approaches to teaching (Trigwell & Prosser 2004, Prosser & Trigwell 2006, Postareff et al. 2008). On the one hand, a learning-focused (or student-focused) approach views teaching as a way of facilitating students’ learning process. The lecturer focuses on what the students are doing in the teaching-learning situation, and students are expected to construct their own body of knowledge and produce a new worldview independent of that of the lecturer. A content-focused (or teacher-focused) approach, on the other hand, is associated with a scenario in which the student is considered a passive recipient of information, transmitted from the teacher to the student. The focus of transmission is on facts and skills, and prior knowledge of the student is considered to be unimportant.

A distinction between approaches to teaching is important, since research has shown that each approach can have a distinct and marked effect on the way students see the learning process (Trigwell et al. 1999, in Trigwell & Prosser 2004). A content-focused approach to teaching has been associated with a surface approach to learning (reproduction), whereas the use of a learning-focused approach to teaching has been shown to result in students adopting a deeper approach to learning (understanding).

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first two authors teach geotechnical engineering and engineering geology at undergraduate and postgraduate level, their interest lies within these two areas of knowledge. Therefore, only lecturers teaching in any of the above two disciplines were selected for the study.

The study aimed at providing preliminary answers to the following two questions, within the context of geotechnical engineering and engineering geology education: (i) what are the lecturers’ approaches to teaching, and (ii) what are the students’ learning needs from the lecturer’s point of view. This paper reports on the methodology and the results derived from this study. The findings are expected to be of use not only to academics involved in the planning of courses in geotechnical engineering and engineering geology in Spain, but also to others outside the country which find themselves in a similar situation.

2 METHODOLOGY

2.1 Participants

A total of 27 lecturers of geotechnical engineering and engineering geology were selected for the study. It is acknowledged that this constitutes a very small sample; however, one must consider (i) the limited number of individuals lecturing in any of these two disciplines in Spain, and (ii) the inherent difficulties in conducting such a study (despite best intentions, academics tend to be rather busy people with little time to spare to fill in questionnaires). Except for one, all participants lecture at the Universidad Politécnica de Valencia (UPV). The last participant teaches at the Universidad Politécnica de Cartagena (UPCT). It is noted that the term “Universidad Politécnica” is given to those institutions specializing in technical degrees (there are four such institutions in Spain).

Regarding the sample’s composition, there was a good spread in academic category and teaching experience, although there was a majority of male respondents. All different academic categories recognised within the university system in Spain were well represented. In terms of teaching experience, six of the respondents had been teaching for more than 21 years, eleven between 11 and 20 years, seven been 5 and 10 years, and only three had been teaching for less than 5 years. Out of the 27 participants, only four were female (equivalent to a 12%, probably representative of the percentage of female lecturers teaching civil engineering in Spain at present).

2.2 Instruments

A two-part inventory was used to carry out the study: the Approaches to Teaching Inventory (ATI) (Prosser & Trigwell 1999, Trigwell & Prosser 2004) and a second inventory designed by the last author of this paper. The ATI was originally developed from research using a relational perspective in order to determine the relationship between teachers’ approaches to teaching and students’ approaches to learning in the physical sciences in higher education. Since made public in 1999, it has been used in a number of different contexts, mainly to collect data for the analysis of relationships between approaches to teaching and other elements of the same teaching-learning environment. Therefore, it seemed appropriate to use the Inventory in this study. The ATI is composed of 16 items, of which eight are in the Conceptual Change/Student-Focused (CCSF) approach to teaching scale, and the other eight in the Information Transmission/Teacher-Focused (ITTF) approach to teaching scale. Response to all items is on a 5-point scale from strong true (score of 1) to only true (score of 5), and all items are scored positively. A list of items, as given in Trigwell & Prosser (2004), is presented in Appendix 1.

The second inventory is composed of 18 items which aim at identifying students’ learning needs from the lecturer’s point of view. Each of these items represents a generic competence grouped under each of the four categories shown in Table 1. All items in the questionnaire are measured on a 5-point Likert scale, from strongly disagree (score of 1) to strongly agree (score of 5).

The ATI was translated into Spanish by the last author and both inventories were printed on the same piece of paper which was handed to each of the participants. The data was analysed using the statistical package SPSS, v.17.0.

Table 1. Learning needs grouped into categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – Information gathering and communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1*</td>
<td>Teamwork</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Time management</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Critical thinking</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Problem solving skills</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ability to make decisions</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Commitment and motivation</td>
<td></td>
</tr>
<tr>
<td>B – Knowledge and understanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ability to communicate</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Understanding of concepts and ideas</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Exam preparation skills</td>
<td></td>
</tr>
<tr>
<td>C – Management, creativity and analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Ability to make sound judgments</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Ability to apply knowledge in practice</td>
<td></td>
</tr>
<tr>
<td>D – Social and decision making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Ability to generate notes in class</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Ability to search for information</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Ability to complete written assignments</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Ability to present written assignments</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Ability to give oral presentations</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Research skills</td>
<td></td>
</tr>
</tbody>
</table>

*Item number in the inventory.

3 ANALYSIS AND RESULTS

Results are divided into two categories: (i) definition of lecturers’ approaches to teaching, as given by the ATI questionnaire; and (ii) identification of students’ learning needs from the lecturer’s point of view, as derived from the answers recorded in the second questionnaire.
3.1 Defining lecturers' approaches to teaching

For each of the participants, aggregate scores in both the CCSF and ITTF approach scales were calculated. On the basis of these, it was possible to differentiate between lecturers scoring higher in one of the two scales. The intention was to distinguish between those lecturers which, in what is believed to be the same context, favoured one of the two teaching approaches, rather than to classify lecturers as being inherently learning-focused or content-focused. Results from this exercise revealed that 67% of the participants (totalling 18 out of 27) had a higher aggregate score in the ITTF approach scale (content-focused) than in the CCSF scale (learning-focused).

As an additional exercise, the mean aggregate score for both the ITTF and the CCSF scales, considering all 27 participants, was computed. This resulted in a mean score of 34.59 for the ITTF approach and a somewhat lower figure of 32.11 for the CCSF approach. Associated standard deviations were 2.37 and 3.49 respectively (corresponding coefficients of variation, COV, of 0.06 and 0.11 respectively).

The significant higher proportion of lecturers scoring higher on the ITTF approach scale, as well as the higher mean aggregate score for the ITTF scale, are in line with findings previously reported in the literature. Lindblom-Ylänne et al. (2006) showed how there was evidence that approaches to teaching were related to teachers' discipline, and how teachers in the “hard” disciplines – amongst which engineering is included – were more likely to apply a teacher-centered approach to lecturing. Similar observations had previously been made by Trigwell (2002) and also Lueddeke (2003). As mentioned by Lindblom-Ylänne et al (2006), this quantitative derived result is consistent with the studies undertaken by Newmann et al (2002) in which teaching in “hard” disciplines is described as involving mainly mass lectures and problem-solving seminars, or simulations and case studies related to professional settings.

The COV reported above can be interpreted as indicative of certitude by the part of the participants, based on their own experience of teaching, when completing the ATI questionnaire. The larger COV associated with the CCSF items suggests that the respondents had a greater degree of uncertainty about the validity of the CCSF than the ITTF approach to teaching.

In summary, it is possible to conclude, based on the results presented above, that for the sample under consideration (i) the ITTF is favoured over the CCSF approach to teaching, and (ii) there is greater certainty about the validity of the ITTF over the CCSF approach to teaching.

3.2 Identifying students’ learning needs from the lecturer’s point of view

In order to analyse students’ learning needs from the lecturer’s point of view, the mean score and standard deviation for each of the items presented in Table 1 was computed for the entire population. Results are presented in the form of bar charts in Figures 1, 2 and 3. Each of the figures has two parts: the top graph represents mean scores, whereas the graph below gives standard deviations. Figure 1 presents statistics from all 27 participants; whereas Figures 2 and 3 give equivalent results for those lecturers favouring an ITTF teaching approach and a CCSF teaching approach respectively. It must be noted that Figure 2 is based on the response of 18 participants and Figure 3 on that of only 9 participants. Therefore, conclusions derived from these two figures are necessarily limited by the reduced sample size. Nevertheless, despite this inherent limitation, the insight derived from looking at the two separate groups is deemed to be of sufficient
Interest to justify the inclusion of these last two figures in the paper.

Inspection of the upper portion of Figure 1 shows the top students’ learning needs, as identified by the entire group, to be (in decreasing order of importance, or decreasing mean scores): ability to apply knowledge in practice (11), problem solving skills (4), time management (2), and ability to make sound judgments (10). The same group considered (in decreasing order of importance) teaching skills (18), and ability to give oral presentations (16) as the students’ least important learning needs. There is an interesting correlation between the ranking of a need (based on the mean score) and its standard deviation. The top needs (2, 4, 10, and 11) display some of the lowest standard deviations. In contrast, the bottom needs (16 and 18) have some of the highest standard deviations. There seems to be, therefore, great certainty amongst this group with regards to which constitute the most important students’ learning needs; however, when it comes to defining the least important, the data suggests doubt.

Students’ learning needs considered of greatest importance by those lecturers who scored higher on the ITTF scale (top of Figure 2) were (in decreasing order of importance) problem solving skills (4), ability to apply knowledge in practice (11), time management (2), and ability to make sound judgments (10). At the other side of the scale, research skills (18), and ability to give oral presentations (16) were considered (in that order) as the least important. As before, higher mean scores are associated with lower standard deviations and vice versa (bottom of Figure 2).

Statistics from the nine lecturers who scored higher on the CCSF scale reveal the following preference: ability to make sound judgments (10), ability to apply knowledge in practice (11) and time management (2) (these two learning needs obtained the same mean score), critical thinking (3), and problem solving skills (4). Except for critical thinking, the same top students’ learning needs are identified by both groups of lecturers. The order of importance, however, is teaching-approach dependent. In fact, there is a reversal in the order of importance assigned to the top learning needs. Whereas the “ITTF group” considered problem solving skills (4) as the top learning need, the “CCSF group” ranked this as the fourth most important need. Similarly, the ability to make sound judgments (10) was considered as the top learning need by the “CCSF group” of lecturers, whereas the “ITTF group” ranked this as fourth in importance.

Ability to give oral presentations (16), and research skills (18), were placed at the bottom of the list by both groups of lecturers; however, as before, the order of relative importance is teaching-approach dependent. Whereas the “ITTF group” considered ability to give oral presentations as the least important need in students of geo-engineering, the “CCSF group” considered research skills as the least important learning need.

4 DISCUSSION

Notwithstanding the limitations of the present study, some general comments can be made regarding current approaches to teaching and perceived students’ learning needs within the areas of geotechnical engineering and engineering geology in Spain. As reported in the literature, there is evidence that lecturers in the “hard” disciplines, such as engineering, are more likely to apply a teacher-centered approach to teaching. The current study, where 67% of the participants scored higher on the ITTF approach scale, further confirms this finding. There are, however, a significant proportion of lecturers that favour the CCSF approach. The small number of participants limits the depth of analysis that can be performed at this stage; thus it becomes difficult to answer, for example, questions such as what is the effect of gender, teaching experience, or academic grading on the preferred approach to teaching geotechnical engineering and engineering geology. These have been left as a research questions for further study. Equally, it is not possible to compare relative percentages of lecturers in geotechnical engineering and engineering geology favouring one or the other teaching approach, with percentages derived from similar studies carried out on lecturers of other subjects included within the civil engineering curriculum. As before, this interesting research question is left open for further study.

Ability to apply knowledge in practice, problem solving skills, time management, and ability to make sound judgments have been identified as top learning needs by all lecturers which took part in the study, irrespectively of their teaching style. In addition, those lecturers with a higher score in the CCSF
scale identified critical thinking as an additional top learning need. Despite similarities in their selection there is, however, a marked difference in the relative importance given to each of these, as inferred from mean scores. Whereas the “ITTF group” sees problem solving skills as the most important need, the “CCSF group” places ability to make sound judgments at the top of the list. This result seems to be in agreement with the idea of a content-focused and a learning-focused approach to teaching. In the present case, it is possible to see clearly how the emphasis of the content-focused group is on transmission of skills – in this case that of solving problems. The emphasis of the learning-focused group, on the other hand, is not so much on acquiring a particular skill, but rather on developing a general aptitude – that of being able to make sound judgments. The question, of course, remains as to what top learning need in particular, and what teaching approach in general, would be more relevant to a geotechnical engineer or an engineering geologist, as opposed, for example, to a structural engineer.

It is worth pointing out that all of the top learning needs identified by this particular group of lecturers correspond to those items grouped under the Management, Creativity and Analysis category (Table 1). Although no comments can be made at this stage, and the implications of this result are not clear, this constitutes, nevertheless, an interesting result deserving further study.

In terms of those learning needs perceived as having the least importance, the results should provide some ground for thought. In particular, the low score attained by the need to have the ability to give oral presentations contrasts markedly with the idea held in the profession that engineers – including geotechnical engineers and engineering geologists – need to develop sound communication skills, both written and oral, during their career. Referring to a quote included on a book on writing aimed specifically at engineers (Beer & McMurray, 1997) and reproduced below:

Communication skills are extremely important. Unfortunately, both written and oral skills are often ignored in engineering schools, so today we have many engineers with excellent ideas and a strong case to make, but they don’t know how to make that case. If you can’t make the case, no matter how good the science and technology may be, you’re not going to see your ideas reach fruition.


The limited relevance given to research skills, on the other hand, should not come as a surprise, given the nature of engineering and the expected career path of most graduates, which will lie outside a research environment. Yet, the profession expects engineers to innovate, and innovation requires a certain degree of skill in carrying out research (Bock, 2001).

5 CONCLUSION

The aim of this paper has been to present results from a small study aimed at determining lecturers’ approaches to teaching and identifying students’ learning needs from the lecturer’s point of view within the context of geotechnical engineering and engineering geology in Spain. The study was performed on a sample of 27 academics. Each was handed a questionnaire consisting of two inventories: the Approaches to Teaching Inventory (Prosser & Trigwell 1999, Trigwell & Prosser 2004); and a second inventory designed by the last author of this paper and aimed at identifying students’ learning needs from the lecturer’s point of view.

Based on aggregate scores in the two scales identified in the first inventory, it was possible to separate between lecturers favouring a content-focused and a learning-focused approach to teaching. Results indicate that for the particular group of lecturers analysed, two thirds of the participants prefer the former to the latter. This result is in agreement with findings previously reported in the literature. Results also show that this group of lecturers is more certain of the validity of a content-focused approach to teaching than a learning-focused approach. Evidence presented in the literature shows that there is a link between teachers’ approaches to teaching and the quality of students’ learning, and a content-focused approach to teaching has been associated with superficial learning on the part of the student. This is an important point to note when analysing current geotechnical engineering and engineering geology teaching and learning, as well as when planning improvements in the education of geotechnical engineers in Spain. It has not been possible, as part of this study, to investigate the influence of gender, years of teaching experience, and academic grade on favoured teaching approach.

Irrespective of the approach to teaching, there seems to be a general agreement on which constitute the most and least important students’ learning needs from those included in the second inventory (Table 1). Both the learning-focused and the content-focused groups of lecturers identified all of the learning needs categorised under Management, Creativity and Analysis as being the most important. These include time management, critical thinking, problem solving skills, ability to make sound judgments, and ability to apply knowledge in practice. There is a difference, however, in the order of importance assigned by each group. Those learning needs identified as being least important to the student include ability to give oral presentations and research skills. As before, the order of importance varies between groups.

In light of the results presented in this paper, two main questions arise. On the one hand, what should be the appropriate approach to teaching geotechnical engineering and engineering geology in Spain. Published research indicates that a learning-focused approach would be more appropriate under all circumstances, since it promotes a deeper approach to
learning. Nevertheless, a majority of the participants in this study – some of who have been teaching for over twenty years – favour a content-focused approach. The second question has to do with the reasons for not giving enough importance to communication in general, and oral communication in particular, by this group of lecturers. It is hoped that these two questions will guide further research on the topic of teaching geotechnical engineering and engineering geology, both in Spain as well as in other countries.

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REFERENCES


APPENDIX 1: APPROACHES TO TEACHING INVENTORY (TRIGWELL & PROSSER, 2004)

1. I design my teaching in this subject with the assumption that most of the students have very little useful knowledge of the topics to be covered.
2. I feel it is important that this subject should be completely described in terms of specific objectives relating to what students have to know for formal assessment items.
3. In my interaction with students in this subject I try to develop a conversation with them about the topics we are studying.
4. I feel it is important to present a lot of facts to students so that they know what they have to learn for this subject.
5. I feel that the assessment in this subject should be an opportunity for students to reveal their changed conceptual understanding of the subject.
6. I set aside some teaching time so that the students can discuss, among themselves, the difficulties that they encounter studying this subject.
7. In this subject I concentrate on covering the information that might be available from a good textbook.
8. I encourage students to restructure their existing knowledge in terms of the new way of thinking about the subject that they will develop.
9. In teaching sessions for this subject, I use difficult or undefined examples to provoke debate.
10. I structure this subject to help students to pass the formal assessment items.
11. I think that an important reason for running teaching sessions in this subject is to give students a good set of notes.
12. In this subject, I only provide the student with the information they will need to pass the formal assessments.
13. I feel that I should know the answers to any questions that students may put to me during this subject.
14. I make available opportunities for students in this subject to discuss their changing understanding of the subject.
15. I feel that it is better for students in this subject to generate their own notes rather than always copy mine.
16. I feel a lot of teaching time in this subject should be used to question students’ ideas.