**DISCUSSION SESSION 1: What should we teach?**

**Group A (Facilitator: Prof. David Muir Wood)**

1A1 What do you consider to be the essential content at various stages of engineering education? What should geotechnical professionals be able to do once they leave university? 

1A2 There is increasing pressure to incorporate more “training” type activities in university engineering (including geo-engineering) modules. What is the relative importance of education and training for students of geo-engineering? How should this vary across the years of study? Is it possible for academics and practitioners to reach a consensus on this issue?

For the purposes of this discussion (see ref 2):

Education = “knowing why” or providing a “conceptual understanding”

Training = “knowing how” or providing a “procedural understanding”

1A3 What are the challenges associated with teaching the benefits and limitations of simple soil models (such as Mohr-Coulomb)? What are the common misconceptions students make when using soil models and how can we prevent these from happening?

1A4 Some undergraduate programmes have full modules on critical state soil mechanics. Other undergraduate programmes do not cover it at all. How much critical state soil mechanics should we teach? How can we avoid perceptions that it is an advanced topic? Or is it?

**Group B (Facilitator: Dr. Brian Simpson)**

1B1 What do you consider to be the essential content at various stages of engineering education? What should geotechnical professionals be able to do once they leave university?

1B2 There is increasing pressure to incorporate more “training” type activities in university engineering (including geo-engineering) modules. What is the relative importance of education and training for students of geo-engineering? How should this vary across the years of study? Is it possible for academics and practitioners to reach a consensus on this issue?

For the purposes of this discussion (see ref 2):
Education = “knowing why” or providing a “conceptual understanding”
Training = “knowing how” or providing a “procedural understanding”

Quite a few papers on geotechnical education have identified inappropriate concepts and topics still taught and promoted in geotechnical textbooks as they are “convenient” to teach. These include the misuse of $c'$, $\phi_u > 0$ as a material parameter, misuse of empirical correlations\(^3\), maximum height of vertical cuts in clay, etc\(^4\).

Can we identify more misleading “conveniences”? How can we qualify or avoid their use? What should we replace them with?

To what extent should geotechnical design codes (such as EC7 in Europe) be integrated into university curricula – if at all?

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DISCUSSION SESSION 2: Laboratory and fieldwork in geo-engineering

Group A (Facilitator: Waldemar Hachich)

2A1 Are pre-prescribed laboratory sessions (involving a different laboratory test week upon week) a worthwhile learning experience OR are student identified and executed laboratory tests, borne out of a project requirement, a more meaningful and enduring learning experience?1

2A2 What kinds of learning outcomes can we achieve with laboratory-based courses? Which independent assessment activities are suitable for checking whether these outcomes are achieved?

Comment: Students learn incrementally by doing things. Hands-on experience of undertaking routine tests and experimental research projects reinforces concepts encountered in lectures2.

2A3 Does modern ‘black box’ lab equipment (e.g. automated triaxial tests) hide the fundamental soil behaviour being assessed: Is there merit in students designing there own ‘string and sealing wax’ laboratory tests to gain a fundamental understanding of soil properties and behaviour? After all this is how Terzaghi started .... And look how far he travelled!

2A4 In the context of an introductory fifteen week semester soil mechanics course, how can geology become a meaningful part of teaching soil mechanics?

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Group B (Facilitator: Declan Phillips)

2B1 Are pre-prescribed laboratory sessions (involving a different laboratory test week upon week) a worthwhile learning experience OR are student identified and executed laboratory tests, borne out of a project requirement, a more meaningful and enduring learning experience?

2B2 What kinds of learning outcomes can we achieve with laboratory-based courses? Which independent assessment activities are suitable for checking whether these outcomes are achieved?

Comment: Students learn incrementally by doing things. Hands-on experience of undertaking routine tests and experimental research projects reinforces concepts encountered in lectures.

2B3 What kinds of learning outcomes can we (only) achieve with fieldwork?

Comment: Examining field exposures of soils, rocks and geomorphology in the field in a structured way is often a revelation and helps students to distinguish idealized soils from natural soils. This is an essential education for understanding the ground profile.
Is it possible for a student of geotechnics to think and act as an engineer when they are encountering the material for the first time, have limited context and no experience! How do we square the circle?

2B4 Is there any guidance on the structure & minimum essential content for a two-day* geology field trip for civil engineers?

Comment: Are motivated and inspiring geologists (equipped with an appreciation of the minimum ‘initial’ knowledge of geology an undergraduate civil engineer must possess) out there?! Please share your experiences and recommendations.
What minimum time period is recommended for a meaningful geology field trip?

* In the context of an introductory fifteen week semester soil mechanics course.

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DISCUSSION SESSION 3: Computing and technology in geo-engineering

Group A (Facilitator: Prof. Stephen Fityus)

Group B (Facilitator: Prof. Mark Jaksa)

3.1 Geotechnical Software

- Is there any evidence that the use of geotechnical software can help students better understand basic geotechnical concepts? If yes, what are the characteristics of this software?
- Are there examples of using geotechnical software to better understand/compare different soil constitutive models?
- How should we educate to enable graduates to use geotechnical finite element software responsibly and effectively?
- What are the dangers in having students use FE without a proper understanding of both the soil models used and the computational basis of FE?
- What kinds of technology (other than computational software, such as FE) brings benefits to geotechnical instruction?

3.2 Computer Assisted Learning

- Is computer assisted learning (CAL) of value and, if so, how is it best implemented?
- Who uses CAL and in what context?
- What CAL tools are needed to improve student learning?
- How will CAL continue to be sustained in the future? What is the best model for us to adopt?

3.3 The Future

- Are there any new or emerging technologies that have yet to be applied to geotechnical engineering education which might show promise?
DISCUSSION SESSION 4: Student-centred learning in geo-engineering

Group A (Facilitator: Prof. Marina Pantazidou)

4A1 Which of the following is closest to your interpretation of the term student-centred learning?
Student-centered learning refers to an instructional approach...
A. ... that pays more attention to the needs and preferences of students compared to traditional teaching in the “transmission” mode.
B. ... that gives students opportunities to be active participants in the educational process and take responsibility for the result of the educational process.
C. ...that is informed by research findings on how people learn5.

4A2 A recent report by the American Society of Engineering Education (ASEE)6 notes that “the dominant approach for educational innovations is based largely on faculty intuition drawn on personal experiences as students and teachers”. It then goes on to remark that “this approach is at odds with the scholarly and systematic approach used by engineering faculty in their technological innovations”. (Quoted text is on page 14 of the report.)

Do we need to consider what does research in (engineering) education tell us about the learner’s perspective? e.g. 7,8
As instructors, what do we believe about the need for and the usefulness of such research?
Perhaps a combination of the intuition and the experience of the instructor is a better guide?

4A3 How can we best engage students in larger classes?
What “student-centered” learning approaches have been used with success for this purpose? (We already heard about clickers9 in this conference.)

Do we know of/could envision other educational innovations applied to geotechnical engineering? Or developed specifically for geotechnical engineering?

Group B (Facilitator: Dr. David Nash)

4B1 (This is a question common to both groups to create a framework for the discussion.) Which of the following is closest to your interpretation of the term student-centred learning? Student-centered learning refers to an instructional approach...
A. ... that pays more attention to the needs and preferences of students compared to traditional teaching in the “transmission” mode.
B. ... that gives students opportunities to be active participants in the educational process and take responsibility for the result of the educational process.
C. ... that is informed from research findings on how people learn.

4B2 There is consensus from both engineering education research and the experience and intuition of instructors that encouraging active involvement of students in the learning process is a good thing.
As a community, how can we achieve a balance between promoting active learning approaches and managing the larger time investment they require from the instructor?

4B2i Is there a role for academics sharing learning and teaching resources to minimize duplication and to improve overall quality? How much can we learn/what material can we use from instructional interventions and innovations implemented by others? e.g. 5,10,11,12,13 Is dissemination of these implementations mainly useful for offering ideas and inspiration to other instructors, in order to attempt similar things in their teaching, or can it also offer ready-to-be-used/adapted educational material as well? What makes for transferable (i.e. readily usable by others) educational material?

10 Kunberger T. (2012). Experiences from revising a course to promote significant learning, Friday, July 6 AM & Proceedings SFGE 2012.
4B2ii How can we get institutional support for these approaches given current research/publication focus?

4B3 Does flipped learning\textsuperscript{14} or inverted classroom (making the material available online and using classroom time for active involvement, problem solving etc) have a role in geotechnical instruction?

\textsuperscript{14} http://www.dashe.com/blog/classroom-learning/the-flipped-learning-revolution-coming-to-a-brain-near-you