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# "Student Centred Learning" Approach in the Development of Social Skills: Implementation in an Experimental Soil Mechanics Course

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ABSTRACT: This paper presents the teaching framework of the "Experimental Soil Mechanics" course, which has been applied at the University of Thessaly (UTh) during the last five academic years and aims to combine the acquisition of scientific knowledge with the development of social skills of students. The latter reflects the needs of post-modern societies, induced by high competition and changing conditions derived from globalisation. For this purpose, the "Student Centred Learning" (SCL) approach has been adopted by means of various teaching techniques: questionnaires, diagnostic assessment, dialog, experiential learning, laboratory experiments, individual work and team work, oral presentation, writing technical reports, role playing, formative evaluation and differentiated teaching. The benefits of SCL to the knowledge targets of the course were direct; however only a qualitative evaluation on the development of skills of students was possible, based mainly on the formative evaluation conducted every week after the completion of the lesson and the hetero-evaluation among students. The results show that the SCL approach provides an effective learning environment for the development of the social skills of students, e.g. communication, initiative, responsibility, collaboration, critical thinking, adaptability, self-confidence, tolerance, leadership.

*Keywords: social skills, student centred learning approach, experimental soil mechanics*

## 1 Introduction

In the history of education research worldwide, the connection of teaching practice with learning theories was initially focused on the subject-based teaching and learning approach, which comprises three questions: What - how - why a certain content of a subject is taught? The evaluation of the results of this approach is quite easy, as it is related only to the level of students' knowledge in a given subject.

Then, a new concept transferring the interest from teacher centred to student centred learning (SCL) approach was developed, as a result of the social conditions improvement. The European Standards and Guidelines for Quality Assurance in Higher Education (ESG, 2015) present the SCL approach to institution programmes in a way that encourages students to take an active role in creating the learning process. However, due to the fact that: (a) the recognition of benefits of the implementation of SCL or other modern educational approaches in teaching practice of Higher Education are not widely known by the academic community, and also (b) many academic teachers are not familiar with learning theories, the evolution in teaching procedure is mostly based on teachers' personal experience and therefore the quality of teaching practice and results remains uneven (Kind, 2009). More recently, Case (2019) has advocated for reconciling the two approaches (teacher centred and student centred) and she also highlighted the significance of the scientific knowledge in the engineering classrooms, in the sense that the curriculum should be taught with the simultaneous students' engagement with it.

In this paper, the design and the main findings of the implementation of the SCL approach in the "Experimental Soil Mechanics" course, taught in the context of the five-year undergraduate study programme of the Civil Engineering Department of UTh, are presented and discussed, with emphasis in the development of social skills of students. The authors jointly developed the SCL approach and then the first author applied it to her course at UTh.

## 2 The "Student Centred Learning" (SCL) approach

The term "student centred learning" (SCL) has been widely used in literature and is linked to a range of related perspectives, such as flexible learning, experiential learning, self-regulated learning etc. (Damşa & de Lange, 2019). Historically, SCL has been credited to Hayward as early as 1905 and later to Dewey's work (1956), but it was Carl Rogers, in the 1980s, with whom the SCL concept was expanded into a learning approach (ESU, 2010). The SCL approach is broadly based on constructivist learning theory, which is built on the idea that knowledge is not acquired by the students, but constructed based on their personal experiences and learning environment. Students bring past experiences and cultural factors to the learning environment and thus each of them has a different interpretation and construction of the knowledge process. The following definition of SCL in Higher Education is given by ESU (2010):

"*Student - Centred Learning represents both a mindset and a culture within a given higher education institution and is a learning approach which is broadly related to, and supported by, constructivist theories of learning. It is characterized by innovative methods of teaching which aim to promote learning in communication with teachers and other learners and which take students seriously as active participants in their own learning, fostering transferable skills such as problem-solving, critical thinking and reflective thinking.*"

Over the last decade, the concept of SCL has gained political recognition on the European level, as well as in national plans for higher education and institutional strategies, e.g. Bologna Process agreements (EHEA, 2009).

## 3 Social Dimension of Education Procedure – Social Skills in the SCL approach

As mentioned above, the education procedure in the SCL approach is determined by both the teacher and the students, who bring their personal experiences and culture, as well as the learning environment, which reflects the contemporary social conditions. In this context, teaching practice is formed as a continuous negotiation between the teacher and students, during which the learning environment evolves according to the evaluation of the teaching procedure, e.g. more team projects are assigned to students after the detection of cooperation problems among them in the classroom (Papamichail, 1988). The social dimension of education procedure is reflected in the above features, as well as in the simultaneous development of social skills of students. The latter corresponds to the needs of post-modern societies, induced by high competition and changing conditions derived from globalisation, facts that require employees with initiative, creativity and teamwork attitude (Goleman, 1999).

The importance of social skills has been officially recognized by the European Commission (1995) in the White Paper on Education and Training, in which the need for the combination of fundamental knowledge and technical knowledge with social skills is underlined. The latter concerns interpersonal skills, e.g. behaviour at work, and a whole range of skills corresponding to the level of responsibility held, such as the ability to cooperate and work as part of a team, creativeness and the quest for quality. The Lisbon Summit (2000) - in which the strategy for the economic growth of EU country members was presented - introduced the concept of "new basic skills", which includes social skills of employees, as a basic requirement for the economic development, with more and better jobs and mostly greater social cohesion. In this context, social skills include self-confidence, self-direction and risk-taking. Moreover, individuals should be able to adapt to changes, new challenges and situations, as well as learn and acquire new skills rapidly (Commission of the European Communities, 2000).

# 4 The SCL Approach in the “Experimental Soil Mechanics” course

## 4.1 The teaching framework

As mentioned previously, the teaching practice of the SCL approach is not limited to a certain methodology, but involves various techniques forming the teaching framework of any scientific subject, adapted to students’ experiences and needs, towards the development of their social skills. Thus, the teaching framework is initially introduced in the curriculum of the course and gradually reconstructed, changed or abandoned in the interactive teaching environment (Clark & Peterson, 1986).

In this paper, the teaching framework of the “Experimental Soil Mechanics” course is presented. It is a 5 ECTS (European Credit Transfer and Accumulation System), seventh semester, undergraduate, mandatory course offered to students of the Civil Engineering Department who choose the Geotechnical and Geoenvironmental Engineering Division. A full-time student needs to complete 30 ECTS per semester. The maximum number of students attending the course during the last five academic years is 25. The course is designed and coordinated by the teacher. There are no teaching assistants or technicians supporting the teaching procedure. According to the authors’ opinion, 25 is the upper limit of students who can actively participate in performing experiments, in the context of the SCL approach, when the course is coordinated by one teacher. The students have not been exposed to the SCL approach in previous courses in the Department.

The teaching framework consists of three levels:

(a) the course is organised in fourteen lessons with four hours duration, and the learning goals are stated. The teaching model used is based on the four pillars of education proposed by UNESCO (Delors et al., 1996; Delors, 2013), which are inextricably linked:
(i) learning to know, (ii) learning to do, (iii) learning to live together, and (iv) learning to be. “Learning to know” develops a thirst for knowledge in students and a desire to gain better understanding of things and situations already known or changed. “Learning to do” nowadays means that students develop skills in order to be self-confident and able to deal with the various challenges of working life. “Learning to live together” focuses on the skills like understanding, tolerance and living harmoniously with others. “Learning to be” concerns self-knowledge, which is the most difficult among the four pillars, and aims to develop creative potential of individuals.

(b) the roles of teacher and students are activated and the learning goals are communicated. The teaching and learning process is implemented by various teaching techniques, in which the teacher acts as a guide and a facilitator and the students are active participants in their own learning (they perform - not watch - laboratory tests). The latter aims to develop their social skills, e.g. communication, initiative, responsibility, teamwork attitude, critical thinking, adaptability, self-confidence, tolerance, as well as other skills, such as writing technical reports and making oral presentations.

(c) the assessment of the teaching and learning process and of the learning goals is performed at the end of each lesson and is used as a feedback for the next lesson. This type of assessment is defined as formative assessment and is used to provide on-going feedback that can be used to improve the educational process while it is happening. The presentation given by each student team after conducting an experiment is evaluated by the other teams of students (hetero-evaluation). A final evaluation of the course, the teacher and the facilities is performed by the students at the end of the semester, providing useful information for the improvement of teaching procedure for the next year, as well as for the studies programme of the Department.

## 4.2 The content of the “Experimental Soil Mechanics” course

The course introduces the students to the experimental tests used for the assessment of physical and mechanical soil properties, which determine the soil behaviour in technical works. It includes two parts: (a) laboratory tests (eleven lessons) and (b) insitu tests (three lessons), as shown in Table 1. The course offers the opportunity to students for a deeper understanding of the basic concepts related to mechanical soil behaviour (e.g. undrained shear strength), which have been taught earlier in the context of “Soil Mechanics” course.

The need for reducing the content of Geotechnical Engineering courses has been stated since 1991 (Orr, 1991): “*More is not better, better is better. Indeed less might be better when planning courses”.*

**Table 1. List of tests included in the "Experimental Soil Mechanics" course**

| Test | Soil parameters | Soils |
|---|---|---|
| Diagnostic exercises performed by the students for the identification / description of | colour, size and shape of soil grains, water content, soil structure, organic matter and soil strength | 15 natural soils (gravelly, sandy and clayey soil samples stored in the laboratory in dry condition) The soil specimens used are artificially prepared in either dry or wet condition |
| Laboratory soil tests performed by the students for the determination of | water content 1<br>density 1<br>specific gravity<br>grading curve (sieving and hydrometer tests)<br>organic content<br>calcareous content<br>Atterberg limits (LL, PL, SL)<br>undrained shear strength (unconfined compression test) 1<br>compressibility parameters (one-dimensional incremental loading test) 1 | Natural clayey soil (samples provided to the Department every year by a geotechnical engineering company, after teacher's request) The samples are covered with paraffin, enclosed in plastic bag and stored in the laboratory<br><br>1 specimens from boreholes |
| | specific gravity 2<br>grading curve (sieving tests) 2, 3<br>coefficient of permeability (constant head permeability test) 2<br>minimum density 2<br>compaction curve (Proctor test) 2<br>strength parameters (direct shear tests CD) 2 | Natural sandy soils (NP) (stored in the laboratory in dry conditions)<br><br>2 uniform clean sand (NP)<br>3 well graded clean sand (NP) |
| Laboratory soil tests performed by the teacher and demonstrated to the students for the determination of | strength parameters (triaxial compression tests CD) 2 (The data records are given to the students for the determination of strength parameters) | Natural sandy soils (NP) (stored in the laboratory in dry condition)<br><br>2 uniform clean sand (NP) |
| Insitu tests presented virtually in the classroom by the teacher (by means of videos). In situ technical visits of students for watching SPT and/or Plate test. Exercises are given to the students for the evaluation of | $D_r$, φ', $c_u$, E, G, $V_s$ etc. based on the results of:<br>SPT<br>CPT<br>Plate load test<br>PMT (pressuremeter test)<br>Vane test<br>Geophysical seismic tests | |

The shift to basic concepts and important technical subjects, which should define the content of instruction, also with references to the recent research achievements in the scientific field, is described in the "KISS method: Keep It Simple Stupid!" (Graham & Shields, 1988). In this logic, and adopting Graham's point of view that "*the process and excitement of learning are important, not the facts themselves*", the content of the "Experimental Soil Mechanics" course is limited to the classical and conventional soil mechanics tests, that are mostly performed in geotechnical practice, but also with some references to modern experimental methods.

## 4.3 The learning goal and targets of the course

The learning goal of the course is that students acquire the knowledge: (a) to choose the appropriate soil mechanics' tests among a variety of experimental methods, and also (b) to perform these experiments, in the case of laboratory tests, in the context of planning and conducting a geotechnical investigation for a technical project, as well as (c) to evaluate the results of a geotechnical investigation. The purpose of the geotechnical investigation is the determination of the design values of soil parameters needed for the geotechnical study of technical projects.

The learning goal is analysed - based on the four pillars of education proposed by UNESCO - to the following targets, which foster the social skills development of students:

(i) learning to know: the students acquire the knowledge to
- identify the physical and mechanical parameters required for the determination of soil behaviour in technical projects.
- describe the experimental methods for the determination of the above parameters.

(ii) learning to do: the students learn to act and investigate for
- the suggestion of the most appropriate experimental methods and testing equipment used for the determination of geotechnical parameters.
- the design of a testing programme of a geotechnical investigation, based on the type and the requirements of the technical project.
- the writing and evaluation of the technical reports presenting the results of the testing programme and the geotechnical parameters derived.

(iii) learning to live together: the students communicate and accept their colleagues in order to
- work together as members of a team under the supervision and the guidance of a student - leader for fast results and high productivity, and simultaneous development of communication, comprehension, tolerance, collaboration, responsibility and organisational skills.
- work together as members of a team for the oral presentation of their test results and technical reports to the other teams. The evaluation of the reviews made by the other teams is used to improve their learning process and their judgement.
- participate in teams who work together for the correction of their test results and their compilation into a common technical report.

(iv) learning to be: the students transfer their knowledge to the real world
- by performing a self-evaluation based on the learning process, e.g. recognition of the importance of knowledge acquired, difficulties during the learning process etc.
- by participating in a role game. The students play the role of professional geotechnical engineers, who design and conduct an experimental soil mechanics testing programme and also write the technical report, which is used for the design of a technical project (Eurocode 7).

## 4.4 The teaching techniques, activities and formative evaluation

Several teachers of Geotechnical Engineering science support the aspect that the course of “Experimental Soil Mechanics” can and should be taught virtually, as these tests require considerable teaching time, and also because the main goal of the course is not the knowledge of performing the tests but rather the design of a testing programme and the evaluation of the experimental data derived. The large number of students, the lack of experimental infrastructure, scientific and technical staff, as well as the limited time available are factors that reinforce this point of view. On the other hand, the teaching in an experimental laboratory offers the students real experience and opportunities for active participation. The students are not observers but protagonists in the education procedure. They acquire knowledge and perceive concepts through experiential learning using their mind, body and senses, and they can alternate focus between theory and practice, developing in this way the transfer of knowledge to a simulation of real life.

The applied teaching techniques and the types of supporting teaching and learning activities of the “Experimental Soil Mechanics” course are the following: questionnaires, diagnostic assessment, dialog, experiential learning, laboratory experiments, individual work and team work, presentation, writing reports, role playing, formative evaluation and differentiated teaching. Differentiated teaching is recognised as a means to meet the individual needs of all students, who bring – as mentioned above – their past experiences and cultural factors to the learning environment, and thus each of them has a different interpretation and construction of the knowledge process. For students with learning difficulties, differentiated teaching provides alternative learning pathways. In this framework, the teacher has mainly the role of a guide; she initially provides the students with the basic knowledge for the experiments (describing experiments through slides, photographs, videos and step-by-step instructions), and then her role changes to that of a coordinator. The students, on the other hand, are active participants in their own learning (they perform - not watch - laboratory tests) and develop social skills (communication, initiative, responsibility, comprehension, teamwork attitude, critical thinking, adaptability and organisational skills).

For the implementation of differentiated teaching in the course, in the beginning of the semester (first lesson) the students fill out a questionnaire with some personal information and their learning preferences and difficulties. The questionnaire includes: their name, age, marital status, place of origin, diplomas and foreign language certificates, professional experience and work status, technology and social media use, personal interests, interests in their studies in the Department, preference between theory and laboratory exercises, preference between individual and team work, expectations and learning goals of the course, and learning difficulties (e.g. dyslexia, visual or hearing difficulties). The questionnaire information is confidential and helps the teacher in organizing the lessons in a way that all students are involved in the educational process. As a result, a variety of learning activities (individual or team works involving the performance of experiments, the calculation of results, the analysis of the data and the writing and presentation of technical reports) are offered to the students. The questionnaire information is very useful especially in the formation of the working teams, which must consist of students with different abilities / disabilities, gender, social background and culture (criteria of students' team formation).

At the first lesson of the course, a diagnostic assessment of the students' knowledge level takes place by means of a diagnostic exercise, which includes the identification / description of a number of soils given to the students, having different composition, soil structure, moisture content and shear strength (Table 1). In this exercise, the students do not conduct experiments but use only basic tools (vernier, magnifying glass, charts for the visual evaluation of size, roundness and sphericity of soil grains), their senses (vision, smell and touch), and their pre-existing knowledge and past experience for the soils' description, in terms of: colour, size and shape of soil grains, water content, soil structure, organic matter and strength. The soil strength can be described (soft, stiff or hard soil) with the use of thumb, thumb nail or finger. A similar exercise, which however included the conduction of soil mechanics tests by the students without having first attended the lectures, has been presented by Hachich (2012). The results of the exercise presented herein reveal the capability (or not) of students to understand the descriptions of soil types given in books or presented in the classroom in previous courses. Most of the students exhibit insecurity and difficulty in describing the soils, but the teacher instead of discussing their performance or presenting the right answers in the classroom, gives the same exercise to the students again by the end of the semester. As shown in Figure 1, where the average results of the diagnostic exercises are presented, at the first lesson the students exhibit difficulties in identifying (among others) the presence of water in soils (53% of students detect water in dry soil samples) and the type of soil grains (76% of students describe the pieces of a dry clayey sample as gravel grains).The first exercise allows the formative feedback of the course and is very useful to the teacher, whereas the second exercise is a useful tool for the self-evaluation of students, who appreciate the knowledge gained and develop critical thinking. For this purpose, an oral presentation of the comparison between the results of the two experiments is given by each student in the class.

At every lesson in laboratory testing, the students have to perform a soil experiment. Initially the teacher presents the methodology, the testing procedure and the expected test results. Then, the students are invited to conduct the test (on their own or in teams) under their teacher's supervision. Natural soil samples are used for the tests, which are retrieved from boreholes for the site investigation of technical projects. In this way, the students understand the importance of the knowledge they acquire during the lessons and the connection with geotechnical practice. After each lesson, the students have to process the data, calculate the results and write a technical report (which describes the testing procedure, the results obtained and the evaluation of the parameters estimated).

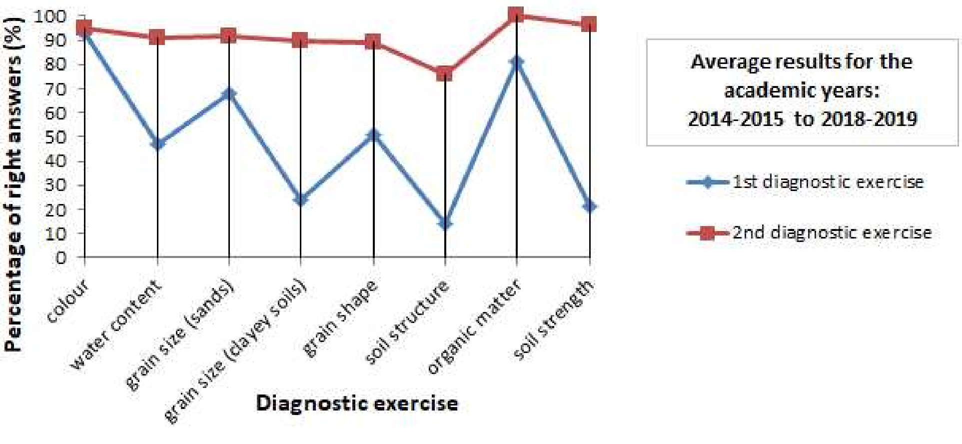


**Figure 1. Results of the diagnostic exercise**

Detailed instructions for the technical report are given to the students, who work together without supervision in order to deliver the report to the teacher at the next lesson and present it to their classmates. All the classes during the last five years have expressed their enthusiasm for the presentation activity as students have not had the opportunity to practice in it many times before. The evaluation of the presentations is made by the other students or teams (hetero-evaluation). The evaluation is based on the following criteria: content and organization, speakers' comfort, clarity of figures and overall presentation, using a grading scale from 1 (weak) to 5 (strong), and is followed by a discussion. During the discussion, the students accept the others' opinion. It is also observed that what impressed the students-evaluators from the presentations of the other students, are incorporated in their subsequent presentations. Figure 2 presents indicative evaluation results of presentations and reports. There is an improvement in student performance in presentations and reports as the course progresses and, hence, in the associated skills (collaboration, communication, self-confidence). The fact that the results of the hetero-evaluation follow the same trend as the presentations' evaluation made by the teacher shows that the students exhibit responsibility.

The assignment of experiments to individuals or teams of students is made by the teacher. In the first experiments, due to their simplicity and short duration, there are no teams and each student performs the tests alone. This front-line teaching is very useful in the beginning of the semester for the detection of any students' learning difficulties. In subsequent lessons, when the students become more familiar with the laboratory environment and equipment, they are assigned to perform more complex experiments in small groups of two to five people. The composition of the teams is not constant in all experiments, but varies. At the first experiment it is the students' decision, which ends up systematically in only-boys and only-girls teams. Then, the teacher based on the information of the questionnaire and the criteria mentioned above decides on the composition of the teams, which is changed in every lesson, so that every student will have the opportunity to cooperate with the maximum number of the other students. The teacher includes in every team a student with preference for teamwork, according to the questionnaire information, which usually acts as the team leader. The usual students' reaction to the team changes is initially negative; they react to the change and the unknown and insist to form teams only with their friends (usually students from the same place of origin). Nevertheless, this learning environment prepares the students for the challenges they are going to meet later on their professional work and also fosters their skills of communication, collaboration, self-confidence and leadership.

During the lessons on field testing, one or two educational visits are planned for the students to watch insitu geotechnical experiments and investigations. The students are invited to keep notes for the testing procedure in the field, which they have to deliver to the teacher at the end of the visit. In this way, the attention of the students is achieved.

Upon completion of every lesson, the students proceed to a formative evaluation by answering the following questions: (a) what is the most important thing you have learned today, (b) what did you do easily, (c) what was difficult for you, (d) what do you propose to do in order to overcome your difficulty, and (e) what is the implementation in practice of the things you have learned today. This evaluation helps the students to sum up the benefits of the learning process and also contributes to the formative assessment of each lesson.

By the end of the semester, when the students' knowledge and experience in laboratory tests is adequate, they are assigned by a technical company to conduct a laboratory testing programme for

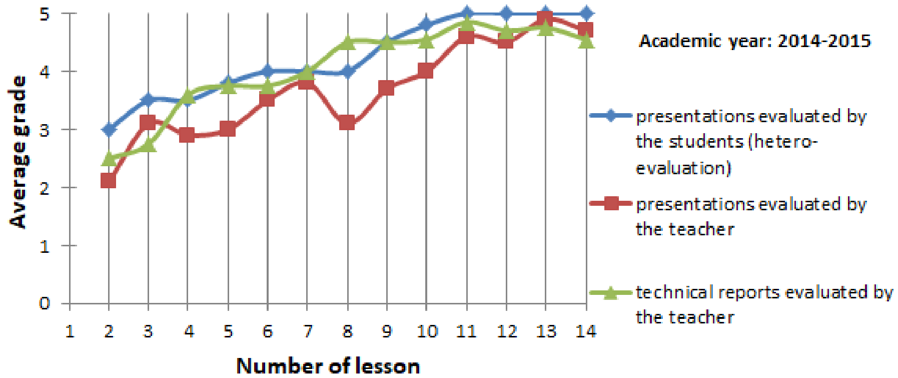


**Figure 2. Results of the evaluation of presentations and technical reports**

the geotechnical study of a technical project. The communication for the assigned study is live and usually done via skype chat, during which the company representative describes the project and asks the students to play the role of the engineer, who will design and conduct the testing programme on soil samples from the project site. Students must submit the technical report to their "client" with the results of the tests and their evaluation within a specified time. With this role playing game, the students have the opportunity to cultivate their responsibility, self-confidence, critical judgment, communication and organisational skills. The report is reviewed by the company and returned to the students. Although the evaluation of this report does not contribute to the final mark on the course, the students participate in it with enthusiasm and responsibility.

### 4.5 The overall evaluation of the education procedure and discussion

The benefits of the diagnostic tests conducted in the first lesson and by the end of the semester, the formative evaluation in every lesson, the hetero-evaluation of the presentations among the teams of students and the evaluation on the project assigned by the technical company were presented in the previous section, since they are inextricably linked to the evolution of education procedure. Their results are used by (a) the teacher, to improve the teaching techniques while the course is ongoing, so that all students are active participants of it, and (b) the students, to assess their knowledge level and progress, identify their abilities and weaknesses, and improve the learning process.

An evaluation at the end of the semester (final evaluation) is also conducted, using the course evaluation system of the Department and by means of a questionnaire. The questionnaire consists of 25 questions, using a scale from 1(low) to 5(high) with space available for comments. The questions are grouped as following for the evaluation of: (a) the course, (b) the teacher, (c) the assistant staff, (d) the laboratory infrastructure, and (e) the student. The results are made accessible to the teacher no earlier than two months after the completion of the semester and are used by the teacher to improve the education procedure of the course for the next academic year. The number of the students that participate in this evaluation is generally low for all courses. In the case of the “Experimental Soil Mechanics” course the participation is also lower (50% approximately) compared to the formative evaluation, because - as the student state - it does not give a feedback to, or can affect, their learning environment, and also because they find the number of questions big. Nevertheless, based on the results of the final evaluation for the last five academic years, (a) the students’ perception on the way that the course is organised, the teacher and themselves is reflected on the value of 4.2/5.0, 4.2/5.0 and 4.4/5.0 respectively, and (b) 14% of the students consider that the writing of the technical reports is a very time consuming activity and should contribute more in their final mark on the course.

At this point, it must be mentioned that the learning goals of the course are communicated to the students in the first lesson, so it is clear to them that the knowledge targets are combined with the development of various social skills. However, whereas the assessment on the knowledge targets’ achievement is easy, the evaluation of the social skills is mainly qualitative in the context of this course. This is because, the social skills are not included in the final evaluation and also in the formative evaluation there are only text answers (without scale grade). For this reason, the general picture of the students participating in the learning activities and the communication level among them and also with the teacher during the lessons is used for the evaluation of the social skills development.

The main findings of the five years implementation of SCL approach to the course are presented below:

The students express their satisfaction for the transparency in the learning goals and the power given to influence their own learning experience.

The diagnostic exercise corresponds to the learning targets (i - learning to know) and (iv – learning to be). The results of the first test show the students’ weaknesses to answer right, as approximately only 50% of the given answers are right. This percentage is significantly increased to 90-100% in the second test, showing that the education procedure gives the students the opportunity to mature as learners. The diagnostic test is followed by a formative evaluation, which shows that the students identify their initial difficulties and the progress achieved later. This self-evaluation of students is a useful tool for the development of their self-confidence. As mentioned previously (CEC, 2000: Lisbon Summit), self-confidence is a social skill which reinforces the social cohesion.

Based on the answers given in the formative evaluations taking place at the end of every lesson, it is shown that, in the framework of the learning activities performed in this course, the students:

(a) successfully participate in the experiential learning activities, in order to acquire the knowledge subject of the course (learning target ii – learning to do). 90% of the students understand the importance of the lessons and 85% find the experimental procedures easy (questions a, b and e of the formative evaluation).

(b) develop social skills like communication, negotiation, collaboration, responsibility, efficiency etc. (learning target iii – learning to live together). In the SCL approach the learning procedure is a social experience. Although almost 50% of the students are negative to the composition of the working teams (question c of the formative evaluation), they act with responsibility, exhibit adaptability to changes and tolerance to each other, realise that first of all they are part of a team, and therefore conduct the experiments with success, write the technical reports and make the presentations.

(c) engage actively with the domain knowledge and practices (learning target iv – learning to be). 70% of the students can see the implementation of the knowledge in practice (question e), and 15% who face difficulties during the experimental procedure (question c), writing or presentation, exhibit self-confidence to overcome their difficulties with more practice and work (question d).

The hetero-evaluation of the presentations among student teams shows that students act with responsibility, and make their review with critical thinking and judgment (learning targets iii & iv), by applying specific evaluation criteria, accepting others' opinion and adopting new ideas from others' presentation to their own presentations.

The evaluation on the project assigned by the technical company shows that the students exhibit a variety of social skills e.g. communication skills, teamwork attitude, responsibility, organizational skills, self-confidence (learning targets ii, iii & iv) through the collaboration within the working team and the company as well.

The final evaluation provides an indication of students' perception on the course, but there is no assessment on the development of social skills of students. Nevertheless, the students' perception of the way that the course is organised is very good.

In addition to the formative evaluation, hetero-evaluation and project evaluation, a qualitative assessment of the development of social skills of students is made by the teacher based on the conversations with the students and the observation of students' classroom behaviour (learning targets iii & iv). The general picture - which is improved during the course - is that the students exhibit high responsibility and enthusiasm during the experiments and role playing game, communicate easily, do not complain for the time spent on homework, see the implementation of knowledge in practice, try to overcome the difficulties, behave with respect to their colleagues, deliver all the projects assigned and exhibit a teamwork attitude even with persons they don't like.

## 5 Conclusions

In the context of the "Experimental Soil Mechanics" course, the SCL approach provides an effective learning environment for the development of social skills of students, as the teaching and learning procedure itself is a social experience. For the implementation of the SCL approach, a variety of teaching techniques is used in order to activate the role of students in the learning procedure.

The main conclusions of this study are presented below:

The number of twenty five students, who can participate effectively in the SCL approach under the guidance of one teacher, is considered the upper limit. For larger classes, a number of teaching assistants should be involved.

Diagnostic exercises followed by formative evaluation are considered as a useful tool for the development of self-confidence and self-knowledge of students.

The experiential learning and the role playing game are the most favourable learning activities of the students. The least favourable is the cooperative working within teams of persons they are not fond of.

An assessment of the development of social skills of students is possible and is mainly based on the hetero-evaluation, the formative evaluation of every lesson, as well as the general behaviour which the students have in the laboratory. This assessment shows that the students develop a variety of social skills, among which are the communication skills, teamwork attitude, responsibility, organizational skills and self-confidence.

Since the benefits of the SCL approach in social skills development are not generally measured or automatically identifiable, an evaluation performed with former students - who have participated in SCL approach and now are professional geotechnical engineers - is suggested.

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