T.I.M.E. European Summer School: An Innovative International Educational Experience*

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This paper presents an innovative experience that was developed by six European universities to teach a common course in an unconventional, remote way, to geographically-separate groups of students. The course is especially designed to enable engineering students to learn the basics of how the European social and sustainable model works, to acquire some basic cultural and religious awareness, and to stimulate transnational group discussions on such intercultural affairs. One over-arching goal of this T.I.M.E. (Top International Managers for Europe) European Summer School (TESS) course is to identify some of the challenges that an academic collaboration organization like T.I.M.E. faces for future education, especially considering that the computer literate and highly web-based children who are born today will, with their expectations of 'virtual 3D encounters', be entering university by 2030. This web-based, social interaction experience has been developed over the last four years. This paper gives the results.

Keywords: international experience; sustainability; innovative education

1. Introduction

The association, T.I.M.E., was created 20 years ago as a means of offering students mobility and to integrate them better into European culture. The organization presently unites 46 universities in Europe in a substantial student network. The organization also has partners in Japan and Brazil. Currently, there are more than 150 bilateral double-degree agreements among T.I.M.E. members and approximately 300 students per year become T.I.M.E. students.

One of the early main objectives for the organization was to allow for a simplified student flow and Double Degrees at the Master level. Consequently, T.I.M.E. was a forerunner of the mobility flows that are seen between many universities today.

The organization today also offers various other student-related intercultural initiatives. One of these is a T.I.M.E. Summer School (TESS) on 'Sustainability; Social Models, Religions and Public Affairs'. The Summer School opened four years ago. The course is given over a two-week period in the summer (including Saturdays and homework after the course is finished in order to complete the assignments). It offers the European perspective on these issues to students. The course offers five academic credits in the 'European Credit Transfer System' (ECTS**) based on a full work-load during the two weeks and the subsequent homework, which the students must complete.

The course is especially designed so that engineering students can learn the rudiments of how the European model works and acquire some basic cultural and religious awareness. It was planned to stimulate transnational group discussions on such intercultural affairs. One overall goal of this TESS course is to identify some of the challenges that an academic collaboration organization like T.I.M.E. faces for future education, especially considering that the computer literate and highly web-based children who are born today, will, with their expectations of 'virtual 3D encounters', enter university by 2030.

To accommodate a large variety of students in the TESS programme, a pedagogical method was conceived for students and teachers who are located at four different universities that are continuously connected audiovisually by the internet. (Later,

** This System is a standard for use in comparing the study attainment and performance of students of higher education across the European Union and other collaborating European countries. One academic year corresponds to 60 ECTS-credits, which are equivalent to 1500–1800 hours of study in all countries, irrespective of standard or qualification type. The system is used to facilitate transfer and progression throughout the Union.

five universities have been connected.) Each participating campus gives one three-hour lecture on sustainability per day during the first week and one three-hour lecture per day covering social models, religion and public affairs during the second week. A considerable number of group workings are scheduled for the afternoons, and students at all four campuses can continuously interact with each other and the teachers. In order for the students to mix even more, and to allow for mobility in the European framework, a significant number of students have participated in a 'geographical re-allocation' during the course.

The course began on a small scale with three campuses and 21 students in 2007 and expanded to three campuses and 28 students in 2008 and four campuses: Kungliga Tekniska Högskolan (KTH), Sweden; Ecole Supérieure d' Electricité (SUPE-LEC), France; Universidad Politécnica de Madrid (UPM), Spain and Budapesti Muszaki és Gazdaságtudományi Egyetem (BME), Hungary and 54 students in 2009. In 2010, six campuses: KTH, Sweden; SUPELEC, France; UPM, Spain, BME, Hungary, Universitá degli Studi di Trento (UNITN), Italy and Istanbul Teknik Üniversitesi (ITU), Turkey and 47 students participated.

This paper gives an overview of the development, and technical and didactical challenges encountered over the years in providing such a course, and illustrates various questions that the students, teachers and organizers face. The development from a very simple two-way interactive scheme to a somewhat more complicated model with all four campuses (or six depending on the year) open at the same time is discussed. Some of the benefits and disadvantages for the students are discussed. The paper ends with a detailed discussion of the possibilities of developing similar courses within the T.I.M.E. universities. It also suggests how the T.I.M.E. member universities can profit from the experience for more coherent collaboration in various regular curricula.

2. State of the art

There is a shift in emphasis in engineering education from professional skills to process skills [1, 2]. Research has shown that students retain minimal information in the traditional didactic teaching environment and frequently experience difficulty in transferring the knowledge acquired to new experiences [3]. The TESS course presents a different way to improve professional skills from other teaching models [4].

In today's engineering environment, it is proven to be important that engineers emerging from the academic process must have the necessary professional skills in addition to the classical technical skills. ABET's EC 2000 criteria contains a set of professional skills, which include process and awareness skills [5, 6].

To achieve these Intended Learning Outcomes, they must be considered in the process of curriculum review [7, 8]. After the ILO's have been considered in the curriculum, the next step is to facilitate opportunities for students to reflect on their learning, and to assess their learning experience so that students, faculty, and programmes can benefit and improve [9].

ABET specifies the minimum curricula for various engineering programmes. For instance, ABET requires that all engineering graduates of a baccalaureate programme receive at least one year of study in the natural or physical sciences and mathematics, and some study in general education (ABET, inc. 2010). ABET also requires that each student completes a capstone project or design class in his or her education. Because of ABET's involvement, engineering curricula are somewhat standardized at the bachelor's level, thus ensuring that graduates of any ABET-accredited programme will have some minimal skill set for entry into the workforce or for future education [10].

After completion of the TESS 2010, the students were required to complete a questionnaire to indicate which of the outcomes that were presented by ABET were strengthened by the course. The model of competences used has been ABET, because two of the participating universities (UPM and ITU) have been accredited with this model.

As regards the remote teaching/learning model, the authors have developed a form that has not been reported extensively in the open literature. Remote (and distance) teaching (by means of closed circuit TV or open lectures, whether recorded one-way beamed on-line) is common in that one teacher gives traditional ex-cathedra lectures. The combination of having both several faculty and various intercultural student groups at different multinational campuses for an intensive course with a high degree of common transnational group work is believed to be a new challenge. Thus, the authors have made a coherent attempt over a five-year period to build up a didactical/technical environment that is intended to foster a good intercultural experience between students, without a long-term need for physical mobility.

During the process, the students worked in groups at their local universities, but they also worked with other groups. The afternoon sessions start with discussions in the local groups, and later in the afternoon there are significant inter-group discussions.

3. Education experience presentation in TESS

The general objectives of this course are to give the student greater knowledge of non-technical issues concerning sustainability and the interactions among social models, religions and public affairs in Europe. Topics on sustainability include sustainability in economic and political terms, approaches and ways to sustainability, sustainability in the world of business and sustainability in climatic and energy issues. The topics discussed on social models, religions and public affairs include European institutions and policies, the concept of Europe in the perspective of world views and values and environmentalism as a civil religion.

Upon completion of the course, the student should understand the principles of sustainability and the principles of, and principal interactions between, social models, religion and public affairs in a European context.

They also should have learned how to 'operate' in an international setting in which they collaborate with students from other cultures in a day-to-day 'traditional face-to-face' cooperation. Furthermore, TESS wants to allow the students to cooperate in exactly the same way, even if they are not all present in the same physical lecture room. Thus, TESS offers, in addition to the geographical mobility for the students, an extensive 'remote participation'. The international experience of others has been published [11], but not involving this method of teaching. The main purpose of the paper is not the course content; but the collaborative learning experience among 'remotely-located students with remotely-located teachers'.

The outcomes [1] that were expected to be sought by the students were: (a) an ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability constraints; (b) an ability to function in multidisciplinary teams; (c) an understanding of professional ethical responsibility; (d) a broad education that is necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; and (e) an ability to communicate effectively.

3.1 Participants

The course was conducted in collaboration with SUPELEC (Paris), BUTE (Budapest) [2007 and 2009], UPM (Madrid) [2008, 2009 and 2010], KTH (Stockholm) and Istanbul and Trento [2010]. All sites have been audio and visually connected by Internet in real time. All information in the course has been published and is available on the website (https://www.time-association.org/Events).

3.2 Course contents

As stated earlier, the objective of the course is to give the student a deeper knowledge of non-technical issues regarding sustainability and interactions between social models, religions and public affairs. Although the concept of sustainability has been around for a long time, it became more widely used in the 1980s. Back in 1983, the Secretary-General of the United Nations established a commission called the World Commission on Environment and Development. This commission is frequently referred to as the Brundtland Commission after Gro Harlem Brundtland, the head of the commission and former Prime Minister of Norway. The commission was asked to look at the world's environmental problems and to propose a global agenda to address them.

The study discovered that no environmental issue was first and foremost in people's minds. People talked about living conditions, resources, population pressures, international trade, education, and health. Environmental issues were related to all of these, but there was no hard and fast division separating environmental issues, social issues and economic issues.

All of the problems were intertwined. There were links between the environment, the economy and society that caused problems in one of these areas to affect the other areas. As a result, the Brundtland Commission came up with a definition of sustainable development that emphasizes meeting needs, not just now, but in the future as well:

> . . . development that meets the needs of the present without compromising the ability of future generations to meet their own needs. [12]

Earlier, independent states used to be the key actors in the world, and national governments were in control of domestic politics, as well as the domestic economy. This is no longer true. There has been a change in the state–market relationship. The re-launch of Europe, the Single European Market, can be seen as an attempt to mitigate the effects of increased globalization, but it can also be seen as an attempt by liberal forces to impose change upon the welfare models of Continental and Nordic Europe [13].

However, the social models of Europe have proved to be very resistant, despite the challenge from globalization, due in large part to the public support of the national social models [14]. The importance of path dependency has been shown to be very strong. The evolution of religions from their primitive forms to their present day forms is a

complex matter. The really important multiethnic religions are: Christianity (Protestantism, Catholicism and Orthodoxy), Islam, Buddhism and Hinduism. In contrast to multiethnic religions are ethnic religions. These issues are discussed and analysed in this course.

3.3 Pedagogical approaches

The pedagogical approach toward the students' 'remote presence' involves the different sites taking turns to give lectures each morning from Monday to Thursday. Lectures are sent by synchronous Internet video link to the other sites. The teachers should speak for a maximum of 10 minutes at a time and then pose a short question that the students should reflect on. (This recommendation was not always considered by all of the teachers.) After each 'reflection time' one (or a few) student(s) at each campus has an opportunity to express an opinion related to the topic. There is a compulsory break of approximately 15 minutes after each lecture of approximately 45 minutes. This method of 'forceful interaction' was judged to be necessary to ensure that all teachers/students included all the campuses in the discussions.

With regard to the pedagogical approaches, the organization of this project is very innovative. Based on the course content, teaching and learning methods, learning materials, work assignments and assessment that were jointly developed by all organizing institutions, each part of the course is co-taught by the four core universities and (with the help of information and communications technologies) on all participating campuses. Every day, the groups link together by the internet and audio-visual technology to compare findings and to exchange points of view. On each campus, classes are taught not only by academics who are physically present, but also by other members of the course team.

The international group of students have time during the afternoon in which to work together on the assignments that the teacher have given them and explained to them during the morning class. All teams must share their completed work with the others by the internet. This experience has proved that dynamic group work can be developed by remote teaching. The course is an Intensive Erasmus Programme. Thus, students have grants to move to other campuses. This means that, at any campus, there are students from all of the other campuses participating in the programme, with or without an Erasmus grant. Students find it far more interesting to learn and interact in such an international group. However, it must be mentioned that this is an intermediate state as the long-term objective is to avoid large-scale physical mobility.

During the two Friday mornings, different study visits are prepared at the different campuses. All visits must be related to the topics of the course. During the afternoon, the students share the experience with the students on other campuses.

All of the documents developed by the teachers and the students' assignments are managed through Bilda, an interactive Learning Management System platform. [15]

The schedule during the first three 'batches' was not as strictly imposed as it was with the 4th and 5th batches of students. This led, in certain cases, to significant inactivity by some students over longer periods. This created tensions in the groups as the more serious students objected to those who did not carry out their tasks properly. The strict schedule in the 4th batch led, however, to more 'care-taking' of the students so that there was always refreshments offered during the breaks. This allowed for stricter time-keeping in the lectures.

3.4 Cost to student to participate in the programme

In the first three batches, the programme was completely free of charge and most of the students were offered scholarships that covered their travel, accommodation and living expenses. Furthermore, there was no academic ranking of the students who applied, as long as they were registered as students at a T.I.M.E. partner university. It was found, however, that a small number of students looked on the course as more of a 'vacation time' than a serious learning opportunity. This meant that not all students passed the course. Furthermore, this partial inactivity created tensions in the class at the respective campuses. For the 4th batch, a small fee, as well as a ranking system of the students, was introduced.

4. Low cost technical equipment used

This experience has been gradually extending the technical equipment used at each campus. For the 2010 course, the technical equipment listed in Table 1 was used.

The course was developed with low-cost equipment so that everyone can participate without special TV-studios. All campuses have equipped one room with very high quality, although relatively low cost, material, which is very different from a closed TV circuit. This means that the method, including the equipment, can be used in larger scale educational programmes.

The prices of the equipment differ, depending on the country, although the classroom can be properly equipped for 5000–8000 €.

Table 1. Technical equipment at each campus

Campus	Technical equipment
All campuses	One computer One beamer and one large screen to view the PowerPoint presentations One internet camera to enable viewing of the students
KTH (Stockholm)	One internet camera to enable viewing of the teacher Five flat screens ($4 \times 55'$ and $1 \times 46'$) for viewing the students at all campuses simultaneously, and one flat screen for presenting the teachers Two wireless microphones: one for the teacher or technician and one for the students Speakers
Supelec (Paris) and UPM (Madrid)	One internet camera for viewing the teacher One flat screen for viewing the students at the other campuses One wireless microphone and speakers
UNITN (Trento)	One flat screen for viewing the students at the other campuses, except ITU in a loop. The students at ITU are viewed in a separate window The teacher is viewed on a separate flat screen One microphone with wire and speakers
ITU (Istanbul)	One screen and one beamer for viewing the students at the other campuses in a loop One microphone and speakers
BME (Budapest)	One internet camera for viewing the teacher One microphone and speakers

5. Results

Evaluating the aims, purposes, and, most importantly, the outcomes of educational programmes is always a difficult task [16]. At the end of the course, the students were required to complete a questionnaire. For the 2008 course, there were ten questionnaires. This had grown to 48 for 2009 and 42 for 2010.

A descriptive statistics tool, the boxplot, is used for analysis. A statistical treatment was performed with the help of the computer tool.

Figure 1 shows the results for 2008. Figure 2 provides the results for 2009 and Fig. 3 gives the results for 2010. The results are shown on the Likert scale (5 for the best, 1 for the worst) [17].

- Q1. What is your overall impression of the course?
- Q2. What do you think about the course content in general?
- Q3. What do you think about the level of the course?
- Q4. How did you feel about the lectures?
- Q5. How did you feel about the afternoon sessions?
- Q6. How did you feel about the individual assignments?
- Q7. How did you feel about the pedagogical level?
- Q8. How did you feel about the course material (e.g., PowerPoint presentations)?
- Q9. What do you think about the interaction between the course activities (lectures, afternoon sessions)?
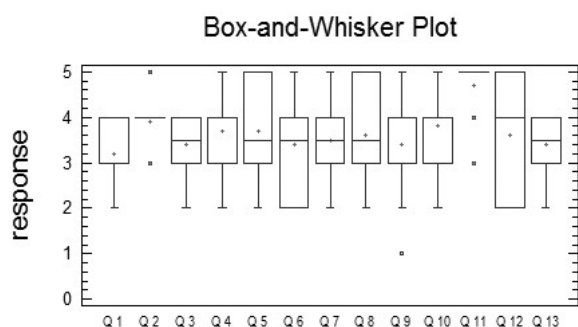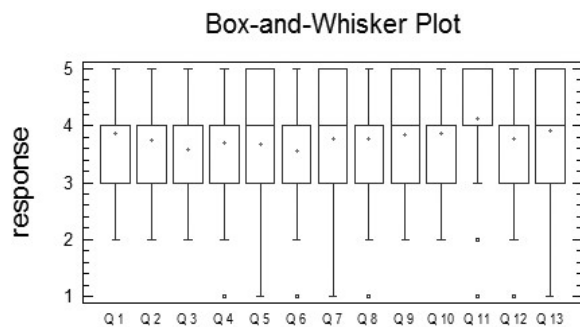
Fig. 2. Results for 2009.

Fig. 1. Results for 2008.
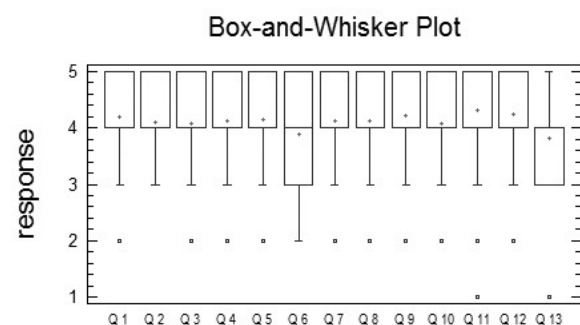
Fig. 3. Results for 2010.

- Q10. What do you think of the interaction between the different lectures on each topic ('Sustainability' and 'Social Models') and among the topics?
- Q11. How did you feel about the study visits?
- Q12. Do you feel that this mode of collaborative efforts with common lectures, assignments and group works via audiovisual connection is good?
- Q13. How do you relate this to "on-single-campus-activities"?

The results are presented in a Box and Whisker plot. The rectangular part of the plot extends from the lower quartile to the upper quartile, covering the centre half of each sample. The centre lines within each box show the location of the sample medians. The plus signs indicate the location of the sample means.

In general, we can see that the results of all questions have improved every year with very high results for the last year. For Q6 (individual assignments), students feel that they have to do lot of work. However, it must be recognized that students achieve 5 ECTS for the course during a time-frame of around two weeks.

The results for the general impression of the course (Q1) have been very high and have improved. The same has happened with the results for the level of the course (Q3), the lectures (Q4), the afternoon sessions (Q5) and the study visits (Q11). The visits have been regarded very positively during all years. Students feel that this mode of learning is good for them (Q12).

These results show that the course has improved every year, but also that it must continue to progress, especially in the matter of individual assignments (Q6) where the results are weaker.

The author's interpretation of the improved result is that there has been progress in both the technical and didactical issues. Some of the teachers who did not receive good evaluations were replaced. The teachers have, in general, adapted better to distant teaching, especially in their communication with the remote students. Several teachers have appreciated the experience, which was new to them, and involved going from a traditional 'one group in the classroom' teaching to a teaching where significant effort had to be made in communicating with the different sites. Improvement in the technical equipment has allowed the students to communicate much better between the groups.

For the outcomes following the course in 2010, the students were asked for their perception of the Intended Learning Outcomes presented by ABET that had been strengthened most by the TESS 2010 programme. The results for the 32 students who participated in the survey, appear in Table 2. On the Likert scale, which was used, 5 is best and 1 is worst. [17].

- Outcome 1: An ability to apply one's knowledge of mathematics, science, and engineering.
- Outcome 2: An ability to design and conduct experiments, as well as to analyse and interpret data.
- Outcome 3: An ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
- Outcome 4: An ability to function on multidisciplinary teams.
- Outcome 5: An ability to identify, formulate, and solve engineering problems.
- Outcome 6: An understanding of professional and ethical responsibility.
- Outcome 7: An ability to communicate effectively.
- Outcome 8: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- Outcome 9: A recognition of the need for, and an ability to engage, in life-long learning.
- Outcome 10: A knowledge of contemporary issues.
- Outcome 11: An ability to use the techniques, skills, and modern engineering tools that are necessary in engineering practice.

The mode is the value that is repeated most. Students say that the outcomes that are strengthened most are outcome 4 (an ability to function on multidisciplinary teams), outcome 6 (an understanding of professional and ethical responsibility), outcome 8 (the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context) and outcome 10 (a knowledge of contemporary issues). It is especially interesting to note that the

Table 2. Outcomes strengthened by TESS 2010. Likert scale (1–5)

Outcome	Mean	Standard deviation	Mode
Outcome 1	2.75	1.18	4
Outcome 2	3.22	0.89	3
Outcome 3	3.88	0.74	4
Outcome 4	4.25	0.61	5
Outcome 5	3.38	1.05	4
Outcome 6	4.25	0.71	5
Outcome 7	4.23	0.73	4
Outcome 8	4.16	0.78	5
Outcome 9	3.75	0.83	4
Outcome 10	4.28	0.79	5
Outcome 11	3.09	1.14	3

main goals of the TESS course are directly related to the ILOs 4, 6, 8 and 10. These received the maximum score. It is, of course, not possible to state whether the result of this evaluation would have been the same if the students had been in a 'regular on-campus' course. It is, however, very encouraging to see that the ILO 4 and ILO 8 identify the ability of the students to function well in this international and distributed environment. The evaluation of ILO 11 is, however, disappointing and shows that course administrators might have 'taken care' of the students too well and have not allowed them to grasp the potential power of such a working environment.

The course has not been designed to strengthen the students' knowledge of mathematics, science, and engineering or an ability to use the techniques, skills, and modern engineering tools that are necessary in engineering practice. Thus, the low results for outcomes 1 and 11 can be considered to be normal.

6. Discussion

With regard to the evaluation of the course, we can appreciate that the students have evaluated the lectures very positively. The materials and the pedagogical level were also evaluated highly. The best evaluation was in 2010. This may be because the universities are improving every year, both on the technology as well as the 'remote didactics.' The experience has been very interesting, because we are learning together—one from the other, both on the student and the faculty sides.

The students' comments on the contents of the course indicated that this had been very interesting for them since they had no opportunity to learn and discuss these issues during their traditional studies at their home universities.

In regards to lessons learned, the surveys conducted after the first and second courses (2008 and 2009) showed that coordination among teachers had to improve. The students also requested more and more comprehensive information about social and religious issues, since they felt that the first courses had concentrated mainly on sustainability.

Another point raised by students was the importance of afternoon sessions where they could clarify matters and delve more deeply into those issues that were presented in the morning, in contrast to students at other campuses.

The outcomes of the results are especially interesting if we consider that some of the Intended Learning outcomes (according to ABET) that are most strengthened (such as outcomes 6 and 8) are difficult to strengthen with other engineering courses [18, 19]. The importance of teaching management ethics has been emphasized [20].

Another positive element to consider, and one that was presented by the teachers who participated in the programme, has been the networking opportunity for the six universities that participate in this programme.

7. Conclusions

After having offered the course for five years, the participating universities have seen that the physical distance between the different campuses does not impair communication between the students and the teachers. This has been demonstrated successfully with this new way of teaching. After analysing the results of the experience, it is recognized that there are some improvements that should be considered.

From a technical point of view, the main problems that appeared during the first year have been solved, since those universities with more experience in this kind of technology have shared their knowledge with the others. Still, the technical aspects should be improved in order to minimize the technical problems that sometimes occur during the course.

From an educational point of view, teachers should become familiar with the audio-visual on-line-conferencing system before the course begins to prevent any problems when using it and to make the course more interactive. Actually, the way in which the lectures are delivered should change to increase interactivity. The lecture should be interrupted every 10–15 minutes in order to check with the other universities/class rooms to ensure that everything is understood. Questions from the students should be dealt with in these breaks. If there are no questions, the teacher should pose one to each class room. By doing this, the interactivity will be increased and the participation will be enhanced.

Guest teachers must be informed in advance that they must change their way of lecturing, according to a certain form (e.g., as suggested above).

Students must be made better aware of the audio-visual interactivity of the course, as well as the strict deadlines for assignments. If, for example, there are questions of how to upload individual assignments, this should be resolved during the lecture. As students come from completely different backgrounds, it is extremely important that what might be 'taking for granted' at a home university is very clearly defined. Owing to the need to coordinate from four to six different universities, as well as holidays and other variables, it is important to adhere to strict deadlines, in order to be able to provide the results within a reasonable time. How-

ever, the students do not adhere to the same kind of guidelines as those of the teachers/faculty.

This experience has been a fairly large-scale pedagogical experiment that is useful for all T.I.M.E. partners. As it was presented, the T.I.M.E. network presently links 46 universities in Europe in a substantial student network. This experience has been shared in the Association's annual meeting and every year more partners join in the experience. Another important aspect for all the participating universities has been the opportunity to learn from other partners. Those with more knowledge of the use of Information and Communication Technologies (ICT) applied to teaching have helped the others. We have all learned together.

New opportunities have arisen since the organizers have new Erasmus Intensive Programme (IP) funding for the next four years and new members have asked to participate in TESS 2011. Students in Sri Lanka will participate in the next course (2011), following this innovative experience. The challenge is to increase the number of participating students and to improve the technical issues of the participating universities, as well as to make this type of learning module available in other locations where it can benefit humanity.

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