Challenges of teaching and learning in English in engineering course

Gao, Chuansi; Yuan, Jinliang; Howard, Christian; Manomaivibool, Panate; Aulin, Radhlinah

2007

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Citation for published version (APA):

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CHALLENGES OF TEACHING AND LEARNING IN ENGLISH IN ENGINEERING COURSE

Prepared by
Gao Chuansi
Yuan Jinliang
Howard Christian
Manomaivibool Panate
Radhlinah Kunju Ahmad

8th November 2007-11-05
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CHALLENGES OF TEACHING AND LEARNING IN ENGLISH IN ENGINEERING COURSES

1. Introduction

The English language is becoming an increasingly common and important component in teaching at Swedish universities. Although, the exact number of courses that are entirely or partially given in English is unknown, in 2006, the estimation figure is around 12-13% (Svantesson, 2006). With Swedish universities adapting to the Bologna process – the joint European project where one goal is to increase the internationalisation of European universities – more international students are applying to study at Swedish universities (Education and Culture Department, 2007). Therefore, the numbers of courses that are given in English are expected to rise considerably during the next few years.

When it comes to the increasing use of English in teaching situations at Swedish universities, Lund Institute of Technology (LTH) is no exception. According to LTH’s annual report for 2006, the international policy clearly encourages international students to study at LTH. This is done via the international student exchange schemes and international Master’s programmes. Based on the agreements with foreign universities and Lund University (LU) or LTH, international students from all parts of the world come to study in Lund. Figure 1 shows a rapid increase in the total number of LTH students studying abroad (outgoing students) and the foreign students at LTH (incoming students).

![Figure 1. Balance of international students at LTH 1996/1997-2006, (Lund University, 2006)](image)

All the incoming foreign students will join with local Swedish students in the LTH engineering programmes or courses taught in English. The trend of increasing numbers of incoming international students implies that LTH will offer more courses in English in the future. Although the courses for international students are taught in English, according to figures from the International office at Lund University (2007), only about 20% of the international students are native English speaking. The origins of these students, a total of 469 in 2006, are presented in Figure 2.
This diversity of student’s origins suggests that we can expect large variations in the student’s English skills, and their ability to understand the content of the course they are participating in. Evaluation reports on three of the international Master’s Programmes conducted by the International Office at the end of 2005 support these suggestions. In these evaluations, teachers from the Master’s Programs Bio & Food Technology (Bio/Food), System on Chip (SOC) and Water Resources (Wat) were asked about their views on teaching international students in English. Response showed that most teachers allocate more work efforts on the international students than on the local students (see Table 1). Concerning teaching in English, more than 50% viewed the variations in the student’s English skills as a problem (Table 2).

| Table 1. Compiled answers from the evaluation report 2005 (Lund University, 2005). |
| Q: How would you describe your work effort for the international master students? | Bio/Food | SOC | Wat |
| The same as for Swedish students | 33 | 43 | 60 |
| Less than for Swedish students | 0 | 0 | 0 |
| More than for Swedish students | 67 | 57 | 40 |

| Table 2. Compiled answers from the evaluation report 2005 (Lund University, 2005). |
| Q: How do you perceive the variations in the international master students English skills? | Bio/Food | SOC | Wat |
| Not a problem | 16 | 29 | 40 |
| Minor problem | 42 | 29 | 60 |
| Major problem | 42 | 42 | - |

In light of the evidence presented above, it is clear that English is becoming increasingly important as a teaching language at LTH. The surveys also suggest that this development presents both teachers and students with a unique challenge. In this project we try to highlight some of these challenges, as well as, propose some recommendations to overcome them.

2. Objectives and description of project

Based on the literature survey, interview with the international office at LTH, and discussion among the course participants and course leaders and our own teaching and learning experiences, this current project is proposed and conducted for the purpose to highlight the
importance and challenges of teaching and learning in English in engineering courses in overall, and LTH education in particular. The aims of the project are to:
1. Examine existing teaching situations in higher educations and LTH International Mater’s Programmes and engineering courses;
2. Identify challenges faced by both teachers and students with various educational and multi-cultural backgrounds;
3. Propose recommendations to overcoming challenges and improving teaching through English at LTH.

3. Challenges of teaching and learning in English

3.1 Challenges for students
Although the challenges of learning through English in Engineering may differ from one student to another, all of them face more or less the same obstacles on the way of acquiring knowledge. Some of the most common questions highlighted by James in his thesis (1996) are to what degree is learning in a second language the same as learning in the first language? Does the competency in the first language facilitate the students in a second? Does a metalinguistic ability related to reading in the first language help or hinder to read in a second? The following discussion highlights the challenges face by engineering students in learning through a second language:

Learning process

James (1996) discussed three stages that students attending second language teaching must undergo. When English is not the mother tongue, these stages can cause problems and if the students fail at the first stage, the problems rolls along to the next stage and gets bigger.

First stage
Language-learning process where students need to be aware of the meanings and relationships involved in the material to be mastered.

Second stage
Students practice conscious production of language to express meaning in restricted controlled activities. The goals are 1) verification of comprehension of material presented in stage one, 2) binding of vocabulary to concepts; 3) accessing needed language to express meaning; and 4) preparation for participation in stage three.

Third stage
This stage is communication, during which students move beyond the more limited and tightly controlled activities of the first two stages. They now attend to topics, situations and activities that require them to make choices of ideas to express and how to express them at a higher level in the SOLO taxonomy.

Double task

Students have to undertake double tasks, meaning they have to master both science content and language. Here students must first learn a new and difficult subject through a medium of a second language. This double task requires difficult and different skills at once – one being related to language and the other to subject content (Bohmann, 2001). Regarding the subject of language, the question is what level of language proficiency is necessary to cope with a second language as an instruction medium? According to Heugh (1999) the minimum vocabulary necessary to cope with English as the instruction medium is 5000 words which on
the contrary an average student after four years of home language and English as a subject, would have acquired only about 800 words.

**Communication**

*Communication between student and the written text*
In university education, students must demonstrate their understanding of the concept taught is both oral and written form. This ability to communicate their understanding of the concept in either form is a challenge that most student face. James (1996) called it as the communicative competence which can be in the form of grammatical competence which include vocabulary and pronunciation as well as grammatical structures and word forms in which they lack.

*Communication between lecturer and students*
It is also difficult to view language in subject knowledge learning in isolation. Language is the medium by which teachers introduce and convey concepts and procedures, through which texts are read and problems are solved. Students feel that communication becomes poorer between them and the lecturers because of weaker ability to use colloquial or familiar language, make digressions, recount anecdotes, understand jokes in class or give spontaneous responses (Wilkinson, 2005).

*Communication between students and students*
Students also need to warm up to ‘socialise’ in the educational cultures. Native students observed that when it comes to English native speakers among their course mates, such students’ accents, speaking speed, and the subtle nuances they could make seems to increase the problems for both peers and the teachers. Given the option, 75% of native students would have chosen native-medium courses (Wilkinson, 2005).

**Language competency**

A theory that is based on two hypothesis: a). threshold hypothesis suggesting that learners who have high competency in their second languages, have potential cognitive advantage over learners with competence in their mother tongue; b). development interdependence hypothesis which predicts the abstraction level of the mother tongue is important for mastering conceptual operations connected with subject knowledge (Cummins, 1978). This theory is supported by Dawe (1983) that discussed the idea of linguistic distances where the greater the distance between learners’ first languages and English, the greater the learning task will be. His study support theories that assert a cognitively and academically beneficial form of bilingualism is dependant on adequately developed first language skills.

**Time**

When it comes to learning a second language, more time is needed to understand terms and concepts, more time to conduct tasks and activities, to complete tests and exams. Students need more time to speak out and intervene in lectures or discussions, discussions become less lively as a consequence and it takes more time to become enthusiastic about the subject or domain (Wilkinson, 2005). More than 50% of respondents agree that English has a negative effect on quality of discussions.
Low awareness of the benefits of second language

Acquisition of a second language may be considered to be an asset which many students fail to realise. Linguistic attainment is not being seen as a valuable addition to what is primarily a technical interest. Students do not acknowledge that the acquired knowledge might be beneficial in improving their career prospects.

3.2 Challenges for teachers

In the situation where there are both native-English speaking and non-English speaking students, challenges exist for teachers regardless of their mother tongues being English or other languages.

Challenges for both native and non-native English speaking teachers

Language support
Native-English speaking teachers may not realize or do not have time to deal with non-native English speaking students’ needs for practical and professional language support for learning in higher education, and the language proficiency differences between native and non-native students. They assume that if the students have passed language tests, they have no problems in studying. Subject teachers usually focus on content knowledge and provide no language support. The latter is of importance for international students, especially in the early stage. The teachers sometimes enjoy using slang, metaphors or jokes, resulting in confusing and excluding non-native English speaking students (Carroll, 2005).

Cultural challenges
Teachers may not recognise cultural differences, or may not have sufficient intercultural competence, thus resulting in misunderstanding and miscommunication in classrooms (McLean and Ransom, 2005). For example, Chinese students in the early stage of their studies are probably appalled by teachers’ behaviour of sitting on tables or putting feet on seats or tables while giving lectures, which is regarded as impolite. Students are quiet because they respect teachers as authorities and also expect clear answers to questions. However, the teachers may perceive them as being inactive, lack of ideas, or not being critical. The Western assumption that talking is connected to thinking does not apply to the East (McLean and Ranssom, 2005). On the other hand, students may consider teachers as being incompetent if the teachers cannot give clear answers to questions and just let students to find answers for themselves in the beginning of their studies.

Indian students may nod to acknowledge they are listening – not to show agreement or understanding. Japanese students “yes” does not necessarily mean they agree, but just to indicate they hear and understand (McLean and Ranssom, 2005). Another example observed by Cortazzi and Jin (McLean and Ranssom, 2005) is that during a discussion, Greek students’ pauses between turns are minimal and overlaps between speakers are considered normal, while Scandinavian students may interpret the behaviour as rude.

Having observed the cultural differences, some teachers may try to “correct” the problems. However, McLean and Ranssom (2005) suggest creating awareness of different cultures that students bring with them to the class, and critically engaging the tradition they bring from their own cultures. With regard to the word “critical”, native-English speaking teachers may
also need to paraphrase terms and words such as instead of “critical”, using “compare and contrast”, “explaining strength and weaknesses of the argument”, etc for students coming from different cultures. According to Ryan (2005), teachers sometimes view international students as a homogeneous group with similar learning styles and expectations; as rote learners with surface approach to learning; lecturers include large amounts of information in their lecture design and delivery and assume certain background knowledge and language proficiency. This could impose more stress on international students than on home students.

**Pedagogic challenges**

Biggs (2003) observed that due to the cultural differences, teachers may have misconceptions and “blame-the-student” thinking, i.e. it is students’ fault if they cannot adopt themselves to western teaching situations. He argues that this is level 1 thinking in his “cross-cultural teaching ladder”. Level 2 is to blame teachers. Teachers should adopt their teaching techniques to a new environment (“teacher-centred” thinking). Biggs (2003) argues that the challenge and right direction for teachers is to move up the ladder from level 1 and 2 to the highest level 3 (“student-centred” approach), focusing on activating students’ deep cognitive learning processes. Then the cultural differences are beneficial rather than detrimental in learning in context. This type of pedagogic challenge for teachers is to focus on cognitive similarities between students rather than the cultural differences.

**Special challenges for non-native English speaking teachers**

**Linguistic competence and confidence**

Besides the above challenges, there may be specific challenges for non-native English speaking teachers. For example, teaching is challenged if teachers’ English proficiency is not sufficient or they are not confident. They may have difficulties in fluency and vocabulary in English as a second language. Teachers may lose spontaneity and self-confidence, in turn resulting in less efficient teaching, and ultimately the loss of students’ interest in the subject and trust in teachers. These are especially the cases when there are native English speaking students in the class. According to our interviews, the tempo of teaching may be slower when using English than mother tongue. The communication style between teachers and students may be different. Wilkinson (2005) showed that the effectiveness of English medium content teaching is influenced by language proficiency. The quality may be lowered. The communications becomes “poorer”.

*One example was that in the international Master students’ class with the teacher from Japan and students from USA. A young female American student asked a question and the teacher misunderstood it as related to pregnancy. Both the teacher and the student were embarrassed.*

Both non-native English speaking teachers and students need more time when teaching and learning in English medium. LTH teachers reported that they spent about 40-67% more time on their teaching efforts for the international Master students than for Swedish students (Table 1). Teachers need more time to prepare their teaching, to explain terms especially abstract concepts and theories clearly. Students may get confuse about terms being used in the class as some terms can have more than one meaning. For example, IEA could mean International Ergonomics Association, Industriell Elektroteknik och Automation, and International Energy Agency; PDF could mean the file format, and Post Doctoral Fellow; HR could mean Heart Rate and Human Resources; BB could mean Bed and Breakfast and Barnbördsavdelning, WC could mean Wind Chilling and Water Closet, etc. Therefore, these kinds of terms should be used with caution.
Changing role of teachers when teaching in English

Teachers had to be more pro-active and intervene in group work more, thus taking a role as discussion leaders rather than monitors or counsellors, especially in the beginning of the group work (Wilkinson, 2005). Students’ previous educational cultures may affect their willingness to take the initiative especially during discussions and tutorials. Therefore, teachers had to instigate discussions among students instead of students asking for their opinion.

4. Recommendations

The following recommendations surface from the literature reviews and our brainstorming sessions. The recommendations are discussed during these sessions regarding their relevance’s to the challenges faced by both students and teachers during teaching and learning through English at LTH.

Minimum proficiency requirements for admission

Carroll (2005) recommends minimum proficiency requirements as a key step towards supporting all students’ learning, providing that the institutions understand what the proficiency tests (e.g. IELTS, TOFEL) can and cannot tell. Such requirements aim to increase the homogeneity of class language proficiency.

At LTH, this measure can be and has already been applied for the admission to international Master’s Programmes and of exchange students. For example, prospect students for the international Master’s Programmes must meet proficiency requirements by *inter alia* (a) IELTS score of 6.0 or more (with not less than 5.0 for each section) or (b) TOFEL score of 550 (computer-based test 213 or internet-based 79) or more (Lund University, 2007). However, its applicability for other programmes, particularly undergraduate education, might be limited. In addition, the requirements do not solve the proficiency challenge; they just limit its variation.

Specialist language units to support students

It is not uncommon for universities in English-speaking countries to have specialist language units to support students’ language needs. Their services can lower the workloads on both students and teachers. These units might also provide pre-session language courses before the start of the academic year to facilitate students’ learning through English. With a growing use of English and internationalisation, the need of specialist units at Lund University/LTH might become apparent (refer Table 2).

Trainings for teachers

Teachers also need supports and trainings, especially those whom do not have English as their mother-tongue. Trainings and seminars can improve their linguistic skills and the effectiveness of using English as a teaching medium. In addition, these might open up an opportunity to exchange experiences with other teachers. Currently, Centre for Educational Development provides a course, ‘Teaching and Learning through English’. According to the
first-hand experiences of two of the group members, increasing the degree of interaction among participants can further enhance the effectiveness of the course (mainly web-based). It is good to have practical teaching assignments and to get both linguistic and pedagogic comments from peers and the teachers.

Acknowledging the language factor

Previous sections underline that language matters. Teachers must appreciate and also make their students aware of this fact. There are two sides of this fact: challenges and benefits. Unless teachers and students are aware, they are less likely to see the challenges, not to mention trying to overcome them. Airey and Linder (2006) suggest teachers to discuss with the students the fact that there are differences when lecturing in a second language. It is worth noting that students with good command of English, e.g. Swedish students, or having a good result from proficiency tests tend to overlook the challenges and might fail to make necessary preparation (Airey and Linder, 2006; Carroll, 2005). Besides the challenges, teachers should be explicit and specific on the benefits which justify why English is chosen as a teaching medium. Preferably, the course objectives should also include acquisition of a second language as a learning outcome.

Buzz groups

Many authors suggest the use of buzz groups to encourage students’ participation in an English-as-a-second-language (ESL) class (Airey and Linden, 2006; Liu, 2006; Carroll, 2005). Buzz groups are small, ad hoc groups of students built around a short topic to discuss in a class (Biggs, 2006). This peer-directed activity can help student to overcome the so-called foreign language anxiety (Liu, 2006). Students normally view their peers as more or less equal and become more ready to ask and to answer in buzz groups. The small size of buzz groups also takes away some of the pressure (compared to being singled out to ask or to answer in front of the whole class). If allowed, a student can fall back to his/her mother-tongue to express difficult or complex ideas. Then, the group can collaboratively help construct the idea in English. The presence of native speakers in buzz groups might be an advantage here. Buzz groups also allow students to check and enhance their understanding with their classmates, which can be appreciated by both non-native and native speaking students. Finally, the products of buzz groups are not personal, but rather group ideas and students (or to be exact the representative of each group) might feel more confident expressing them. Buzz groups are generally applicable. The activity can be used to stimulate students to form an answer to a question or a question that needs further clarification from the teacher. As demonstrated in this course, the use of buzz group had proved to be a success and it is particularly useful to refresh what has been learned in previous class.

It is evident from the discussion above, the structure of buzz groups need to strike a balance between a few considerations. As most students prefer to work with students like themselves, De Vita (2005) suggests that culturally mixed groups must be arranged by the teacher, rather than allowing students to decide which group to participate in if intercultural contrast as part of formal study is to take place. This might be partly the reasons why our groups had been engineered already before the start of this ongoing “Introduction to Teaching and Learning in Higher Education” course conducted in English (with the teachers and most of the students being non-native English speakers, and with multicultural backgrounds).
Lightening the language load in a class

There are several recommendations aiming at lightening students’ language load in an ESL class. The list ranges from asking students to read materials before the lecture, providing handouts and pre-printed notes, giving multi-representational supports (e.g. visual illustrations), to speaking techniques and tips like using plain English in chronological order and pauses (instead of merely trying to speak slowly and/or loudly) and avoiding (culturally-loaded) jokes and slang (Airey and Linden, 2006; Carroll, 2005). The keys are to lessen the burden of the aforementioned double task nature of ESL classes.

This approach targets mainly on listening and note taking. As Olsen and Huckin (1990) observe, encountering new knowledge in second language, some students resort to an information-driven listening strategy which focuses on collecting information instead of a point-driven one which concentrates on understanding main points. This tends to result in suboptimal learning outcomes, e.g. uni- or multistructural levels in the SOLO taxonomy (Biggs, 2006). Asking students to prepare before the class aims to familiarise them to the subject; handouts and pre-printed notes ease note taking; multi-representation supports offer alternatives when verbal learning (Felder, 1993) in English can be difficult; plain English removes the (unnecessary) complexity of scientific information; chronological order makes the messages easier to follow; pausing gives more time in a natural way; jokes in English, especially cultural ones, can be incomprehensible to students; and, so on. All these enhance students’ opportunities to understand and reflect on the messages and can be universally recommended. A caution is needed for the use of multi-representations, however. As Airey and Linden (2006) put it, “using multiple representations without a clear reason will simply confuse students”.

Building up discipline-specific vocabulary list

This is a classroom-based language support. As mentioned above, students need vocabulary as a basis for understanding the subject. Every subject has its special vocabulary – jargons. While jargons can be effective and economical for professionals, they are normally obscure for people new to the field. There are several options to help students build up discipline-specific vocabulary. The simplest way is to hand out a glossary containing key terms and definitions accumulated years after years. It is also preferable to let students play an active role in the process. They should be able to raise up the issue when new words are introduced without drawing undue attention (if students feel that such an action will draw undue attention and disrupt the class, they might be a self-restraint and not speak up). Carroll (2005) gives an example where a teacher gives students “yellow cards” which they can use to alert her to the use of new words.

Creating communication channels with an informal atmosphere

The communication between teachers and students can be enhanced through informal channels. Some students do not feel comfortable asking questions in English to the teacher in the class. Informal channels to the teachers can remove this language barrier. For example, Airey and Linden (2006) suggest to end the class early and to allow time for students to come up and ask questions, possibly in their first language. E-mail can be another good candidate because students have more time to think and formulate the questions.
Good teaching and learning is similar in any language

One thing seems to surface from the literature and our discussions: ESL does not change the nature of education and “good [teaching] techniques are the same in any language” (Airey, and Linden, 2006). Although the recommendations are discussed relating to the ESL context, most of them are generally applicable to teaching in the first language as well. On the other hand, the awareness of this ELS context might stimulate a search for effective teaching and learning. For teachers, when lectures are conducted in English, its limitations become more obvious. Then, those who realise the challenges might try to diversify course’s activities, especially adding more peer- and self-directed ones as evident in this on-going course. It is worth noting that, though most of our literature focuses on lecturing, their recommendations constitute a move away from conventional, one-way, monotonic lecturing to a more “constructive alignment” (Biggs, 2006). For students, being aware about increasing challenges but having a supportive learning environment (to create one, see recommendations above), they might consciously put more effort which can, in turn, result in better learning outcomes. Airey and Linden (2006) note that while some students read the materials before classes conducted in English and claimed to have better understanding, none of them did the same for those conducted in their first language, Swedish (though preparation before the class is universally applauded practice regardless the language).

5. Conclusions

It is clear that English is becoming significantly important as a teaching and learning language for both international Master’s Programmes and courses at LTH. It is particularly true when Swedish universities have adapted to the Bologna programme, and more international students are applying to study at LTH due to no tuition fees are applicable and high reputation achieved. Consequently, new challenges face not only to the international students studying in a new country, but also to the teachers either speaking native English or coming from non-native English speaking countries. The challenges origin from both multi-language backgrounds and diverse educational systems the teachers and international students have.

It is suggested by this course project that the teachers involved should be aware of the challenges faced, and employ the efficient methodologies for the course teaching, such as acknowledging the language factor, forming buzz groups, lightening the language load in the class, building up subject-specific vocabulary list, creating communication channels with an informal atmosphere, etc. It is also suggested that in addition to the minimum proficiency requirements, LTH or LU should set up specialist language units to support international students, and establish the necessary training programmes or course for teachers to facilitate overcoming the challenges.

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