

Language and the experience of learning university physics in Sweden

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Abstract

This qualitative study explores the relationship between the lecturing language (English or Swedish) and the related learning experiences of 22 undergraduate physics students at two Swedish universities. Students attended lectures in both English and Swedish as part of their regular undergraduate programme. These lectures were videotaped and students were then interviewed about their learning experiences using selected excerpts of the video in a process of stimulated recall. The study finds that although the students initially report no difference in their experience of learning physics when taught in Swedish or English, there are in fact some important differences which become apparent during stimulated recall. The pedagogical implications of these differences are discussed.

1. Introduction

In many European countries the teaching of university physics is divided between two languages – the national language and English. Surprisingly we know very little about the effects of this dual language approach for students' learning of physical concepts. Meanwhile, in the wake of the recent *Bologna declaration* on harmonization of European education, the number of courses given in English in European physics departments seems set to increase. With these two facts in mind we believe there is an urgent need to better understand the relationship between physics learning and language. This study set out to illustrate this relationship by examining one section of this teaching and learning system – namely the ways Swedish students experience learning physics when the language of teaching varies between Swedish and English.

2. Research background

Surveys of language use in Swedish higher education show that high proportions of English textbooks are prescribed in engineering, natural sciences and medicine. (Gunnarsson and Öhman, 1997; Falk, 2001). The default position in undergraduate physics appears to be one of lectures in Swedish with course texts in English, but the presence of even a single exchange student on a course can change the teaching language to English (Airey, 2004). The reasons for the widespread

use of English in university physics can, of course be traced to many more factors than the presence of students who do not speak the national language. Other important factors influencing language choice in favour of English are; availability of relevant up-to-date course texts, use of foreign academics, competitive advantages on the job market and preparation of students for an academic world dominated by English (Airey, 2003).

Even without the added complication of a second language, we believe language problems in physics lectures are particularly acute due to the experienced complexity and abstractness inherent in learning a science such as physics. As Östman (1998) points out, scientific language is abstract and represents special communicative traditions and assumptions. Moreover, Halliday and Martin (1993) claim that language is much more than a simple representation of disciplinary knowledge, it is actively engaged in bringing such knowledge into being. Learning a subject like physics therefore depends on learning the language in which the knowledge of the discipline is construed (Lemke, 1990). Thus it can be argued that the relationship between a student's first language and physics learning is by no means straightforward. But what about the effects on physics learning when students are taught in a *second* language?

Surprisingly, there has been very little research into the relationship between student performance and the lecturing language at university level. In Sweden no studies have been carried out into the effects of lectures in a foreign language, although internationally a number of researchers have found negative correlations between learning in a second language and undergraduate performance (Neville-Barton and Barton, 2005; Gerber *et al.*, 2005; Klaassen, 2001; Vinke, 1995). These studies are undoubtedly interesting for those faced with deciding *which* language to use in a given lecture situation. However, lecturers faced with the day-to-day reality of giving courses in their students' second language remain unsure as to any *specific* negative effects of such lecturing. We therefore believe that it is important to find out *what* students may find difficult in second-language lectures and *how* student learning patterns change as the lecture language changes. In his summary of research into second-language lectures in all disciplines, Flowerdew (1994) concluded that a great deal of work needs to be done before we can say what constitutes a successful second-language lecture. It was expected that the results of this study would contribute in some part to filling this particular gap in knowledge.

3. The study

The study set out to explore an illustrative relationship between the lecturing language and the learning experiences of 22 undergraduate physics students at two Swedish universities – one a larger, established research university and the other a smaller teaching university. The study focused on two lecture blocks at each university, one in each language – with each individual student attending both a Swedish and an English block. These lectures were video filmed. Prior to this filming, the lecturers had been interviewed about any areas where they expected students to have problems with the physics material to be covered. Guided by these interviews and our methodological interest in capturing as much variation as possible, the video footage was edited down to four short segments for each lecture block.

Semi-structured interviews lasting for an average of 1hr 30mins were then held with each student. In the interviews students were asked to describe their experiences of learning physics in the two courses. Thereafter the 2x4 edited segments of video footage were used in what is commonly known in educational research circles as a process of *stimulated recall*. This process attempts to recreate a significant part of the atmosphere of the original learning situation, thus allowing students to better describe their learning experiences in the specific situations that they are shown (Bloom, 1953; Calderhead, 1981).

4. Findings

4.1. Language is seen as unimportant

The most striking aspect of the findings is that when asked directly, students say they notice very little difference in their learning when taught in English rather than in Swedish. This is something that is common for all students at both universities.

- Student: Language is not very important I think. It doesn't matter.
 Interviewer: Why's that?
 Student: Well, I think... Like I said, understanding English is not a problem for me.

This result is similar to those of Neville-Barton and Barton (2005) who find that the second-language mathematics students in their study self-report levels of understanding similar to those of first-language students. The overwhelming majority of students interviewed in our study feel the lecturer should use the language he or she is most comfortable with – i.e. since the students are well-versed in English from high school they do not see their *own* competence in English as problematic. Students suggest that the limiting factor for their learning is the lecturer's ability to mediate physics knowledge in the chosen language:

- Student: As long as he has a message to deliver it's fine... If it would be better for him then it's fine, he could take it in English.
 As long as he thinks he can do a better job.

However, despite *all* students initially maintaining that language was not an important factor for their learning, both our analysis of the videoed lecture material and the students' own accounts of their learning experiences during stimulated recall indicate a number of problems related to learning in English rather than Swedish.

4.2. Asking questions

We observed that the *willingness to ask and answer questions* was greatly reduced in English-medium lectures. This was also reported by the students themselves:

- Student: If you want to ask a question, you have something you want to ask, then I don't speak English so well as I speak Swedish, so its easier for me to ask... to talk in Swedish and ask things.
 Interviewer: I noticed in [the Swedish lecture] there were a lot more questions than in [the English lecture] is that common or is that just...?
 Student: No... It's common, um actually [laughs]. Yes, that for sure has to do with the language, that people don't er... they're a little shy to speak English because they cannot speak English so well. Erm... For me it is like that.

That the traditional reluctance to ask questions is exacerbated when lectures are in English is all the more worrying when we take into account the fact that *lecturers* see a strong correlation between asking questions and student understanding:

- Lecturer: Of course there are exceptions, but typically those who, er, who perform better, those are the ones who ask questions.

In our observation of this particular lecturer's sessions we found that a number of students, though quiet in the lecture, came forward at the end of each session to ask questions.

4.3. Answering questions

Here is a student on the subject of *answering* questions when lectures are in English:

- Interviewer: Do you think it would have been easier to answer the question in a Swedish lecture rather than an English lecture?
- Student: Um I thought about that anyway when I had [the English lectures] that sometimes, you know, when he asked a question I was pretty certain I knew the answer but because it was English and so on you worried that it perhaps wasn't quite that he was looking for. Um, you get a little uncertain.

We believe this reduction in asking and answering questions to be an important finding. If lecturer/student interaction is reduced in this way (in extreme cases effectively limiting lectures to a monologue) then we would expect what is widely characterised as the shared space of learning (Tsui, 2004) to be correspondingly reduced.

4.4. Focusing on note taking

When lectures are given in English, those students who take notes report spending a large proportion of their time concentrating on *the process of writing* rather than understanding lecture content:

- Student: You're not as used to listening to someone speak English as Swedish. ... You know speaking Swedish you can just er. You can listen and you can write what he's saying and you don't have to, you know, make such a big effort out of it. But if it's in English you've maybe got to focus a bit more on what he's saying and maybe the general message of the physics or maths gets lost a bit more...

4.5. Work outside class

For students who take notes, their success in understanding the content of a lecture given in English appears to critically depend on the work done outside class after the lecture (or sometimes before the lecture, see section 4.6.).

- Interviewer: To what extent do you think that you can follow what's going on in the lectures? Do you follow then or do you follow when you work through afterwards?
- Student: For me it's more, I, in the lectures I write down what the teacher says and do[es] and don't reflect on it under the lecture. But then when I come home I go through the notes and try to understand what the teacher has done! [laughs].
- Interviewer: So you feel like you're more, spending more time taking the notes than actually trying to follow what's going on?
- Student: Yep.
- Interviewer: It's more important to get down exactly what, what the person's written?
- Student: Yeah
- Interviewer: And then you have to do the work afterwards?
- Student: Umm. Er – usually the teacher's explains are more simple than to read in the book. So it's a combination of the teacher and the book and re-reading the notes. And some things, it can, go er, one or two weeks and then ooh! It's like that! [in Swedish] The penny's dropped!

Here, we do not mean to suggest that when the students attended lectures in Swedish they did not need to do work outside class. Rather, as we showed in section 4.4., the students in our study indicated that when they took notes in a lecture given in Swedish they were better able to *simultaneously follow the thread* of that lecture than they were when taking notes in a lecture given in English. Consequently, when the students took notes in a lecture given in English, they found they typically had to do more work outside class than when the lectures were given in Swedish.

4.6. Reading before the lecture

In some cases students had read through the relevant chapters *before* the English language lecture and, without exception, these students were those who claimed higher levels of understanding during the lecture.

Student: I've seen everything before and of course there's a lot of questions everywhere, but then I can spend the time on the lecture by straightening them out.

And here another student who does not take notes in class, on the same theme:

Student: I talked to the students that are in the third year. So they said you should read through everything before [the English lecture] so I've tried to do that – and I think it works really well. So, I read myself and I take notes, but I don't take any notes at the class because I think it's better just to listen then I can follow.

This reading done before class would probably have the same positive effect on the understanding of lectures given in Swedish; however, the students in our study only mentioned reading before class as a strategy they adopted when they were lectured in English.

4.7. Multi-representational support

In the case of both of the quotes in section 4.6, the lecturer followed one textbook very closely in lectures, working through each of its sections on the board. Often there was little difference between the pages of the book and what was written on the board. Our initial thought was that this would be a boring and unproductive lecturing strategy, however, this 'walking students through the landscape' was appreciated by all the students we interviewed:

Interviewer: Do you have [the textbook] with you in class?

Student: Er, *now* I have it because I don't have the time to listen to [the lecturer] and try to understand what he's saying and taking notes at the same time. So now I have this book with me and do some notes in the text.

So one useful lecturing strategy could be to follow a book or a set of lecture notes that students have already had access to – students can then simply annotate the text whilst concentrating on what is being said. Similarly, another student talked about the need for written support for oral descriptions:

Student: It's easier in a lecture when you have a... when they write things down on the board. That's actually something with English, that it's difficult to sit and spontaneously make notes 'cause you've got enough on your plate

trying to first understand the English and then understand the physics. If they only talk it's difficult to translate and make notes, you end up with a bit of a mixture, a bit of Swedish and a bit of English. I think it's easier – actually I think it's *always* easier when the teacher writes a lot on the board...

Interviewer: So the lecturer has to, if it's taught in English, has to write down a lot otherwise it becomes very difficult?

Student: Yep [...] I personally find it difficult to take things in when I only hear it and don't get written notes.

Here we can see that when lecturing in a second language, writing extensively on the board appears to help students. We can speculate that other forms of support such as handouts, overhead slides, demonstrations, computer simulations, etc. would also help.

5. Conclusions and recommendations

5.1. Conclusions

Whilst we recognize that 22 students is a relatively small sample from which to draw conclusions, we believe that the results reported here provide a good illustrative case study of second-language lecturing. The main conclusion of this study is that there appear to be differences in the ways Swedish physics students experience lectures in Swedish and English – and that students are on the whole unaware of these differences.

When taught in English the students in our study asked and answered fewer questions and reported being less able to follow the lecture and take notes at the same time. Students employed a number of strategies to meet these problems by; asking questions after the lecture, changing their study habits so that they no longer took notes in class, reading sections of work before class or – in the worst case – by simply using the lecture for mechanical note taking and then (perhaps?) putting in more work to make sense of these notes later.

5.2. Recommendations for second-language lectures

Some experienced lecturers might suggest that they could have anticipated the results reported here, however, the fact remains that with the increased movement of students throughout Europe envisaged in the Bologna declaration we need to base our pedagogical decisions on empirical work rather than gut feeling. Moreover, the finding that students initially see the lecture language as unimportant simply highlights the fact that empirical findings can be counterintuitive. In this spirit the following are some tentative recommendations drawn from the results of this study and our own experience.

When lecturing in the students' second language we believe students will be helped if lecturers:

- *Discuss the fact that there are differences when lectures are in a second language.* A common response from students in our study was to thank us for the opportunity to discuss these issues. Students need to be aware that specific problems can occur in second-language lectures and that there are strategies (see below) that can minimize these problems.
- *Create more opportunities for students to ask and answer questions.*

Three reasons for the lack of interaction in lectures appear to be; student uncertainty about whether they have understood the question correctly, fear of revealing lack of understanding to the lecturer and a fear of speaking English. We recommend using short, small-group discussions within a lecture to come up with answers to questions and to generate new questions. These small ‘buzz groups’ allow students to check their understanding in a less threatening forum than the whole class. Moreover, the resulting student interaction with the lecturer becomes less threatening since it takes place on a *group* level rather than an individual level. Each group can also choose one person to express their ideas. Those students with a particular aversion to speaking English will still avoid speaking in class but at least they participate in vicarious interaction with the lecturer (Bligh, 1998).

- *Allow time after the lecture for students to ask questions.*
Being available for informal questions at the end of the lecture allows students to come forward and discuss problems in a less threatening environment. In this respect it is probably a good idea to finish lectures early so that both students and lecturer do not need to be somewhere else. If possible students should be allowed to ask questions in their first language.
- *Exercise caution when introducing new material in lectures.*
A typical approach to new subject matter is to introduce the topic in a lecture. Our research suggests that lectures may not always be the best way to introduce students to a topic, since students may have difficulty following and taking notes at the same time. If lectures are used to introduce a topic it may be prudent to simultaneously give out lecture notes that students can annotate.
- *Ask students to read material before the lecture.*
A good strategy is to ask students to read about a subject *before* lectures, the lectures can then be used for confirmation and clarification of what students have already seen. Choose a book or use a set of lecture notes which are then followed closely in class.
- *Give as much multi-representational support as possible.*
Lecturers should support their oral descriptions with a number of other types of representation such as overhead slides, handouts, demonstrations, computer simulations, etc. However it is important that each representation reinforces the main themes of the lecture – using multiple representations without a clear reason will simply confuse students. Similarly, planning a logical structure and layout to any input on the board will also be useful.

5.3. *Good lecturing techniques are the same in any language*

The recommendations listed above could be said to apply equally well to lectures in the students’ first language. We believe that changing the lecturing language merely accentuates communication problems that are already present in first-language lectures. In her study of Dutch engineering students Klaassen (2001) found that effective lecturing behaviour had a much greater effect on how students experienced lectures than the language used. We suggest that those teachers who were rated as more effective lecturers in Klaassen’s study may have already used some of the strategies listed in 5.2. to help students to cope with the shift in language.

5.4. Relevance for other teaching situations

The extent to which these results can be generalized to other types of student within Sweden and to other countries where the English language ability of both students and lecturers varies is an open question. We can, however, speculate that since Sweden is widely believed to be one of the countries in Europe with the highest levels of second-language English ability, that the problems we have described would perhaps be even more pronounced in countries with generally lower levels of English language competence.

This study set out to inform physics lecturers about what might be problematic when their students are taught in a second language. We believe we have succeeded in this task and that physics lecturers will be able to transpose these results to other specific lecturing situations, devising their own strategies to mitigate any possible problems. Although there will always be questions about the generalizability of this kind of study, we believe the very fact that we have shown that problems *can* be experienced by students should be enough to prompt lecturers to rethink their strategies when presenting physics in a second language.

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