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Walking a mile in their shoes: Non-native English speakers' difficulties in English language mathematics classrooms

Dann G. Mallet
Faculty of Science and Technology
Queensland University of Technology, Australia
dg.mallet@qut.edu.au

Abstract

This autoethnographic investigation considers an English-speaking lecturer's observation and consideration of the predicament of non-native speakers of English in an English language mathematics classroom based on that same (non Spanish-speaking) lecturer's experience in a Spanish language mathematics classroom. Difficulties of understanding a course of mathematics instruction in a particular language for mathematically competent but language deficient students are outlined, and a number of guidelines for lecturers to improve the experience for such students are presented.

Keywords

Non-native English speakers; learning support; mathematics; quantitative literacy

Introduction

The international student education industry was the third highest export earner in Australia in 2008, worth more than $15 billion a year and bettered only by exports of coal and iron ore (Commonwealth of Australia, 2009). This figure had increased by 23.4% from 2007 earnings and included over a half a million student enrolments in 2008-2009 (Commonwealth of Australia, 2009). At Australian universities, the average proportion of total university revenue derived from international student fees is approximately 15% (Commonwealth of Australia, 2009). More than 80% of international students in Australia in 2007 were from Asia (Commonwealth of Australia, 2009). It is clear, from these figures, that Australian universities need to regard seriously the needs of international students, known variously as NESB (non-English speaking background) or ESL (English as a second language) students. In this paper, the author "walks a mile in their shoes" and recounts his own experiences as a non-native speaker in a university classroom. The approach sits within the qualitative methodology of autoethnography, which, at its simplest is a form of autobiographical personal narrative that explores the author's experience of life (see Chang, 2008; Reed-Danahay, 1997). Autoethnography affords personal insight into problems frequently overlooked or oversimplified in society, for example, the nature of identity, political power, cultural patterns and life in academia. The study described in this paper allowed the researcher to gain empathy and a deeper cultural understanding of the non-native English speakers in his mathematics classes.

The literature related to teaching English as a second language is extensive; however, literature discussing the teaching of mathematics to international students and/or students who speak English as their second language is not so comprehensive. This is particularly the case when considering the teaching of university-level mathematics as opposed to mathematics at the school level. A few researchers, including Wood (1990), and Novak and Langerova (2006) did consider teaching of mathematics and statistics in multi-language environments and presented some suggestions for dealing with the issues inherent in such teaching environments. Other researchers discuss teaching

students from non-English speaking backgrounds (NESBs) in other contexts and offer further suggestions for supporting the learning of these students (see, for example, Biggs & Watkins, 1996; Bretag, Horrocks, & Smith, 2002; Kennedy, 2002; Kirby, Woodhouse, & Ma, 1996; Tang, 1996).

Wood (1990) discussed the teaching of statistics for students who are not native speakers of English and suggested that the teaching of statistics can be adapted or enriched by adopting techniques normally used in the teaching of second languages. Such adaptations are also said to be useful to native speakers of English taking statistics classes. This can be understood more easily if it is noted that mathematics and statistics involve not only natural spoken/written English, but also mathematical English, that is, the language of communication of mathematical ideas and content based in the English language (Austin & Howson, 1979). So in some sense, even native English speakers are also confronted with a new language when they study mathematics and statistics. Wood (1990) proposed encouraging verbal interactions in the classroom as well as adapting teaching materials to help students develop their English language and mathematical English language skills. Novak and Langerova (2006) considered the problems arising when teaching mathematics with the aid of tools such as computer algebra systems that are not available in the students' native language; a problem encountered in the context of their Czech Republic-based classroom. These authors suggested the use of a bilingual dictionary of mathematical terminology to partially overcome such issues. This tool has been developed and is available online (Novak & Langerova, n.d.). The literature concerning teaching of school level mathematics to non-native speakers of English is not devoid of important contributions in the university-level context though. Cuevas (1984) discussed the learning of mathematics, taught in English, by students for whom English is their non-native language. Importantly, Cuevas points out that a poor grasp of the instructional language is related to underachievement at the school level.

Moving away from mathematics-specific issues, Kennedy (2002) observed the influence on Chinese students' learning styles of their Chinese and/or Confucian cultural background. Kennedy noted the responsiveness to new modes of learning of adult learners from Hong Kong and their receptiveness to adopt learning styles different from those they developed in school. This has important implications for learning support strategies employed to assist students from non-English speaking background when they commence their studies in English-language institutions. For instance, some authors suggested that students of Confucian heritage background show unquestioning obedience and acceptance of authority of the teacher (see for example, Ho & Crookall, 1995; Murphy, 1987). If this is the case, then the students' ability to independently develop strategies to overcome their learning difficulties related to the language of instruction may be hindered. However, Watkins and Biggs (1996) found that adult Hong Kong Chinese students preferred learning rich in high-level meaning over rote learning when compared with Australian students. Similarly, Volet (1999) argued that, in fact, students with Confucian heritage do not rely on so-called surface learning approaches. Such findings are positive signals of the ability of international students to take up learning support opportunities such as those presented in later sections of this paper. These findings also provide an important reminder not to simply rely on stereotypical views of different types or cultural groups of students when considering their learning styles.

Bretag et al. (2002) addressed the problem of the consistent lower-than-average achievement of international students from non-English speaking backgrounds in information systems courses in South Australia through an action research project aimed at facilitating improved learning outcomes for these students. They found that the performance of students from non-English speaking backgrounds (NESB) is affected by socio-cultural and linguistic factors and contended that educational institutions have a responsibility to support these students. Like Wood's (1990) strategies for teaching statistics, Bretag et al. (2002) suggested the use of teaching strategies used by English-as-a-Second-Language teachers for their information systems tutors as well as the provision of additional support tutorials for students who require them due to language difficulties. Further to this, authors such as Tang (1996), Biggs and Watkins (1996), Barber (2003), and Kirby et al. (1996) suggested:

a. learning support strategies such as interactive tutorials;
b. the provision of explicit statements regarding assessment expectations;
c. providing opportunities for international and native English speaking students to work together;
d. the development of strategies that compensate for students' lack of English language fluency;
e. providing assistance with discipline specific vocabulary (cf. Novak & Langerova, 2006), slang and cultural-specific language for students of Confucian heritage; and,
f. the use of diagrams and pictures whenever possible, particularly diagrams, plots and sketches (Barber, 2003).

The investigation described in this paper concerns situations: first, involving an English-speaking lecturer (the author) in a Spanish-language mathematics classroom, and then second, students from various Asian and Middle Eastern countries undertaking studies in an English-language mathematics classroom. The literature related to these specific language combinations and the context of university level mathematics is limited to non-existent. However, this should not be concerning – here it is not intended that the issues arising out of language mismatches be tied closely with any particular language or country of origin. The findings discussed in this paper should be considered in a more general sense.

This paper presents the author's account of the predicament faced by students from non-English speaking backgrounds in English-language university mathematics classrooms. This account is enriched by the non-Spanish speaking author's recent experience in a Spanish-language university mathematics classroom. Recently at the author's home institution, greater numbers of international postgraduate coursework students have been commencing courses in mathematics, a factor that makes consideration of non-native speakers of the language of instruction all the more important. In this paper, the difficulties of understanding a course of mathematics instruction in a particular language for mathematically competent but language-deficient students are outlined and a number of guidelines, both for lecturers and institutions, for improving the experience for such students are presented.

Many of the points that will be made in the paper may seem quite obvious when considered in a black-and-white sense or out of context. For example, a person who cannot understand the language of instruction obviously will not fully, if at all, understand what is being taught. However, it is the subtleties of the ideas presented here that arise when understanding of the language of instruction is *limited*, rather than non-existent, that are important and may be overlooked in many classrooms. For example, a person who cannot quickly comprehend the spoken form of the language of instruction will have difficulty understanding what is being taught without the provision of additional learning support. With appropriate learning support however, the student may be quite successful in their learning. It is such observations and the related recommendations for learning support that are the subject of this paper.

Experiences in the Spanish language mathematics classroom

The author spent time in the lectures of a mathematics course taught entirely in Spanish to Spanish speaking students. The course was a second year undergraduate level statistical modelling class for engineering students at a private university in Santiago, Chile. The class time was split so that approximately half the time was spent with the lecturer answering questions asked by the students while the remainder involved the lecturer presenting solutions to problems in a somewhat more structured manner. The author sat at the back of the classroom and was involved only as an observer.

The first half of the class time, that is, the free question time, involved students querying the lecturer regarding previously discussed work. This was carried out in semi-structured manner with students either raising their hand to offer questions or simply shouting their question out to the

lecturer. In almost all cases, open verbal discussion ensued, primarily between the lecturer and the poser of the question but also with other members of the class who became involved in the conversation. The discussion was mostly carried out at a level audible to all in the class but always in Spanish.

In response to a number of questions, the lecturer made use of the whiteboard at the front of the classroom. Usually this was simply to ease the communication of a mathematical expression rather than attempting to verbally express, say, an integral. What is important to note is that while the mathematical expressions were clear and readable, for the non-Spanish speaker it was not clear what the mathematics was related to. Furthermore, the important learning process embodied in the verbal interaction between the learner and the lecturer was entirely concealed from the author due to deficiency in the Spanish language. The process is also surely significantly concealed from a student who is weak in the language of instruction.

The second half of the class time involved the lecturer presenting and discussing the method for solutions to a number of problems of relevance to previously taught material. The presentation was mostly via the whiteboard and quite well structured, as exemplar solutions tend to be when given by competent teachers. There was some discussion, again in Spanish, but much less than was the case in the first half of the class where the dialogue was frequent, extended and involving multiple parties. Generally, the lecturer simply provided voice-over commentary for his own written mathematical working of the solution. Here, to the mathematically competent but non-Spanish speaking author observing the class, the presentation was much easier to follow. In most cases, it was possible to reconstruct the question following the presentation on the whiteboard of some part of the solution. In a number of cases, due to the point in the solution process at which a question was posed by a class-member, the author felt comfortable that he was aware of what the student's question was about and how the lecturer would go about responding to the question. This was the confirmed by the calculation presented on the whiteboard in response to the students' queries.

The key to the non-Spanish speaker being able to follow the second section of the class was that there was order and familiarity in the communication due to the inherent structure of the written mathematics. Written mathematics in many languages, including Spanish and English, share common notations and symbols even when the spoken terms differ. The first half of the class, where written mathematics was not used to any great degree was much harder to follow, as the non-Spanish speaker had no structure to guide his understanding.

In the section to follow, the author's observations as a non-Spanish speaker in a Spanish-language mathematics classroom are used to elucidate some of the difficulties experienced by non-native English speakers in English-language mathematics classroom.

Difficulties in the English language mathematics classroom

The author teaches mid- to upper level courses in Differential Equations and Applied Mathematics at a large public university in Australia into which both undergraduate and postgraduate coursework students enrol. Due to the introduction of new postgraduate coursework degrees in around 2007, higher numbers of postgraduate coursework students are now enrolling in these courses than was previously the case. Many of the postgraduate coursework students are from non-English speaking backgrounds, often from the Middle East or Asia. While they are trained mathematically, they have generally not studied mathematics with English as the language of instruction. Furthermore, while they have been taught English language communication, often their skill in comprehending verbal English in the context of mathematics instruction is not strong. This forms the basis for difficulties experienced by these students when studying in Australia.

In the courses mentioned above, and in general for courses at the author's university, there is an emphasis on the application of mathematics and on discussing mathematics within various non-mathematical contexts. This is considered more important than focussing on mathematical theory and technicalities, although, naturally these do arise and are dealt with appropriately. As such, the

courses involve a considerable amount of verbal and written description of contextualised mathematics – that is, a heavy reliance on understanding English and indeed on verbal English conversations between the lecturer and students. This is in contrast to a classroom where the verbal communication is essentially to repeat written mathematics and even where the verbal communication extrapolates on steps that may be hidden in the written mathematics. The difference being that, in the latter, English is used as a backup language to the language of mathematics and essentially repeats the information, whereas in the former, the spoken English does not directly replace the written mathematical equations and stands alone providing an additional component of information.

In the following section, suggestions are offered for addressing issues such as these in an English-language mathematics classroom to support the learning of non-native speakers of English.

Attempting to address difficulties

Written communication provides static support to the dynamic classroom-based communication of lectures. Often, problems with verbal communication are simply due to the speed of a conversation. It is often the case that non-native speakers of a language can more easily read information than they can understand it when it is spoken to them. This can be caused by, for example, the speaker's accent or use of culture-specific slang. Weiland and Nowak (1999) for example, contended that the greatest problem for student learning is the Australian style of communication that is new to the student. With the provision of written or typed materials such as adequate and appropriate pre- or post-provided lecture notes and appropriate text books, students have the opportunity to investigate the information provided verbally in the classroom, at their own pace and with greater possibility for translation into their own language to assist with understanding. This is made even more beneficial with the introduction of new online tools such as *Google Translate* [http://translate.google.com]. Adequacy and appropriateness are vital and materials presented to students should have an obvious rather than tangential relationship to the course of study.

Although languages with similar origins do have some similarities in terms of the sounds and appearances of the words, these similarities are often insufficient to assist in student learning of mathematics in unfamiliar languages. On the other hand, conventions such as numerical order and even the use of numerical symbols in many cases are common across languages and cultural boundaries. A clear structure in a classroom presentation is vital when verbal communication provides additional information over and above the written mathematics. In relation to this, the similarities shared by languages and cultures around numerical order and symbolic representation of numbers can be very useful to both the lecturer and the student. Clear cues can be achieved, for example, using visually presented numerical flags such as chapter and section numbers both for written and for verbal communication. Many lecturers do this normally, sometimes by habit, but it should not be overlooked. It is also vital that a student knows where to look in their written materials whenever they become lost in the verbal communication as a result of language difficulties. Providing regular visual cues on white/blackboards and presentation slides, such as section numbers, when engaging in verbal communication of concepts can provide non-native speakers with sufficient information to know where they should focus their later reading activities. The use of such cues is also useful in assisting non-native speakers of English to move progressively toward English language skills in the field of study thus providing a bridge between the two languages (Layton, 1982).

Google Translate is still in its early stages of implementation and naturally features some flaws and inconsistencies. Dual language students or even students who have previously undertaken a course as a non-native speaker of the language of instruction can often provide better translations of course-related communication than those available online. It could be contended that such former students may not always be considered ideal candidates to play a role in mathematics

learning support centres. The past experience of these students with the language-based difficulties discussed in this paper can be invaluable and this should not be overlooked in the staffing of learning support centres. This is especially the case as the number of students in a course who are non-native speakers of the language of instruction increases.

Employing former students such as these in learning support centres needs to be carefully considered and the former students should be appropriately trained. In addition to the standard training offered to employees of such centres (see for example, MacGillivray, 2009), these former students must be made aware of the fact that their native language should be used to assist the learning of the student. The learning support should not be entirely conducted in a language other than that used in the instruction of the course as the student is undertaking an education in the second language not their own. Relying on the foreign language would be of no long-term help to the student as they will continue to experience difficulties in the classroom that could have been previously cleared up by their dual language tutor.

Conclusion

When teaching all but the most exceptional and adequately prepared students, considering the difficulties that the student might be expected to encounter provides crucial guidance to designing a teaching strategy. Often, the difficulties experienced by students who are not native speakers of the language of instruction are overlooked. Because these students make a pointed and often very expensive decision to enrol in courses taught in such a language, the issues of communication are on occasion seen to be their own fault and requiring attention by them rather than by the educational institution to which they are paying fees.

If universities are to continue receiving fees from such students and in large numbers, the learning support needs of the students must be addressed. A set of preliminary guidelines for dealing with these needs has been suggested in this paper. These guidelines have been built on an observational investigation undertaken by the author as both a lecturer in an English-language classroom with a significant number of non-native speakers of English and as an observer with no skills in Spanish in a Spanish language classroom. ‘Walking in the shoes’ of non-native English speaking students revealed to the author that it is not only continued financial gain to the university that is strengthened by addressing these learning support needs but also the perception in the community and with its customers of the university organisation conducting ethical business practices.

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