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TEACHING TECHNICAL UNIVERSITY SUBJECTS IN ENGLISH TO MIXED-LANGUAGE STUDENT CLASSROOMS

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ABSTRACT

This study examined the authors' experiences with teaching technical material in English to international students using mixed-language classrooms. The authors have identified both effective and ineffective ways of teaching these types of courses. Through systematic classroom observation and analysis, the authors identified what students had learned from each course taught entirely in English. In response to the complexities of implementing English Medium Instruction (EMI) in multiple languages and at multiple levels of academic studies, this longitudinal study tested and evaluated the use of the Language Responsive Delivery Model (LRDM). This model was used throughout all undergraduate and postgraduate Construction Management classes in four countries: the Czech Republic, New Zealand, Turkey, and the USA. Based on an Action Research methodology, the LRDM has three components of iterative phases as follows: prior to class delivery of the instructional materials including preliminary language assessments and a list of technical vocabulary terms; during class delivery using the "pause – paraphrase – probe" method and collecting data by minute-paper evaluations; and after class delivery, assessing learning outcomes through multimodal formats. This study explored how students with various levels of language proficiency affect their ability to comprehend instruction. Due to the differences in reading abilities among students, the authors found that traditional written exams were subject to biases related to reading literacy. The results indicated that using verbal testing and developing well-crafted rubrics for evaluating student performance provided a more equitable way of assessing a student's technical knowledge rather than their ability to communicate in English. The authors also outlined common pedagogical obstacles experienced by educators and suggested scalable approaches for universities. Lastly, the authors synthesized possible developmentally oriented directions and emerging trends that may enhance the model's long-term viability globally in engineering education such as integrating generative AI, large language models, micro-credential systems, and immersive digital twin labs.

KEYWORDS

Language, Construction, Proficiency, English, Barriers

INTRODUCTION

This paper presents a practice-based empirical pedagogical study that integrates real-world classroom observations with a structured instructional framework to systematically enhance technical education in multilingual environments. The paper's development has occurred through the authors' collective experience of teaching construction management and related technical disciplines to students from a variety of cultural and linguistic backgrounds within multiple institutional and cultural settings. The article is intended primarily for teachers, programme coordinators, and higher education institutions responding to the growing linguistic and cultural diversity of technical education.

It also presents the results of a systematic analysis of specific methodologies and approaches that have been employed, analyzed, tested, modified and developed over time. While the authors did not seek to test hypotheses in order to draw conclusions regarding the effectiveness of one teaching method versus another, rather they sought to determine those teaching practices that were most effective in their own classroom situations. Additionally, the authors sought to document the many recurrent problems experienced by both instructors and students in teaching and learning in increasingly diverse English Medium Instruction (EMI) classrooms. Lastly, the authors identified several potential solutions that may assist other EMI instructors experiencing similar challenges in the educational environments in which they teach.

METHODS

Rooted in an Action Research Methodology, the authors have implemented a systematic deployment and evaluation of the Language Responsive Delivery Model (LRDM) through their Undergraduate and Postgraduate Construction Management courses at multiple International Institutions across Czechia, New Zealand, Turkey and the United States. The use of this longitudinal approach has enabled LRDM to deal with the unique problems that are inherent in EMI.

Characteristics of the Research Sample

The research sample consists of students from various global regions, creating an environment with a high degree of linguistic and cultural diversity that requires a specific teaching approach. Students' different way of thinking, communication styles and cultural and academic backgrounds have to be taken into consideration. Another important feature - respectively a condition - is an interactive format for lectures and seminars, which is facilitated by dividing students into small groups.

The results reported herein are based on a long-term pedagogical observation that has been carried out through the course of dozens of consecutive semesters while working with thousands of students from all backgrounds taking Construction Management and other technical programs delivered wholly or partially in English at participating institutions in the Czech Republic, New Zealand, Turkey and the U.S.A. The typical cohort sizes in the participating institutions were around 25 to 30 students; cohorts tend to be culturally diverse as well as linguistically and educationally so. In total, then, the multilingual student cohorts across all our courses represent around 300 students each semester. Although the study does not attempt to achieve statistical generalisability, the extensive duration of our observation periods; the iterative application of successive delivery cycles and the continuity of our pedagogical observations in a number of different national contexts and institutional settings, provides us with a strong basis to identify recurring instructional difficulties; evaluate various teaching/learning interventions; and refine iteratively the proposed LRDM.

Pedagogical Intervention: Language-Responsive Delivery Model (LRDM)

To improve both comprehensibility and inclusivity in multilingual classrooms, the LRDM model was implemented through three iterative phases. First, pre-class phase of Preparation that

was a preparation for building personal rapport through welcome videos or podcasts and assessing language skills using pre-course surveys in the LMS.

Second, in-class phase of Implementation introduced the teaching process that relied on the 'pause–paraphrase–probe' method, supplemented by specialized glossaries and visual explanations of technical concepts through detailed drawings, schematics, and diagrams.

And third, it was a post-class phase of Consolidation in which adaptive tasks and multimodal assessment were emphasized. In this last phase of the process students could demonstrate understanding of the subject matter either in writing or orally.

Assessment and Validation Methods

The primary component of the methodology was an analysis of how different types of assessments work in a multilingual setting. The study first assessed comparative testing by comparing the test scores from written exams to those from oral exams for the purpose of reducing bias due to differences in reading literacy. Most students demonstrated better technical knowledge as shown through their performance on the oral exam compared to the written exam. As such, the authors then developed evaluation rubrics that would allow them to differentiate between technical accuracy (70%) and communication (30%). The methodology also included iterative action cycles, or review/revision of instructional practices every semester, based upon student responses and the authors' own observations, as a way to continue adapting their instruction.

CONTEXT AND CHALLENGES OF TEACHING TECHNICAL SUBJECTS IN MULTILINGUAL CLASSROOMS

Background and Institutional Context

In order to understand the complexity of the analysed multilingual teaching context, it is necessary to introduce its participants at the outset. Professor Johnston speaks only English. Professor Tomek's first language is Czech, but he is also fluent in English, Professor Gonca Telli Yamamoto, PhD teaches in both English and Turkish and Associate Professor Mani Poshdar, PhD, teaches in English but his mother tongue is Persian, which is not used in his teaching in New Zealand.

Most of the classes and teaching that are referenced in this paper are taught entirely in English. Most students who attend our classes come from all different countries from around the globe. Each of the make up students within our classes are different and the part of the globe that we are teaching in makes a difference in the makeup of the students within our classes.

Professor Tomek and Professor Johnston have collaborated on many English-taught only classes together, teaching various subjects, with all the classes falling under the umbrella of Construction Management.

We all tend to use slide presentations to support our lectures and always have a short question and answer period at the end of class. These classes often tend to be smaller and are not in a large lecture format. Professor Yamamoto also teaches a seminar-based class where each seminar is given by an outside expert and the common language by these experts is English. Some of these classes live in the classroom while others live online. In New Zealand, English is the primary medium of instruction across higher education. A typical Architectural and Civil Engineering class at AUT includes a mix of domestic students and those from a range of countries across Asia, the Pacific, and beyond. This diversity – which is, of course, at a very similar level across all regions where we concluded our research - adds richness to class discussions while also bringing not only different cultural and academic backgrounds into the class, but quite often also different communication styles.

Although each of our respective universities — located in United States, Turkey, New Zealand, and the Czech Republic — experience is unique, it represents an even larger trend internationally. As such, institutions all over the world have started to introduce English as a medium

of instruction (EMI), because employers require graduates with skills to work in global teams. Not only have there been clear signals from real practice in the long term, but also reports from organizations including the World Economic Forum - specifically their report "The Future of Jobs" (2025) - further indicate that there will be a growing demand for technical experts worldwide. [1] Therefore, we believe that at each of our institutions EMI has become necessary — not simply as an optional foreign language course — so our students are prepared for collaborative work in global engineering environments.

The purpose of this study was to develop practical educational techniques for those facilitating instruction using English only, with a focus on developing best practices through positive results for students as well as faculty. Through the years, we have identified instructional methods that have been successful while others may need some modifications. It is our goal to provide new educational ideas for teachers who are looking to implement and adjust for their own success. We believe that all technical subjects have a universal interest and applicability. Therefore, we continually work to demonstrate to our students the value and importance of technical subjects.

Technical Vocabulary and Early Student Engagement

One early issue that comes up in any teaching of a technical class where students are learning and understanding in another language, is the lack of translation of technical words. [2] This is a key to be kept in the forefront of teaching as it may be the largest language barrier to teaching a technical course with multiple second language students.

The earliest opportunity to establish a relationship with our students is at the beginning of the semester, which provides a solid base for the rest of the course. The personal contact we make prior to the first actual lecturing can be instrumental in eliminating anxiety that many students experience concerning classes taught only in English. Most of the students are multilingual, however, they might not possess full fluency in English, especially regarding technical terminology. Encouraging students to engage early on with the instructor can create an atmosphere of support where students feel encouraged to ask for clarification whenever it is necessary. It is recommended that we reach out to our students via e-mail, podcasts, or video greetings - this minimizes administrative overhead while creating an effective method of removing the barrier that exists initially between students and instructors.

Various online tools for using surveys or self-assessment exercises for breaking the Learner-Teacher barrier can be widely found online. The educational level we generally teach is mostly 3rd and 4th year and often not all students within our specific discipline. In trying these two online techniques, we found that the students have not warmed up to either of these tools.

We have experimented with the use of students introducing themselves at the first class and have found that following such an introduction, most students start feeling comfortable speaking in class. This also helps us learn the overall level of English in the class and how we need to tailor our ideas and concepts to the needs of the students to ease their understanding of the subject.

Key Pedagogical and Linguistic Challenges

The challenges in Teaching Technical University Subjects in English to Mixed-Language Student Classrooms" can be numerous and often these challenges seem to repeat themselves year after year.

We also identified the following common teaching challenges:

- Students' varying degrees of English fluency and cultural backgrounds influence their approach to learning. [3]
- There are many different ways to teach (learning style), and therefore there are many different ways to assess what has or has not been learned from an education perspective.
- Technical terms related to all industries can vary depending on where you live.
- All curricula and materials need to be developed with an awareness of the global context.

- Even when PowerPoint presentations are provided in multiple languages, they are often poorly translated.

Continuous Model Refinement and Successful Strategies

At the beginning of every semester we evaluate which teaching methods were most successful for both the instructor(s) and the students, and which ones did not work so well. We've had a lot of classes over the years, and while each one was unique based upon how the instructor taught and who comprised the classroom, we have continued to develop new ways of doing things. This is because we continually refine our instruction, using the success of previous semesters to guide us, and we discard those that do not succeed. At this point in time we are using a very effective instructional model, but we acknowledge that such models should be adaptable enough to fit the size of the class, the various cultural background of the students, and the format of instruction being used. For instance, whether it's in a large lecture setting or in a small group of students speaking a variety of languages will determine if a certain method of teaching is effective. Therefore, our methods of instruction will continue to evolve as each incoming group of students requires different approaches to address their individualized language proficiency needs.

Listing here are some of our first successful, repeated successes and ideas that may bring success:

- Early connection with your students
- In class Introductions by both the students and teacher.
- Class language evaluations after class by the teachers
- Pre-teaching technical vocabulary
- Continue technical vocabulary throughout the semester
- Using visual aids and multimedia resources
- Providing glossaries and bilingual resources if there are enough students with the same secondary languages (if done the first time a class is taught, this can grow each semester)
- Incorporating diverse case studies and examples into the class with a period of discussion that brings the full class into the discussion.
- Group projects, peer learning, use of construction management simulation followed by weekly discussion.
- Using online chat and collaboration tools help the learning process
- Virtual reality and 3D modeling BIM used in construction - not used by us yet.
- Outside video study material (YouTube)
- An idea that we have not tried would be the actual video of the lectures for the student to review a second or third time. This could turn into a required group activity where learning could be peer to peer.
- Students that have common language tend to band together form small peer learning groups. This works well and can be supported by the teacher.

Detailed Structure of the Language-Responsive Delivery Model (LRDM)

The LRDM has a purpose of providing a way for designing and delivering any technical course in English to a multilingual group, ensuring comprehension, engagement, and assessment. [4] It is built around three parts:

Pre-Class Preparation

The first step — Pre-Class Preparation — involves Personal Outreach through sending an introductory video or podcast from each instructor. Then, we complete a Baseline Language Audit. The audit consists of a five-minute LMS survey and a diagnostic quiz designed to identify the level at which students listen, speak, read, and understand technical vocabulary. The final element of our

Vocabulary Primer is a bilingual glossary (PDF + Audio) of the most important technical vocabulary related to that week's topics.

In-Class Delivery

Then comes In-Class Delivery using Layered Input. This model combines Short Explanations, Annotated Technical Terms and Rich Visuals (Schematics). Next are Interactive Checks. Here we employ the PAUSE-PARAPHRASE-PROBE method along with real-time polling and minute-papers to get any misunderstandings identified quickly. [5] Finally, during Peer-Assisted Work, students will have time for short breakout sessions in the shared first languages they may use to help them clarify difficult concepts after they reconvene in English.

Post-Class Consolidation & Assessment

Next follows Post-Class Consolidation & Assessment. This is done through Multimodal Demonstration. Students can present verbal, written or multimedia artefacts demonstrating what they've learned throughout the week; these artefacts will be assessed according to a single rubric. The final component of this section is Rubric-Anchored Feedback. Using a rubric that differentiates between content mastery and language clarity (for instance 70% technical accuracy, 30% effective communication), instructors give feedback about whether students have demonstrated what they need to know in order to succeed in the course.

Project Based Global Collaboration: Technical Challenge Sprints

Finally, Project-Based Global Collaboration: Technical Challenge Sprints allow multinational student groups to apply the theoretical knowledge gained through participating in the course to solving real-world problems requiring collaboration across many disciplines of engineering (such as creating an Internet-of-Things enabled smart factory dashboard, developing an off-grid solar micro-grid system or designing a climate-resilient bridge retrofit). Each challenge sprint has twelve weeks divided into several phases. To enable flexible curricula across partner universities each phase of the challenge sprint can earn credits (i.e. ECTS / credit fractions) that count towards earning all or part of the overall grade for the course; this enables universities to either replace modules or add additional modules as desired.

Structured Questioning as a Learning Engine

Lastly, Structured Questioning as a Learning Engine. Diverse classrooms require structured questioning. We outline a three-layered structure: First layer: begin with flipped learning and then post Socratic prompts - within 24 hours of class via the LMS to stimulate students' prior knowledge. [6] Second layer: In-class probing - utilize the "pause-paraphrase-probe" technique to guide students with less English proficiency while engaging those with higher English proficiency. Third layer: Post-class reflective queries - short voice or text submissions that relate the previous day's lesson to each individual's experiences or local realities.

RESULTS

The results of the LRDM project across institutions in Czechia, New Zealand, Turkey, and the United States demonstrate that a collaborative teaching model based on both evidence and action research can help to reduce or eliminate the effects of students' language difficulties in their ability to understand construction management materials presented in English. Qualitative observations systematically gathered during dozens of semesters and thousands of students in above mentioned four countries indicate that a structured approach to supporting students in developing their understanding and participation with regard to course materials provided by instructors using English improves the extent to which they comprehend and participate in classroom activities related to construction management.

Probably the hardest aspect of teaching technical university subjects in English to mixed-language student classrooms is the method used to assess and evaluate this multi-language student

setting. [7] We have found that many students with good English language skills may not have that same level of reading skills. This is another area that is often verified greatly with the different classes. Based on the collective pedagogical experience/evaluation of the teaching faculty, the best solution for us was the use of verbal testing which eliminated the issue of reading levels. This still did not solve the problem of the different verbal skills level but seemed to be better balanced than written testing. This allowed us to recognize an issue of understanding with our verbal questions, and we could dig deeper into the students' understanding by adding an explanation along with the question. Now this did add greatly to the time of assessment and is much harder in the grading process. To further balance the verbal questioning we found ourselves asking fewer questions from semester after semester. Another help in this process was the development of better assessment rubrics to help us as instructors produce equal assessment of all the students.[8] A continuing and recurring problem is balancing proficiency with the technical language that often was the first time the student may have heard the technical words used in our class. We still are experimenting with and discussing other ways of demonstrating understanding of the class material. One thing we wished for was a more formal setting and a broader way of addressing these issues. Technical education, unlike many other disciplines, has not settled on one master list of topic material that is needed to be studied and a list of what the student is required to take away from the specific subject of our classrooms.

CONCLUSION

This paper discusses how we are approaching the issue of teaching technology based (technical) university subjects in English for students with multiple languages. We recognize that while teaching in this manner is challenging, it has also provided us with many rewards. The purpose of this paper is to provide you with an overview of what we have learned about teaching in this environment, and effective ways that we have found to address the needs of our students. Each new group of students is like a new experimental test for us.

In order to identify possible next developmental stages for technical EMI education, we synthesised major emerging trends and corresponding action steps needed to continue the applicability of the LRDM model globally:

Tab. 1 - Emerging Trends and Action Points

Emerging Trend	What It Means for Teaching	Action Point
Augmented Multilingualism	LLMs will provide instant, context-aware translation, pronunciation coaching, and technical terminology glossaries.	Build LLM plugins into the LMS and train students to use prompt engineering ethically.
Immersive & Remote Laboratories	XR and digital twin platforms will let students run complex lab experiments from anywhere.	Bridge the current gap in XR deployment by partnering with industry to license or co-develop future VR/AR lab modules.
Micro-credential Ecosystems	Universities will unbundle large courses into stackable nano-modules aligns with global skills frameworks (e.g. ESCO, IEEE).	Align each sprint or lab with a verified badge that syncs to students‘ Europass or LinkedIn Learning profiles.
Data-driven Personalization	Learning analytics dashboards will adapt pace, difficulty and language scaffolding to each learner’s profile.	Adopt open standards and set clear data privacy policies.
Global Industry Co-mentorship	Cloud collaboration tools will enable engineers from different continents to mentor student teams in real time.	Formalise a „co-mentor agreement“ template that covers IP, meeting cadence and cultural guidelines.

As a final thought, we are spending more time studying Artificial Intelligence for use in the classroom and can see many new ways it can supplement the teaching and learning in this environment. As Bob Dylan famously said in a song “The Times They Are A-Changin” on February 10, 1964, this sentiment perfectly captures the technological paradigm shift that began when ChatGPT was launched on November 30, 2022, and this new change is just now starting. We hope that this paper will help educators and their present and future students navigate this rapidly changing landscape and successfully embrace the new possibilities it brings.

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