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The Effectiveness and Implementation of the Brain-Targeted Teaching Model in Chinese EMI Courses: an Empirical Study and Teaching Plan

Shuxin Liu, Qinxin Wang

School of International Education, Xianda College of Economics & Humanities Shanghai International Studies University, Shanghai, 200083, China

ABSTRACT
This study investigates the effectiveness of the Brain-Targeted Teaching (BTT) model in enhancing English learning outcomes among Chinese freshmen and sophomores, with a focus on skills relevant to the BEC workshop. Through a quasi-experimental design, the study compares the pre- and post-intervention performance of students in grammar/vocabulary (G&V), coherence (C), and pronunciation/communication skills (P&C), assessed against the CEFR scale. The results demonstrate significant improvements in pronunciation/communication skills, suggesting the BTT model's potential to significantly impact oral proficiency in a BEC workshop context. Furthermore, the study proposes a detailed teaching plan based on the BTT model, tailored to the 6-week BEC workshop format and incorporating CEFR-aligned assessment.

KEYWORDS
Brain-targeted teaching model; BEC workshop; CEFR scale; English as a medium of instruction; Teaching plan

1 Introduction

In recent years, there has been a growing emphasis on improving English for English as a Medium of Instruction (EMI) education in China, particularly for freshmen and sophomore students preparing for professional English examinations like the Business English Certificate (BEC). Traditional teaching methods often struggle to engage students and achieve desired learning outcomes in these specialized contexts. This study investigates the potential of the Brain-Targeted Teaching (BTT) model to enhance English learning outcomes in a BEC workshop setting, focusing on skills directly assessed by the CEFR-aligned BEC oral examination.

2 Literature review

2.1 Relationship between neuroscience and education

Neuropedagogy aims to apply cognitive neuroscience to teaching. It can better serve human social, cognitive, and emotional development (Martín-Loeches, 2015). Modern brain imaging techniques are used for educational diagnosis and effectiveness evaluation (Ansari et al., 2012; Kelly, 2017). However, there are gaps between neuroscience research and teaching practice. The discipline faces challenges such as methodological difficulties, insufficient interdisciplinary training, and poor communication between educators and neuroscientists (Ansari et al., 2012; Cui & Zhang, 2021). Therefore, a systematic teaching approach guided by neuroscience theory should be introduced to translate neuroscience evidence into concrete models and frameworks, which is supported by the work of Tokuhama-Espinosa (2011), who emphasizes the importance of bridging neuroscience research and classroom practice. This can enhance the interaction between disciplines and support student learning (Mystakidis et al., 2023).

2.2 Overview of the brain-targeted teaching model

The Brain-Targeted Teaching (BTT) model, proposed by Hardiman in 2012, is a cognitive science and neuroscience-based teaching system for K-12 and higher education (Darden, 2012; Hardiman, 2012b). According to Hardiman (2012a), the model includes six Brain-Targets to guide classroom teaching (Figure 1). These objectives create a holistic and engaging learning experience that supports cognitive development, which is particularly relevant for the complex skills required in BEC examinations.

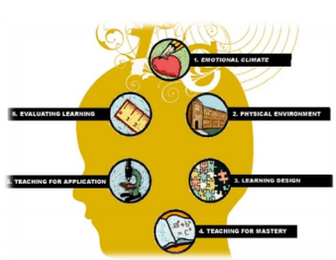

Figure 1 The Brain-Targeted Teaching Model for 21st-Century Schools

2.3 International research findings on BTT

International studies on the BTT model has been used in K-12 language learning, like improving UAE students' reading and comprehension (Chowdhury, 2020). However, its application in higher education is limited, as most institutions focus on academic research rather than teaching (Mystakidis et al., 2023). Kelly (2017) suggests that effective language teaching involves multi-sensory input, emotional valence, spaced repetition, and rich narrative forms. These methods help release neurotransmitters like dopamine, cortisol, and oxytocin, enhancing learning outcomes. The six goals of the BTT model align well with these recommendations.

2.4 BTT in the chinese EMI teaching environment

Applying the BTT model in Chinese EMI education presents both challenges and opportunities, particularly in specialized workshops like BEC preparation. Challenges include traditional teaching practices that emphasize rote memorization and teacher-centered instruction (Cui & Zhang, 2021). However, the BTT model's focus on emotional engagement, multi-sensory learning, and practical application offers a potential solution to these challenges by creating a more dynamic and student-centered classroom environment, directly addressing the communicative competence required for BEC success.

3 Research methodology

3.1 Research design

This study employed a quasi-experimental design with experimental groups. Freshmen and sophomore students from Xianda College of Economics & Humanities Shanghai International Studies University in Shanghai, China. Participants engaged in a structured 6-week BTT training program aimed at improving Business English Certificate (BEC) oral English proficiency through intensive practice with BEC materials. The program includes 4 weeks of BTT training, starting with a week of standard teaching, and ending with a final assessment. Two EMI teachers conducted 2-hour weekly sessions in separate classrooms over the 6 weeks, following the BTT model.

3.2 Participant recruitment

Participants were selected based on their English proficiency levels, as determined by their scores on the College English Test (CET) and their enrollment in the BEC workshop. A total of 40 students participated in the study, with 20 students in each group. Two EMI teachers with at least five years of teaching experience and familiarity with BEC examination requirements were also recruited to implement the teaching interventions.

3.3 Data collection methods

Data were collected through a variety of methods, including:

(1) Student academic performance data: Pre- and post-intervention oral test scores, aligned with the CEFR scale and BEC examination criteria, were collected to assess changes in grammar/vocabulary, coherence, and pronunciation/communication skills.

(2) Teaching observation records: Classroom observations were conducted to document the implementation of the BTT model and identify any challenges or opportunities for improvement within the BEC workshop context.

3.4 Data analysis

Quantitative analysis was conducted to assess the impact of the BTT model on students' grammar/vocabulary (G&V), coherence (C), and pronunciation/communication skills (P&C), as measured by CEFR-aligned BEC oral examination criteria (see appendix II). Data from 40 participants were analyzed using independent samples t-tests with Welch's correction for unequal variances, following data cleaning procedures that converted non-numeric entries to NaN values and removed missing cases.

4 Data analysis

4.1 Descriptive statistics

Table 1 presents the descriptive statistics for all measured constructs across pre-test (Test 1) and post-test (Test 5) administration, aligned with CEFR BEC oral examination criteria:

Table 1 Descriptive Statistics for Language Proficiency Measures (CEFR-aligned BEC Criteria)

Construct	Timepoint	Mean (SD)	Range
G&V	Test 1	2.56 (0.54)	1.5-3.5
	Test 5	2.75 (0.45)	2.0-3.5
C	Test 1	2.50 (0.55)	1.5-3.5
	Test 5	2.88 (0.35)	2.0-4.0
P&C	Test 1	2.50 (0.55)	2.0-3.5
	Test 5	3.13 (0.35)	2.5-4.0

4.2 Inferential statistics

As shown in Table 2, significant improvements were observed in P&C scores while C scores approached statistical significance:

Table 2 Inferential Statistics for BTT Model Effectiveness (CEFR-aligned BEC Criteria)

Construct	t-value	p-value	Cohen's d	Interpretation
G&V	-1.35	0.1918	-0.55	Non-significant improvement
C	-1.99	0.0593	-0.80	Marginally significant ($p < .10$)
P&C	-2.63	0.0157	-1.06	Statistically significant improvement ($p < .05$)

4.3 Visual analysis

Boxplot visualizations (Figure 1) illustrate the distribution of scores at both time points, highlighting the significant upward shift in P&C performance and notable reduction in variability for all constructs post-intervention, as assessed by CEFR-aligned BEC criteria.

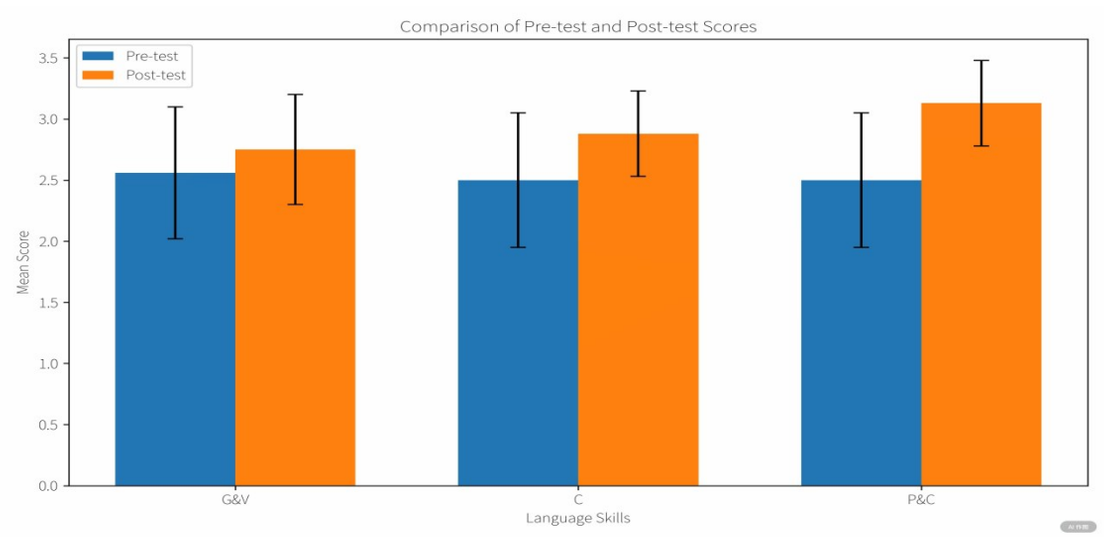

Figure 2 Comparative Boxplots of Pre-test and Post-test Scores (CEFR-aligned BEC Criteria)

5 Teaching implications

The data analysis reveals significant improvements in pronunciation/communication skills (P&C) and approaching significance in coherence (C), while grammar/vocabulary (G&V) showed non-significant improvement. This suggests that the BTT model had the most substantial impact on P&C skills, directly aligning with the CEFR-aligned BEC oral examination criteria which emphasize effective communication in professional contexts.

5.1 Pronunciation/Communication skills (P&C) - greatest impact

The statistically significant improvement in P&C scores ($p < .05$, Cohen's $d = -1.06$) indicates that the BTT model's emphasis on practical application and interactive communication was highly effective in this area. This has significant implications for BEC workshop instruction, as P&C skills are crucial for success in the BEC oral examination and real-world business communication.

Teaching strategy:

(1) Increase focus on pronunciation drills and real-world communication tasks: Incorporate targeted pronunciation exercises focusing on problematic phonemes for Chinese learners (e.g., /θ/, /ð/, /v/) and integrate communication tasks that simulate BEC examination scenarios, such as role-plays, presentations, and negotiations.

(2) Leverage technology for pronunciation practice: Utilize speech recognition software and online platforms that provide immediate feedback on pronunciation accuracy and fluency.

5.2 Coherence (C) - marginal significance

The marginal significance in coherence scores ($p < .10$, Cohen's $d = -0.80$) suggests that the BTT model also positively influenced students' ability to organize and express ideas logically. While not statistically significant at the $p < .05$ level, this improvement is noteworthy and indicates potential for further gains with targeted instruction.

Teaching strategy:

(1) Explicit Instruction in Cohesive Devices and Discourse Markers: Teach students how to effectively use linking words, transitions, and discourse markers to enhance coherence in spoken and written English.

(2) Structured Practice in Organizing and Presenting Arguments: Provide opportunities for students to practice structuring and presenting arguments on a variety of business-related topics, emphasizing clear topic sentences, supporting details, and logical conclusions.

5.3 Grammar/Vocabulary (G&V) - non-significant improvement

The non-significant improvement in G&V scores ($p > .05$, Cohen's $d = -0.55$) indicates that the BTT model had a lesser impact on these areas within the 6-week BEC workshop context. This could be due to the already relatively high baseline proficiency of participants in G&V, or the need for more explicit and targeted grammar and vocabulary instruction within the BTT framework.

Teaching strategy:

(1) Integrate Contextualized Grammar and Vocabulary Instruction: Embed grammar and vocabulary practice within meaningful communicative activities, focusing on business-related contexts and lexical items relevant to the BEC examination.

(2) Utilize Corpora and Authentic Materials: Incorporate the use of corpora and authentic business English materials to expose students to natural language use and enhance their grasp of contextualized grammar and vocabulary.

6 Suggested teaching plan for BEC workshop (6 Weeks)

This teaching plan is designed for a 6-week BEC workshop, integrating the BTT model and incorporating CEFR-aligned assessment. It focuses on enhancing P&C and C skills, while also providing contextualized support for G&V development.

7 Conclusion

This study investigates the effectiveness of the Brain-Targeted Teaching (BTT) model in enhancing English learning outcomes for Chinese undergraduates preparing for the Business English Certificate (BEC) examination. Through a quasi-experimental design, significant improvements were observed in students' pronunciation/communication skills (P&C). The BTT model's emphasis on practical application and interactive communication proved highly effective in improving P&C skills, crucial for success in the BEC oral examination. Traditional teaching methods often struggle to engage students and achieve desired learning outcomes in these specialized contexts. However, despite the effectiveness of BTT in improving P&C skills, further research is needed to address the non-significant improvement in grammar/vocabulary (G&V) skills within the BTT framework. Future studies could benefit from the insights provided by DeKeyser (2015), who discusses the complexities of grammar instruction and the need for context-specific approaches.

Table 3 Example Lesson Plans

Lesson Plan (General)

Student Group: 1.1st year 2+2 and 3+1 program students majoring in Fashion Management 2.2nd year 2+2 and 3+1 program students majoring in Fashion Management	**Classroom Teacher Name:** 1.Qinxin Wang 2.Shuxin Liu
Supervisor Name: 1.Qinxin Wang 2.Shuxin Liu	**School:** UCA Shanghai Centre, Xianda College of Economics & Humanities Shanghai International Studies University
Date of Lesson: 1.May 8th- June 19th 2.May 6th- June 17th **Start/End Time of Lesson:** 1.10:30am-11:30am, 1h/week 3:30pm-4:30pm, 1h/week	**Grade Level :** 1st and 2nd year college art students **Content focus: Evaluation** **Ex:** Students will notice the importance of the book's title and author. Also, Students will recognize and sound out the first letter of certain words.
Focus of the observation and/or your personal teaching goals for the lesson: *Identify at least one teaching strategy that you are working on in this lesson. (See list at end of lesson plan template).* *Demonstrating, modeling, engaging in feedback cycles, encouraging, praising, helping, telling and instructing, reinforcing, facilitating (including discussions), suggesting, describing, listening, questioning, recalling, co-constructing, problem solving, scaffolding, eliciting student thinking, open-ended questioning, connecting and applying, and encouraging student creativity through brainstorming, planning, producing* **Foregrounding social justice:** How does this lesson support your growth as a teacher for social justice? How are you considering your reflections on yourself (your identities, educational background, where you are from) in this lesson? I will assess the actual impact of the Brain-Targeted Teaching model on students' ESL learning outcomes by applying the model in the classroom. I will also analyse the applicability and feasibility of the model in ESL teaching environments in mainland China and provide more specific teaching strategies.	

Teaching strategies to consider during your procedure: Demonstrating, modeling, engaging in feedback cycles, encouraging, praising, helping, telling and instructing, reinforcing, facilitating (including discussions), suggesting, describing, listening, questioning, recalling, co-constructing, problem solving, scaffolding, eliciting student thinking, open-ended questioning, connecting and applying, and encouraging student creativity through brainstorming, planning, producing), (From MacNaughton and Williams, 2004, and CLASS, 2008)

Table 4

Lesson Procedure, Lesson 2

Materials, Environment, Prep (please list): (*Prioritize materials that are local, high quality, and multicultural)*	*What materials are needed? How will you arrange or use the environment to facilitate engagement? What prep needs to happen?* **Cambridge BEC Vantage 4 WITH ANSWERS, Test 1 Speaking Reading material** **Example emoticons for the Emotion Test** **Demonstration Video** **Background music**	
Time/Task	**Teacher does** **Students do**	**Rationale for what you are doing/other considerations**
Lesson Opening: 5min	**Emotion Test 5min BT1 & 2** Ask students to draw emoticons to express their emotions and invite a few to share their reasons. Play soft background music throughout the lesson. (https://www.bilibili.com/video/BV1AA4y1d7Gq/?spm_id_from=333.337.search-card.all.click)	Build an emotional connection and provide psychological support for students. Create a relaxing Physical Environment.
Procedure: 50min	**BEC Part 1 Practice & Demonstration 10min BT4** The teacher will first play the video and then explain how students can give answers in Part 1. Demonstration Video for Part 1: https://www.bilibili.com/video/BV1EG411W74u/?spm_id_from=333.337.search-card.all.click **BEC Part 2 Shared Reading & Discussion 30min BT3** 1. The teacher explains how students can organize their time and introduces possible vocabulary to be used in Part 2 (10 min). 2. The teacher assigns students who have chosen the same topic to the same group (three groups in total). Students read the suggested ideas of their topic from the reading material, and practice retelling the ideas in their own words (10min). 3. Students discuss in groups how to approach the topic from other perspectives (10min). **Presentation 10min BT5** Ask students to present to the class.	Provide speaking materials.Teach for mastery of Skills content and concept. Allow students to connect to and apply prior knowledge .
Lesson Closing: 5min	**Ask for students' feedback BT6** The teacher will ask students to answer in a shared document: What was the most valuable thing you learned today? What are some of the issues in your speech that you need to work on?	Assess learning outcomes. Identify student problems and provide coaching for further instruction.

Table 5 Table for CEFR 3.3 : Common Reference levels - Qualitative aspects of spoken language use

	Range	Accuracy	Fluency	Interaction	Coherence
A2	Uses basic sentence patterns with memorised phrases, groups of a few words and formulae in order to communicate limited information in simple everyday situations.	Uses some simple structures correctly, but still systematically makes basic mistakes.	Can make him/herself understood in very short utterances, even though pauses, false starts and reformulation are very evident.	Can ask and answer questions and respond to simple statements. Can indicate when he/she is following but is rarely able to understand enough to keep conversation going of his/her own accord.	Can link groups of words with simple connectors like 'and', 'but' and 'because'.
A1	Has a very basic repertoire of words and simple phrases related to personal details and particular concrete situations.	Shows only limited control of a few simple grammatical structures and sentence patterns in a memorised repertoire.	Can manage very short, isolated, mainly pre-packaged utterances, with much pausing to search for expressions, to articulate less familiar words, and to repair communication.	Can ask and answer questions about personal details. Can interact in a simple way but communication is totally dependent on repetition, rephrasing and repair.	Can link words or groups of words with very basic linear connectors like 'and' or 'then'.

B1+	Has a sufficient range of language to describe unpredictable situations, explain the main points in an idea or problem with reasonable precision and express thoughts on abstract or cultural topics such as music and films.	Communicates with reasonable accuracy in familiar contexts; generally good control though with noticeable mother tongue influences.	Can express him/herself with relative ease. Despite some problems with formulation resulting in pauses and 'cul de sacs', he/she is able to keep going effectively without help.	Can exploit a basic repertoire of strategies to keep a conversation or discussion going. Can give brief comments on others' views during discussion. Can intervene to check and confirm detailed information.	Can use connecting words to link sentences into a coherent sequence, though there may be some 'jumps'.
B1	Has enough language to get by, with sufficient vocabulary to express him/herself with some hesitation and circumlocutions on topics such as family, hobbies and interests, work, travel, and current events.	Uses reasonably accurately a repertoire of frequently used 'routines' and patterns associated with more predictable situations.	Can keep going comprehensibly, even though pausing for grammatical and lexical planning and repair is very evident, especially in longer stretches of free production.	Can initiate, maintain and close simple face-to-face conversation on topics that are familiar or of personal interest. Can repeat back part of what someone has said to confirm mutual understanding.	Can link a series of shorter, discrete simple elements into a connected, linear sequence of points.
A2+	Has sufficient vocabulary to conduct routine, everyday transactions involving familiar situations and topics, though he/she will generally have to compromise the message and search for words.	Can use some simple structures correctly in common everyday situations.	Can adapt rehearsed memorised simple phrases to particular situations with sufficient ease to handle short routine exchanges without undue effort, despite very noticeable hesitation and false starts.	Can initiate, maintain and close simple, restricted face-to-face conversation, asking and answering questions on topics of interest, pastimes and past activities. Can interact with reasonable ease in structured situations, given some help, but participation in open discussion is fairly restricted.	Can use the most frequently occurring connectors to link simple sentences in order to tell a story or describe something as a simple list of points.

	Range	Accuracy	Fluency	Interaction	Coherence
B2+	Can express him/herself clearly and without much sign of having to restrict what he/she wants to say.	Shows good grammatical control; occasional 'slips' or non-systematic errors and minor flaws in sentence structure may still occur, but they are rare and can often be corrected in retrospect.	Can communicate spontaneously, often showing remarkable fluency and ease of expression in even longer complex stretches of speech. Can use circumlocution and paraphrase to cover gaps in vocabulary and structure.	Can intervene appropriately in discussion, exploiting a variety of suitable language to do so, and relating his/her own contribution to those of other speakers.	Can use a variety of linking words efficiently to mark clearly the relationships between ideas.
B2	Has a sufficient range of language to be able to give clear descriptions, express viewpoints on most general topics, without much conspicuous searching for words, using some complex sentence forms to do so.	Shows a relatively high degree of grammatical control. Does not make errors which cause misunderstanding, and can correct most of his/her mistakes.	Can produce stretches of language with a fairly even tempo; although he/she can be hesitant as he or she searches for patterns and expressions, there are few noticeably long pauses.	Can initiate discourse, take his/her turn when appropriate and end conversation when he/she needs to, though he/she may not always do this elegantly. Can help the discussion along on familiar ground confirming comprehension, inviting others in, etc.	Can use a limited number of cohesive devices to link his/her utterances into clear, coherent discourse, though there may be some 'jumpiness' in a long contribution.

	Range	Accuracy	Fluency	Interaction	Coherence
C2	Shows great flexibility reformulating ideas in differing linguistic forms to convey finer shades of meaning precisely, to give emphasis, to differentiate and to eliminate ambiguity. Also has a good command of idiomatic expressions and colloquialisms.	Maintains consistent grammatical control of complex language, even while attention is otherwise engaged (e.g. in forward planning, in monitoring others' reactions).	Can express him/herself spontaneously at length with a natural colloquial flow, avoiding or backtracking around any difficulty so smoothly that the interlocutor is hardly aware of it.	Can interact with ease and skill, picking up and using nonverbal and intonational cues apparently effortlessly. Can interweave his/her contribution into the joint discourse with fully natural turn taking, referencing, allusion making etc.	Can create coherent and cohesive discourse making full and appropriate use of a variety of organisational patterns and a wide range of connectors and other cohesive devices.
C1	Has a good command of a broad range of language allowing him/her to select a formulation to express him/ herself clearly in an appropriate style on a wide range of general, academic, professional or leisure topics without having to restrict what he/she wants to say.	Consistently maintains a high degree of grammatical accuracy; errors are rare, difficult to spot and generally corrected when they do occur.	Can express him/herself fluently and spontaneously, almost effortlessly. Only a conceptually difficult subject can hinder a natural, smooth flow of language.	Can select a suitable phrase from a readily available range of discourse functions to preface his/her remarks in order to get or to keep the floor and to relate his/her own contributions skilfully to those of other speakers.	Can produce clear, smoothly flowing, well-structured speech, showing controlled use of organisational patterns, connectors and cohesive devices.

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