A VALIDITY ASSESSMENT OF ENGLISH-FOR-ENGINEERS BRIDGE COURSE MATERIALS USING LEARNER PERSPECTIVES

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ABSTRACT

This study assessed the criterion-referenced validity of English-for-engineers bridge course materials (EEBCM) designed for CEFR A1- and A2-English-level engineering students. The research examined the helpfulness of the EEBCM in facilitating the learning of English for general purposes (EGP), English for specific purposes (ESP), and the micro-skills of vocabulary, grammar, reading, and conversation; the perceptions of the learners of different language proficiency subgroups; and the appropriateness of the difficulty level of the EEBCM. Data were collected by using questionnaires and individual and focus group interviews after 562 second language learners had undergone a 6-week trial teaching period. The quantitative data were analyzed with paired- and independent-sample t tests, ANOVAs, and Pearson correlations. The qualitative data were analyzed by using the constant comparative method.

The EEBCM was found by the learners who participated in the study, especially those at the A1 level, to facilitate the development of English skills. Learner perceptions of the EEBCM were also found positive when the micro-skills of EGP and ESP were examined. Self-efficacy (i.e., appropriateness of the level of difficulty) and task value (i.e., relevance to the learners' career goals) were found to be the major reasons contributing to the positive learner perceptions.

Key Words: English-for-engineers bridge course materials (EEBCM), English for specific purposes (ESP), materials evaluation, self-efficacy, task value

INTRODUCTION

In recent decades, English for specific purposes (ESP) has been established as an international trend in the field of English language teaching (ELT). The increasing significance of ESP is reflected by the

growing number of ESP courses and programs at institutions of higher learning worldwide, such as at the University of Winnipeg in Canada, the Massachusetts Institute of Technology in the United States, the University of Queensland in Australia, Chongqing University in China, and Waseda University in Japan.

The notion of ESP is consistent with communicative language teaching (CLT), which emerged in the ELT field in the 1970s (Hyland, 2007; Savignon, 1972). CLT underscores meaning and communicative competency instead of form; language should be meaningful to the learner to facilitate effective learning. Thus, language learning tasks and curricula should be developed according to their authenticity and relevance to the learner, instead of the course objectives and materials being pre-determined by the teacher or institution (Johnson, 1982; Littlewood, 1981; Savignon, 1972, 2001). ESP is often considered the best example of CLT (Hutchinson & Waters, 1984; Hyland, 2002) because ESP pedagogy requires its practitioners to collect data from empirical needs analysis and to develop or revise materials to meet specific needs (Belcher, 2004).

Efforts in Creating Needs-Based ESP Curricula

ELT practitioners and researchers worldwide have conducted numerous ESP needs analyses as the initial step toward creating appropriate ESP curricula in recent years. Such studies have been conducted to facilitate the realization of particular professional objectives for learners in diverse occupational and cultural contexts, such as mountain guides in France (Wozniak, 2010), medical doctors (Shi, Corcos, & Storey, 2001) and textile and clothing merchandisers (Li & Mead, 2000) in Hong Kong, technical writers (Belcher, 1998) and nurses (Bosher & Smalkoski, 2002) in the United States, civil engineers in Thailand (Kaewpet, 2009), engineers in Malaysia (Kassim & Ali, 2010), and hotel maids in Hawaii (Jasso-Aguilar, 1999).

Similar endeavors have been undertaken in Taiwan. For example, ESP needs analyses were conducted to develop curricula in English for Tourism and Hospitality (Chen, Chu, & Lin, 2011), Business English (Chen & Lee, 1996), Medical English (Chia, Johnson, Chia, & Olive, 1999), English for Nurses (Wang, Chuang, Yang, & Chiu, 2010), and English for Aviation Security Officers (Chang, 2011). A corpus-based, genre-analytic approach was also adopted to develop online EAP

(English for academic purposes) learning materials for computer science researchers (Chang & Kuo, 2011). Among the various ESP efforts, Basic English for Engineers was identified as an underdeveloped area (Liao & Chang, 2011).

Perceiving the need to develop ESP materials for different majors, an ESP project team at National Cheng Kung University (NCKU) in Taiwan developed textbooks for specific subjects, including engineering, and utilized them as materials in English courses (Tsou, 2009). Nevertheless, despite its successful implementation, the NCKU ESP project was intended to meet the needs of higher proficiency learners at that university. The NCKU ESP project is atypical and consequently inappropriate and irreproducible for students at technical and vocational education system (TVES) universities (Chen, 2011). As Harmer (2001) and Rea (1987) have argued, no groups of learners are ever identical; needs are thus dynamic rather than static. Therefore, ESP materials must be context-specific and responsive to the academic and occupational needs of the learners of particular settings.

A More EGP Approach to ESP for Learners at a Linguistic Disadvantage

ESP instructors at TVES universities in Taiwan are facing a considerable challenge. Although the Ministry of Education (2011) has prescribed the enhancement of ESP proficiency as a major educational goal of the TVES, ESP materials incorporating highly authentic workplace English might be beyond the comprehension of TVES university students who are often at a linguistic disadvantage. Studies have indicated that the EGP (English for general purposes) levels of TVES university students are relatively low when compared to those of regular university students (Hwang & Yu, 2006; Joe, 2005, 2009). Many of these students lost interest in English in junior high school and then received insufficient hours of English instruction at vocational high schools (i.e., 2 hr vs. 5 to 7 hr per week at regular high school) (Lo, 2011). Upon entry to TVES universities, such students are typically far behind their regular university counterparts in language proficiency and learning motivation (Liao & Chang, 2011).

Consideration of these learner factors clarifies why Belcher (2004) contended that authentic, target situation ESP activities do not automatically guarantee progress in language learning. For learners who struggle with linguistic barriers, it is also vital to have a "safe house"

(Canagarajah, 1997), in addition to authenticity and task value, where the curriculum is structured in a way that can be scaffolded for learners to transfer progressively (Belcher, 1998, 2009) from EGP to ESP learning contexts. Maintaining learner self-efficacy and keeping the changes in the level of the difficulty of learning tasks incremental and, therefore, manageable are two essential ingredients in facilitating a successful transition (Belcher, 2004, 2009; Miller, 2001). Miller (2001) adopted a more EGP approach in teaching English to university engineering students in Hong Kong. Instead of selecting materials from professional engineering textbooks that might be difficult to students, Miller used more manageable engineering materials from popular engineering periodicals. By using this EGP approach to ESP, Millar could maintain the students' self-efficacy while easing them into the study of more specific professional materials. This approach was closely related to the concept of Vygotsky's zone of proximal development (1978) and Krashen's "$i + 1$" input hypothesis (2003), which respectively contend that learning is maximal when the language input is slightly above the learner's current development level and the input is comprehensible. Miller's EGP approach to ESP is also in agreement with previous research findings regarding learner preferences on task difficulty. When task choices are available, learners tend to start with easy or intermediate-difficulty tasks and then move in an ascending order to more challenging ones (Schneider & Posse, 1982). Learners prefer tasks of intermediate-difficulty levels because these tasks often help them know their level of capability (Weiner et al., 1971).

Curriculum Development and Validation

In response to the demand for ESP materials for Taiwanese TVES university engineering students at basic levels of English proficiency, a collaborative research team was organized to develop English-for-engineers bridge course materials (EEBCM). This paper reports on the last stage of the collaborative research efforts. The team conducted a present-situation analysis and a target needs analysis (see Dudley-Evans & St. John, 1998; Hutchinson & Waters, 1987) to determine the level of the English proficiency of the target learners and the language requirements for the target situation. As a result of the needs analysis (Liao & Chang, 2011) done at the initial stage of the larger study, the research team identified the target users of the EEBCM to be engineering

students at the A2 (basic) and A1 (pre-basic) English levels based on the Common European Framework of Reference for Languages (CEFR) (European Union, 2002).

Although the advantages of tailor-made ESP materials are evident because of their specificity (Belcher, 2009), curriculum validation of the EEBCM was warranted. According to Rea (1985, 1987), curriculum validation can be ensured by performing construct and criterion-related validity assessment through input from three sources: ELT specialists (including teachers and curriculum developers), second language (L2) learners, and subject specialists. The assessment of construct validity involves systematically analyzing the learning materials and tasks developed by the curriculum developers, teacher feedback in interviews, teaching meetings, and curriculum revision meetings, examination of the implementation of the instruction compared with the curriculum objectives, end of course reports, and feedback from subject specialists. The assessment of the construct validity of the EEBCM was conducted and is reported in a separate study (Young, 2010).

In addition to the assessment of construct validity, Rea (1987) argued for the necessity of a criterion-referenced validity check. Whereas the construct validity assessment examines curricula using input from ELT and subject specialists, it does not reflect input from the target students. Rea stated that criterion-referenced validity assessment examines the extent to which the curriculum meets the needs, including real and perceived, of the target learners. Therefore, it heavily relies on feedback from the learners, including learner perspectives and learner performances. Criteria such as the difficulty level of materials also fall appropriately within the sphere of investigations into learner perceptions.

As Belcher (2004) contended, it is necessary for ESP practitioners to develop and revise materials to meet the specific needs of different learners in particular contexts. The use of criterion-referenced assessment for curriculum validation is in line with current trends in ESP teaching that focus on context specificity (Barnard & Zemach, 2003; Belcher, 2009) and learner-centeredness (Hutchinson & Waters, 1987; Satya, 2008). Criterion-related validity assessment has been employed in various recent studies to examine ESP curricula. For example, Cheng (2012), Kao and Ko (2012), and Wang, Chuang, Yang, and Chiu (2010) examined learner perceptions of English for Tourism, English for Information Technology, and English for Nursing programs, respectively, using feedback questionnaires; Tsou (2009) and Wang (2012) analyzed

student performance in language proficiency testing to examine the effectiveness of NCKU ESP courses for enhancing receptive skills; Hayati and Jalilifar (2010) used language achievement testing to assess an EAP curriculum; Lo (2011) evaluated both the receptive and productive skills of learners to examine the effects of a high school ESP program; Cheng (2012) and Lo (2011) used a student self-evaluation checklist and a questionnaire, respectively, to examine the learner perceptions of the effects of two English for Tourism programs.

The researcher of the present study conducted a two-phase study to ensure the criterion-referenced validity of the EEBCM by applying trial teaching in real L2 classroom contexts. The phase-one evaluation involved subjects from a single classroom. Positive initial results were detected in the pilot study (Liao & Chen, 2012b). The present study reports on the phase-two evaluation, which continued the criterion-referenced validity assessment of the EEBCM with 562 participants from two different engineering majors and 12 classes across three TVES institutions of higher education. Moreover, the perceptions of subgroups of different levels of English proficiency were also analyzed. To triangulate the results, in addition to the questionnaire conducted in the phase-one evaluation, the present study also conducted individual and focus group interviews to verify the results obtained through the statistical analyses. Furthermore, additional question items were added to the questionnaire to enhance reliability and validity.

The purpose of this study was to examine the extent to which the EEBCM meets the needs of target students. Learner perceptions of traditional English curricula (TEC) were also investigated as a reference point of comparison. Although the participants of this study were from three different TVES universities across Taiwan and were taught by five different teachers, their English curricula as implemented at the time of the study were similar in the manner in which they focused primarily on EGP reading skills, and the contents were on topics only tangentially related to the students' specific academic majors. TEC, in this study, refers to reading-focused curricula that is EGP-oriented and scarcely addresses aspects of ESP. In contrast, EEBCM was tailored for the target engineering students and was intended to serve as a bridge so that learners could be scaffolded and transferred gradually from the EGP to the ESP domain. The following four research questions guided the present study:

1. How helpful is the EEBCM in facilitating English learning, including EGP and ESP, based on learner perceptions? How do these perceptions compare with those regarding the TEC?
2. How helpful is the EEBCM in facilitating language learning in the micro-skills of vocabulary, grammar, reading, and conversation based on learner perceptions? How do these perceptions compare with those regarding the TEC?
3. Do learner perceptions vary between the subgroups of different levels of language proficiency regarding the helpfulness of the EEBCM in developing EGP and ESP skills development? How do these perceptions compare with those regarding the TEC?
4. How appropriate is the difficulty level of the EEBCM based on learner perceptions? How do these perceptions compare with those regarding the TEC?

METHODOLOGY

English-for-Engineers Bridge Course Materials (EEBCM)

As aforementioned, the EEBCM was developed by a research team to meet the needs of TVES university students in Taiwan. To identify the needs of the learners, a needs analysis for TVES engineering students and a suitability study of available course materials were conducted (Liao & Chang, 2011). The needs analysis indicated that, although the target students considered English competence significant, they generally had low self-efficacy in learning English. They recognized the need to enhance their ESP skills to be competitive in their future careers, but they also worried that English could become even more difficult to manage as a subject once ESP elements were added to the existing EGP structures. Considering the needs of the target learners, a core vocabulary list for CEFR A1- and A2-level engineering students was developed based on the results of a corpus-based study (Cheng, 2009). The research team then prepared a must-use vocabulary list for the EEBCM, with reference to the recommendations drawn from Cheng (2009). While constructing the EEBCM, the research team constantly consulted the research findings of Liao and Chang (2011) to determine the needs of the target learners and the advantages and disadvantages of existing textbooks. Finally, the draft of an eight-unit textbook was completed by the research team. Each unit contained nine sections: definition-matching, conversation practice,

pre-reading questions, an article reading of approximately 250 words, reading comprehension exercises, cloze tests, grammar points, grammar exercises, and discussion questions. Six instructional hours were allotted to each unit.

Sampling

Convenience sampling and purposeful sampling were adopted for the present study. First, six teachers were recruited to participate in the study. They were from three TVES universities located in northern, central, and southern Taiwan, and they were willing to conduct the trial teaching in their intact English classes. The educational and teaching backgrounds of these teachers were examined to ensure they were proper candidates for participation in the study. Next, based on the academic standing and majors of the classes the teachers were currently teaching, 12 of the sophomore classes taught by five of the teachers were selected for inclusion in the study. The classes of the sixth teacher were not used for the trial teaching because their academic standing or majors differed from the rest of the sampling pool under consideration. The five remaining teachers had either a Ph.D. or M.A. degree in TESOL or in linguistics. Their number of years of teaching experience ranged from 7 to 15 years, and their most recent teaching evaluation scores from the students ranged from 4.25 to 4.40 on a 5-point scale.

A total of 562 students were in the 12 selected intact classes; they majored either in mechanical engineering (ME) or electrical engineering (EE). As shown in Table 1, 192 students were from University A in northern Taiwan, 182 were from University B in central Taiwan, and 188 were from University C in southern Taiwan. Among the participants from University A, 98 majored in ME and 94 majored in EE. Among those from University B, 88 majored in ME and 94 majored in EE. Among the participants from University C, 93 majored in ME and 95 majored in EE. The table also illustrates the levels of the English proficiency of the participants within each class, major, and university. The language levels were determined using the scores of a TOEIC simulation test administered before the trial teaching, and the categorization criteria were based on TOEIC guidelines (Educational Testing Service, 2007) and the CEFR (Council of Europe, 2012). The reliability of the test was high at .85. The ratio of A1 to A2 participants was 1:1.23, 1:0.70, and 1:0.96 at Universities A, B, and C, respectively.

In considering all of the participants, the ratio was 1:0.94. The subjects were considered representative (Fraenkel & Wallen, 2006) of the target textbook users because of their academic backgrounds and levels of English proficiency.

All of the participants receiving the trial teaching were administered a questionnaire. Eight of them were invited to participate in individual interviews, and four of them were invited to join a focus group interview. As shown in Table 2, care was taken to ensure that the interviewees were representative of participants of different levels of language proficiency in the trial teaching, and that they were from classes of different instructors, academic majors, and universities.

Procedure

Two units, one on nanotechnology and the other on robots, from the EEBCM were used as the teaching materials in the trial. The trial teaching was conducted for 2 hr each week for 6 weeks. To ensure treatment integrity, that is, the degree to which a treatment condition is employed as planned (Moncher & Prinz, 1991), various procedures were used throughout the duration of the study to ascertain that the appropriate protocol was followed in the trial teaching.

First, for the trial teaching to proceed uniformly in all 12 classes, lesson plans entailing concrete unit objectives and instructional steps (see Appendix A for an excerpt) were constructed based on the guidelines provided by Dubin and Olshtain (2000). Because the EEBCM was designed for pre-basic and basic-level English language learners, interactive activities and educational games were included in the lesson plans to foster learning (Woodward, 2006).

Table 1

Number of Participants in Each Class, Level of English Proficiency, Academic Major, and University

Class	a	b	c	d	e	f	g	h	i	j	k	l	Subtotal
Teacher	A	A	A	A	B	C	C	B	D	E	E	D	
A1 Participants	20	24	20	22	25	27	26	29	25	20	27	24	289
A2 Participants	27	27	26	26	17	19	19	20	23	25	21	23	273
Subtotal	47	51	46	48	42	46	45	49	48	45	48	47	
Major	ME		EE		ME		EE		ME		EE		Subtotal
A1 Participants	44		42		52		55		45		51		289
A2 Participants	54		52		36		39		48		44		273
Subtotal	98		94		88		94		93		95		
University	A				B				C				Subtotal
A1 Participants	86				107				96				289
A2 Participants	106				75				92				273
Subtotal	192				182				188				
Total	562												

Table 2

Interviewee Information

Interviewee	1	2	3	4	5	6	7	8	9	10	11	12	Subtotal
Class	a	b	c	d	e	f	g	h	i	j	k	l	
Teacher	A	A	A	A	B	C	C	B	D	E	E	D	
English Level	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	
Major	ME		EE		ME		EE		ME		EE		
A1 Participants	1		1		1		1		1		1		6
A2 Participants	1		1		1		1		1		1		6
Subtotal	2		2		2		2		2		2		12
University	A				B				C				
A1 Participants	2				2				2				6
A2 Participants	2				2				2				6
Subtotal	4				4				4				12
Total	12												

Note. Interviewee 1: April. 2: Allan. 3: Alex. 4: Anthony. 5: Bryan. 6: Christopher. 7: Cherry. 8: Betty. 9: Daniel. 10: Edward.

11: Ernie. 12: Derik.

Two rounds of pre-teaching conferences were arranged. The first round occurred 1 week after the teachers received the EEBCM and the accompanying lessons plans; the second round occurred 2 weeks before the trial teaching began. The purpose of the conferences was to ensure that the teachers understood the materials and lesson plans. The foci of the first round were two-fold. The first objective was for the teachers to understand the rationale behind the construction of the EEBCM materials and the importance of ensuring the treatment integrity of this study by adhering to the lesson plan protocol. The second objective was to guide the teachers through the two trial units and lesson plans of the EEBCM and to answer any initial questions. Conversely, the focus of the second round of pre-teaching conferences was to enhance the quality of the teaching while ensuring treatment integrity. Teaching demonstrations and peer feedback were used to achieve this purpose. The first round lasted 75, 70, and 65 min in the case of the teachers in northern, central, and southern Taiwan, respectively, and the second round lasted 120, 130, and 120 min, again respectively. Between the two rounds of pre-teaching conferences, I maintained frequent face-to-face, e-mail, and telephone communication with the teachers to discuss any question or concern regarding the materials and lesson plans.

During the trial teaching, I observed each instructor teach four sessions, twice by sitting at the back of the classroom, and twice via videotape recording. The results of the procedures showed that the trial teaching of all five of the instructors was conducted as intended by the protocol.

The learner-perceptions questionnaires and interviews were conducted at the end of the trial teaching to examine the helpfulness and appropriateness of the EEBCM materials. The same questionnaires were also administered earlier at the end of the preceding semester to elicit learner perceptions of the TEC materials as a reference point of comparison.

Instrumentation

A 33-item questionnaire, developed based on Liao and Chen's (2012b) 12-item questionnaire, was used to collect data regarding learner perceptions of the EEBCM and TEC. The questionnaire (Appendix B) consisted of 10 scales, including how the materials facilitated learning in vocabulary, grammar, reading, conversation, EGP skills in general, ESP

vocabulary, ESP reading, ESP conversation, ESP skills in general, and the appropriateness of the difficulty level. These scales were developed to reflect learner needs as revealed from an earlier needs analysis (Liao & Chang, 2011). In addition to the scales of macro- and micro-skills of English learning, the scale of appropriateness of the level of difficulty was specifically included in the questionnaire to examine whether the materials met the needs of the target learners, who considered both EGP and ESP skills development to be vital but had low self-efficacy for learning the language. Special attention was given to ensure the appropriateness of the questionnaire items for eliciting perceptions regarding both the EEBCM and TEC. Three experienced L2 teachers were invited to conduct expert reviews of the validity and the English-Chinese translation of the questionnaire. In addition, before the Chinese questionnaire was administered to all of the participants, it was first given to three of them to measure the administration time and to detect any ambiguity in the questionnaire items.

To ensure that the participants had a shared reference point when they responded to each item, the questionnaire items were measured on a 5-point Likert scale with the first and fifth points anchored as *strongly disagree* and *strongly agree*. Table 3 provides an interpretation of the levels of the score ranges.

Table 3

Questionnaire Score Interpretation

Score	Alternatives for Response	Helpfulness of the Materials	Appropriateness of the Difficulty Level
1.00-1.50	Strongly disagree	Very unhelpful	Very inappropriate
1.51-2.50	Disagree	Unhelpful	Inappropriate
2.51-3.50	Neutral	Moderate	Moderate
3.51-4.50	Agree	Helpful	Appropriate
4.51-5.00	Strongly agree	Very helpful	Very appropriate

To explore the learner perceptions of the EEBCM further, eight individual interviews and a focus group interview were also conducted. These interviews followed a semi-structured interview protocol, which guided the collection of data in a systematic and focused manner but also

afforded the researcher flexibility to probe unanticipated concerns that emerged during the interviews (Lodico, Spaulding, & Voegtle, 2010).

Data Analysis

To answer Research Questions 1 to 3, descriptive analyses were first conducted to examine learner perceptions of the overall helpfulness of the materials for EGP and ESP skills development, as well as in the micro-skills of vocabulary, grammar, reading, and conversation. Subsequently, paired-samples t tests were used to compare learner perceptions between the EEBCM and the TEC. In addition to the aforementioned statistical procedures, independent-samples t tests were also carried out for Research Question 3 to compare perceptions between learners of varying levels of proficiency.

Research Question 4 was answered with descriptive analysis and one-way analyses of variance (ANOVAs), which compared the means of subgroups of the participants who were from different majors, from classes taught by different instructors, from various universities, and who had varying language proficiency levels. ANOVAs were selected in lieu of t tests to prevent Type I error from being inflated (Cronk, 2004). In addition, a Pearson correlation was used to examine the relationship between level of language proficiency and learner perceptions of appropriateness of difficulty level. Furthermore, paired-samples t tests were used to compare the perceptions of the A1, A2, and total participants regarding the EEBCM and TEC.

In addition, qualitative data collected from the interviews were transcribed and analyzed to supplement the results from the quantitative data analyses. The constant comparative method (Cohen, Manion, & Morrison, 2007) was used to probe unanticipated themes that emerged from the interviews. The data were first organized and interpreted through open coding. Axial coding was next used to interconnect categories that had been established through open coding.

RESULTS

As indicated in Table 4, the reliabilities of the questionnaire scales were satisfactory, ranging from .82 to .98. The results of the questionnaire are presented in Table 5.

Table 4

Reliabilities of the Questionnaire Scales

Scales	Question Items	Reliability
EGP Vocabulary	2, 9, 16	.83
EGP Grammar	3, 10, 17	.82
EGP Reading	4, 6, 11, 13	.84
EGP Conversation	5, 12, 18	.86
EGP Skills	1, 8, 15	.84
ESP Vocabulary	20, 24, 27(R), 31	.82
ESP Reading	23, 26, 30	.86
ESP Conversation	22, 29, 32	.82
ESP Skills	21, 25, 28, 33	.86
Difficulty Level	7, 14(R), 19	.98

Note. R denotes questionnaire items that were reverse coded.

Helpfulness of the EEBCM in Facilitating English Learning

Descriptive and inferential analyses were used to examine Research Question 1. As shown in Table 5, the learner perceptions of the helpfulness of the EEBCM were generally positive. Using the standards for the interpretation of the questionnaire scores listed in Table 3, the EEBCM was found to be helpful in facilitating English learning (M = 3.76, SD = .20). By comparison, the learners held neutral attitudes toward the helpfulness of the TEC (M = 2.67, SD = .38). A paired-samples t test was calculated to compare the above two mean scores, and a significant difference was found (t(561) = 79.948, p < .001), indicating that the learners considered the EEBCM to be more helpful to their English language development.

Table 5

Learner Perceptions of Various Aspects of the EEBCM vs. TEC

Micro-Skills	EEBCM		TEC		Paired-Samples *t* Tests		
	Mean	SD	Mean	SD	*t*	*df*	*p*
EGP Vocabulary	3.98	.53	3.06	.78	36.715	561	.000
EGP Grammar	3.98	.53	3.22	.74	28.883	561	.000
EGP Reading	4.05	.38	2.35	.72	64.237	561	.000
EGP Conversation	3.15	.82	3.19	1.02	-1.618	561	.106
EGP Skills	4.16	.55	3.31	.94	26.880	561	.000
ESP Vocabulary	3.82	.46	2.51	.50	148.659	561	.000
ESP Reading	3.84	.51	2.46	.53	179.335	561	.000
ESP Conversation	3.15	.79	1.79	.80	180.506	561	.000
ESP Skills	3.83	.42	2.46	.44	247.981	561	.000
Appropriateness of Difficulty Level	3.06	1.26	2.80	1.49	13.806	561	.000
EGP Total	3.87	.28	3.02	.67	30.899	561	.000
ESP Total	3.66	.29	2.31	.31	362.024	561	.000
Total	3.76	.20	2.67	.38	79.948	561	.000

Table 5 further shows that the learners considered the EEBCM to be helpful for both EGP (M = 3.87, SD = .28) and ESP (M = 3.66, SD = .29) development. By contrast, the learners held neutral attitudes towards the helpfulness of the TEC for EGP (M = 3.02, SD = .67), and they considered the TEC unhelpful for their ESP development (M = 2.31, SD = .31). Paired-samples t tests were calculated to compare the above mean scores. A significant difference was found for both the EGP (t(561) = 30.899, p < .001) and the ESP (t(561) = 362.024, p < .001) repertoires, indicating that the EEBCM was deemed more helpful than the TEC in both the EGP and ESP aspects.

Learner perceptions revealed through the constant comparative analysis of the interview data were supportive of the statistical results. The interviewees stated that their language skills had progressed during the 6-week trial teaching period, and that sitting in an English classroom was less of or no longer a torment to them. A major theme that emerged from the analysis of the interview data was the relevance of the English teaching materials to career goals, which appeared to play a substantial role in how the learners at both the A1 and A2 levels perceived the value of the EEBCM. Ernie (Interviewee 11 as indicated in Table 2; pseudonyms are used in this paper to refer to all of the interviewees and instructors), an A1-level EE student taught by Instructor E at University C, compared the EEBCM and the TEC from the aspect of ESP development:

> The current curriculum in my English class focused on EGP skills only. It had nothing to do with ESP. I didn't see its connection to my future job development. This set of new materials was different. It was more relevant to my area of study [i.e., engineering] than the existing learning materials.

Allan (Interviewee 2), an A2-level ME student taught by Instructor A at University A, also perceived the task value of the EEBCM because of its facilitation of the development of ESP language skills:

> I personally preferred the trial materials because they facilitated ESP skills development. When I earn my bachelor's degree two years from now, I want to become an engineer. I will need ESP skills to help me read manuals and have intellectual, professional-level talks with foreign engineers and customers. The [course] textbook did not foster my ESP skills at all, but the trial materials did.

Betty (Interviewee 8), an A2-level EE student taught by Instructor B at University B, talked about how the relevancy of the materials to the area of her major interested her:

> I pride myself on my performance in engineering subjects. However, I was not interested in the English curriculum because I didn't see much relevancy of it to my future career. Although my English was better than most of my classmates, I was not motivated by the English materials, not to mention my poor classmates who lacked the enthusiasm and language foundations required to manage the English course. The trial materials, on the other hand, were more relevant to us engineering students. I observed that most of my classmates were also willing to pay more attention in class and exert more efforts after class because these English skills will come in handy one day when we graduate from college.

Christopher (Interviewee 6), an A2-level ME student taught by Instructor C at University B, shared similar perspectives:

> I think the main point about the trial materials that attracted me was their relevance and fit to individual needs. Because of their topics and content, as an ME major, I feel their relevance to my professional development and thus I am interested in using the book.

Alex (Interviewee 3), an A1-level EE student taught by Instructor A at University A, was also motivated by the perceived relevance of the materials to his future career:

> Ms. Penn explained to us that the vocabulary items [used in the EEBCM] were among the most frequently used words for engineers. Although English used to be very difficult and still is, learning English has become more meaningful and less tedious after I understood the purpose of the materials. The words are no longer strangers; they are what I'll encounter every day when I become an engineer.

Helpfulness of the EEBCM in Facilitating the Development of Micro-Skills

Research Question 2 was examined using descriptive and inferential

analyses. As Table 5 indicates, the learners believed that the use of the EEBCM could facilitate the development of the micro-skills of EGP vocabulary (M = 3.98, SD = .53), grammar (M = 3.98, SD = .53) and reading (M = 4.05, SD = .38). However, the learners held reservations about the helpfulness of the use of the EEBCM in the development of micro-skills of EGP conversation (M = 3.15, SD = .82). Similarly, the learners believed that the use of the EEBCM could help them to develop the micro-skills of ESP vocabulary (M = 3.82, SD = .46) and ESP reading (M = 3.84, SD = .51). Nevertheless, they found the EEBCM to be only moderately helpful in facilitating ESP conversation skills (M = 3.15, SD = .79).

By comparison, the learners held either reserved or negative attitudes toward the helpfulness of their TEC in developing vocabulary (M = 3.06, SD = .78), grammar (M = 3.22, SD = .74), reading (M = 2.35, SD = .72), and conversation (M = 3.19, SD = 1.02) in the repertoire of EGP. They found the TEC even less helpful in facilitating ESP skills of vocabulary (M = 2.51, SD = .50), reading (M = 2.46, SD = .53), and conversation (M = 1.79, SD = .80).

Paired-samples t tests were calculated to compare the above mean scores. Significant differences were found in all the micro-skill areas (*p* < .001) except EGP conversation, indicating more positive learner attitudes toward the EEBCM in almost all of the micro-skill areas. The results of these *t* tests are also presented in Table 5.

The interviewees commented on specific areas of micro-skills development, including vocabulary, reading, and speaking. Daniel (Interviewee 9), an A1-level ME student taught by Instructor D at University C, made the following remarks regarding how the spiral feature of the EEBCM helped him with learning vocabulary:

> English has been my weakest subject since junior high. I could not even remember the word list in each unit. Nevertheless, this new set of trial materials had words recycled from one unit to another. The repeated exposure to the new words helped me recognize and memorize the vocabulary. That was quite a breakthrough for me.

Cherry (Interviewee 7), an A1-level student taught by Instructor C at University B, and Anthony (Interviewee 4), an A2 student taught by Instructor A at University A, were of the same opinion that the recycling of new vocabulary in the EEBCM enhanced learning, but they also

suggested that example sentences accompany the list of vocabulary in both the EEBCM and TEC to facilitate understanding, and that flash cards be added to the end of the EEBCM to facilitate reviewing. Cherry and Anthony were both EE students.

The length of the reading passages was another area of concern for the L2 learners. Edward (Interviewee 10), an A2-level ME student who was taught by Instructor E at University C, stated,

> Since English is the most problematic subject among all, I often got lost in long reading passages across pages. I think it is a good idea that the editors [of the EEBCM] have controlled the reading passages [to be approximately 250 words each] so that they are comprehensible and manageable. Although it was sometimes challenging for me to understand the grammatical structure of the reading texts, the reasonable amount of reading in each unit gave me plenty of time to review the challenging parts and digest the grammar points in the materials.

Finally, the interview data further confirmed the research results obtained through the questionnaire regarding the development of ESP conversation skills. Derik (Interviewee 12, A2, EE, Instructor D, University C) observed the following:

> The traditional English curriculum mainly focuses on reading. Limited time is allotted for EGP conversation practice, let alone ESP conversation, which is essentially nonexistent. The trial materials, on the contrary, helped with both EGP and ESP conversation, although I wish there would have been more practice.

Perceptions of Learners at Different Levels of Language Proficiency

To address Research Question 3, the data were further analyzed to examine if different perceptions existed between the A1 (pre-basic) and A2 (basic) subgroups of learners about the helpfulness of the EEBCM in developing EGP and ESP skills. As shown in Table 6, although both the A1 (M = 3.90, SD = .28) and A2 learners (M = 3.83, SD = .28) believed that the use of the EEBCM facilitated EGP learning, the results of the independent-samples t tests indicate that the A1 learners had significantly more positive attitudes than the A2 learners ($t(560) = 2.742, p < .01$).

Similarly, as shown in Table 7, the A1 (M = 3.65, SD = .29) and A2 learners (M = 3.68, SD = .30) both had positive attitudes toward the helpfulness of the EEBCM in the development of ESP skills. However, the independent-samples t tests indicate no significant difference between the two mean scores *(t*(560) = -1.176, *p* > .05).

By contrast, as shown in Table 6, whereas the A1 learners found the TEC unhelpful in facilitating EGP development (M = 2.43, SD = .46), the A2 learners considered it helpful in developing EGP skills (M = 3.65, SD = .44). The independent-samples *t* test indicates that the A1 learners had significantly less positive attitudes than did the A2 learners (*t*(560) = -31.777, *p* < .001) toward the TEC.

However, as shown in Table 7, participants in both language proficiency groups believed that the TEC did not help in their ESP development (M = 2.29, SD = .33 and M = 2.32, SD = .41 for the A1 and A2 groups, respectively). No significant difference was found between these two mean scores (*t*(560) = -1.024, *p* > .05).

In addition, paired-samples *t* tests were calculated to compare learner perceptions of the helpfulness of the EEBCM with that of the TEC. The results in Tables 6 and 7 indicate that the A1 learners considered the use of the EEBCM to be more effective in facilitating both EGP (*t*(288) = 58.569, *p* < .001) and ESP learning (*t*(288) = 185.871, *p* < .001) than the use of the TEC. Similarly, the A2 learners also found the use of the EEBCM to be more effective in facilitating EGP (*t*(272) = 10.345, *p* < .001) and ESP learning (*t*(272) = 97.731, *p* < .001).

Appropriateness of Difficulty Level

To address Research Question 4, learner perceptions of the EEBCM were first examined. As shown in Table 8, the total sample found the appropriateness of difficulty level to be moderate (M = 3.06, SD = 1.26).

Table 6

Perceptions of Different Proficiency Subgroups of the EGP Repertoire

Subgroups	EEBCM					TEC					Paired-Samples *t* Tests		
	Mean	SD				Mean	SD				*t*	*df*	*p*
A1	3.90	.28				2.43	.46				58.569	288	.000
A2	3.83	.28				3.65	.44				10.345	272	.000
Independent-Samples *t* Tests	*t*	*df*	*p*			*t*	*df*	*p*					

Table 7

Perceptions of Different Proficiency Subgroups of the ESP Repertoire

Subgroups	EEBCM					TEC					Paired-Samples *t* Tests		
	Mean	SD				Mean	SD				*t*	*df*	*p*
A1	3.65	.29				2.29	.33				185.871	288	.000
A2	3.68	.30				2.32	.41				97.731	272	.000
Independent-Samples *t* Tests	*t*	*df*	*p*			*t*	*df*	*p*					
	-1.176	560	.240			-1.024	560	.307					

Variation within the total sample was moderate to large with a standard deviation of 32% of the scoring range. Because of the size of the variation that was observed from the standard deviation, it was necessary to examine further the perceptions of the learners from different subgroups to explore possible causes. One-way ANOVAs were used to compare the perceptions of subgroups in the categories of instructors, academic majors, and universities. No significant difference was found among the subgroups who were taught by different instructors ($F(4, 557) = 1.27$, $p = .281$), among those who majored in different academic specializations ($F(1, 560) = .10$, $p = .758$), or among those who were from different universities ($F(2, 559) = 2.49$, $p = .084$). However, as shown in Tables 8 and 9, a significant difference ($F(1, 560) = 2665.81$, $p = .000$) was found between subgroups of different levels of English proficiency. Whereas the A1 learners considered the level of difficulty inappropriate (M = 1.94, SD = .60), the A2 participants considered it appropriate (M = 4.24, SD = .43).

Table 8

Perceptions of Subgroups of Different Levels of Proficiency of the Appropriateness of the Difficulty Level of the EEBCM and the TEC

Learner Perceptions	EEBCM		TEC		Paired-Samples *t* Tests		
	Mean	SD	Mean	SD	*t*	*df*	*p*
A1 Learners	1.94	.60	1.49	.75	16.758	288	.000
A2 Learners	4.24	.43	4.19	.48	2.650	272	.009
Total Sample	3.06	1.26	2.80	1.49	13.806	561	.000

Table 9

One-Way ANOVA of the Appropriateness of the Difficulty Level of the EEBCM between A1 and A2 Learners

Source	SS	*df*	MS	*F*	*p*
Between Groups	738.34	1	738.34	2665.81	.000
Within Groups	155.10	560	.28		
Total	893.44	561			

A Pearson correlation coefficient was calculated to determine the relationship between the participants' level of language proficiency and their perceptions of the appropriateness of the difficulty level of the EEBCM. A strong positive correlation was found ($r = .91$, $p < .001$), indicating a significant linear relationship between the two variables. The learners with a higher proficiency in English tended to find the EEBCM more appropriate in level of difficulty.

Subsequently, learner perceptions of the TEC were examined. The total sample found the appropriateness of the difficulty level of the TEC to be moderate (M = 2.80, SD = 1.49). Variation within the participants was moderate to large with a standard deviation of 37% of the scoring range. Because of the size of the variation that was observed from the standard deviation, it was necessary to examine further the perceptions of the learners from different subgroups to explore possible causes. One-way ANOVAs were used to compare the perceptions of subgroups in the categories of instructors, academic majors, and universities regarding the existing curricula. No significant difference was found among the subgroups who were taught by different instructors ($F(4, 557) = 1.76$, $p = .136$), among those who majored in different academic specializations ($F(1, 560) = .15$, $p = .699$), or among those who were from different universities ($F(2, 559) = 3.51$, $p = .061$). However, as shown in Tables 8 and 10, a significant difference ($F(1, 560) = 3452.79$, $p = .000$) was found between subgroups at different levels of English proficiency. Whereas the A2 learners (M = 4.19, SD = .48) considered the level of difficulty to be appropriate, the A1 learners (M = 1.49, SD = .75) considered it to be very inappropriate, which was the lowest level of score interpretation according to Table 3.

Table 10

One-Way ANOVA of the Appropriateness of the Difficulty Level of the TEC between A1 and A2 Learners

Source	SS	*df*	MS	*F*	*p*
Between Groups	1018.24	1	1018.24	3452.79	.000
Within Groups	165.15	560	.30		
Total	1183.39	561			

A Pearson correlation coefficient was calculated to determine the relationship between the learners' level of language proficiency and their perceptions of the appropriateness of the difficulty level of the TEC. A strong positive correlation was found (r = .94, p < .001), indicating a significant linear relationship between the two variables. The learners with a higher level of proficiency in English tended to find the difficulty level of the TEC more appropriate.

Paired-samples t tests were subsequently calculated to compare learner perceptions of the difficulty appropriateness of the EEBCM and the TEC. The results in Table 8 indicate that the total sample believed the level of difficulty in the EEBCM to be more appropriate than that in the TEC ($t(561) = 13.806$, $p < .001$). A further examination of the results for the proficiency subgroups revealed that both the A1 ($t(288) = 16.758$, $p < .001$) and A2 learners ($t(272) = 2.650$, $p < .01$) considered the level of difficulty in the EEBCM to be more appropriate than that in the TEC.

An examination of the interview data indicated that difficulty appropriateness not only influenced learner perceptions of the teaching materials but also influenced learning motivation and behavior. Although from three different universities across the country, the participants, especially the A1-level learners, considered the EEBCM more appropriate than their current English curricula for engineering majors. For example, Ernie (Interviewee 11, A1, EE, Instructor E, University C), felt exasperated by the difficulty of the TEC:

> Even though it aims to promote our EGP abilities, it seems to be designed for aliens because I could not understand most of it. I hate to admit that I often dozed off in class, but I could not help it. They were alien words!

Ernie's remarks were echoed by Bryan (Interviewee 5), an A1-level ME student taught by Instructor B at University B, and April (Interviewee 1), an A1-level ME student taught by Instructor A at University A, in separate interviews. Bryan described the texts in the TEC as like "a princess sitting in a high horse carriage, beautiful, elegant, yet cold and unapproachable," whereas the texts in the EEBCM were "a pretty girl who just moved next door. You need to take action to get her phone number, but as long as you are sincere, you can make friends." April believed that the level of the EEBCM was more accessible to her and that this feature made her a more confident and active learner. April

stated,

> I like my English teacher, Ms. Lee. She is kind and patient. But my English basically stayed at the same pathetic level no matter how hard Ms. Lee tried to help me last semester. The [TEC] textbook, although well-printed and with nice illustrations and everything, was boring, difficult, and way over my head. I showed up in the English class every Wednesday morning, but my mind was totally absent. What could I do? The content was too tough! Honest! This semester was different. Ms. Lee brought in a new set of materials. I found it a bit easier and I was able to comprehend her instruction. My mom was very surprised seeing me reviewing the materials at home this semester. "I thought English was your deadly enemy," she said to me. Although there were still many challenges to meet, at least I no longer felt like an idiot sitting in the classroom for two hours per week. And I wanted, really wanted to do something to keep myself out of the idiot category.

A further two participants, Christopher (Interviewee 6, A2, ME, Instructor C, University B) and Alex (Interviewee 3, A1, EE, Instructor A, University A), stated that they truly enjoyed using the EEBCM because of the combination of ESP for study at the basic English level. Christopher mentioned that the other ESP books available on the market were unsuitable for his basic level of English proficiency:

> Because the English curriculum did not have ESP content, I spent a lot of time during the winter break searching for English-for-engineers textbooks available in the bookstores. The search was in vain. I realized that most of this kind of books were designed on the basis that the book users had a good EGP foundation. Unfortunately, it was not the case for most of us engineering students at technical universities. By contrast, this [EEBCM] book has been designed for A1 and A2 students, the appropriate level of difficulty of the language motivated me to work harder learning English.

Alex believed that the level of the difficulty of the EEBCM fitted his needs. "Except for some essential technical terms," said Alex, "only A1 and A2 vocabulary were included in the materials. The materials were specifically designed for us engineering students at a basic English level.

And I liked it because of that."

Despite the positive attitudes toward the EEBCM, the learners understood that mastering the EEBCM did not guarantee the competence required to manage workplace ESP tasks because the materials were at a very basic level. However, they also recognized that it was what they needed at the present stage of learning. For example, Allan (Interviewee 2, A2, ME, Instructor A, University A) remarked in the focus group interview, "Although the ESP contents [of the EEBCM] were pretty basic, it was what we could take at our current English level. We have to take one step at a time."

DISCUSSION

After undergoing 6 weeks of the trial teaching period using the EEBCM, the electrical and mechanical engineering students from 12 intact classes across three technical universities in Taiwan showed positive attitudes toward the EEBCM. The EEBCM was found to be more helpful in facilitating language learning and at a more appropriate level of difficulty than the TEC.

In the EGP repertoire, the EEBCM was found to be more helpful than the TEC for the micro-skills of vocabulary, grammar, and reading, as well as for the EGP repertoire in general. However, neither the EEBCM nor the TEC was found to help develop the micro-skill of EGP conversation. In the ESP repertoire, the learners believed that the EEBCM was more helpful than the TEC for the micro-skills of vocabulary, reading, and conversation, as well as for the ESP repertoire in general.

When the level of the language proficiency of the learners was accounted for, the EEBCM was considered more helpful than the TEC regarding either EGP or ESP skills development by the learners in both the A1 and A2 groups. As illustrated in Figure 1 ("○" denotes helpful and "x" denotes unhelpful"), the A1 and A2 learners were in agreement that the EEBCM was helpful whereas the TEC was unhelpful in promoting ESP skills development. The two ability groups, however, differed in their views in the aspect of EGP. Although the A2 learners preferred the EEBCM over the TEC, they thought that their EGP skills could be facilitated by using either of the two sets of materials. By contrast, the A1 learners found the EEBCM helpful but the TEC unhelpful in facilitating the development of their EGP skills.

	EEBCM				TEC		
	EGP	*ESP*			*EGP*	*ESP*	
A1	O	O	vs.		x	x	*A1*
A2	O	O			O	x	*A2*

Figure 1. Helpfulness of the materials as perceived by different ability groups.

Learner perceptions of the helpfulness of the materials were related to their self-efficacy (i.e., the appropriateness of the difficulty level of the materials) as well as their task value (i.e., relevance to career objectives). Although the learners were from three different universities that used separate sets of TEC, no distinct perception regarding the difficulty appropriateness of the TEC was detected. However, language proficiency was found to be related to how the learners perceive the difficulty appropriateness of the materials. For the A2 learners, both the TEC and the EEBCM were at an appropriate level of difficulty. For the A1 learners, nevertheless, the level of difficulty of the EEBCM was inappropriate and that of the TEC very inappropriate. The A1 learners' extremely negative attitudes toward the difficulty appropriateness of the TEC were also reflected in the participant interviews, where the texts in the TEC were described as "strangers" (Alex), "alien words" (Ernie), and a "cold and unapproachable princess" (Bryan) by learners at the A1 level. It is no wonder that they considered English a "deadly enemy" (April) and could not help but "doze off" (Ernie) in the "boring, difficult" (April) English class.

Learner perceptions can be discussed in the context of self-efficacy theory. According to Bandura (1993), how individuals define their ability to reach the goal of a particular task is likely to influence their motivation and future learning actions. Learners with low self-efficacy, therefore, tend to perceive difficult tasks as personal threats. They tend to shy away from challenging tasks and have low aspirations and weak commitment to goals. When the difficulty of materials and learning tasks are beyond such learners' comprehension and mastery, they might slacken in their efforts and give up easily unless they are motivated by other factors.

Some people might wonder why the A1 learners in the present study perceived the EEBCM to be at an inappropriate level of difficulty (Table 8) but considered it helpful to the development of language skills (Tables 6 and 7 and Figure 1). This is where the second factor, task value, comes into play. Although the EEBCM was difficult for the A1 learners, as compared to the TEC, it had task value because it was "relevant to my area of study" and had "connection to my future job development" (Ernie). As one of the participants stated, "Although English used to be very difficult and still is, learning English has become more meaningful and less tedious after I understood the purpose of the materials" (Alex). The learners also understood that, although the EEBCM was challenging for some of them (i.e., the A1 learners), mastering the EEBCM content and skills was only a small step toward an effective grasp of English for engineers. Nevertheless, they recognized that "it was what we could take at our current English level. We had to take one step at a time" (Allan).

The positive results of this study indicate that the EEBCM had criterion-referenced validity. The findings are in agreement with Krashen's input hypothesis (2003) and Vygotsky's zone of proximal development (1978), that learners learn most effectively when the content is slightly above the learners' current level of development. The findings also correspond with the model of task values, which is related to the question of "Do I want to do the task?" (Dornyei, 2001). Regarding the model of task values, the findings are particularly related to utility value, which refers to the degree of relationship a learner perceives between a task and short- or long-term goals (Eccles & Wigfield, 2002). This relationship is exemplified through the relevance perceived by the learners (Ernie, Allan, Betty, Christopher, and Alex) of the teaching materials to their goals, i.e., career development.

In addition, the learners mentioned in the interviews that the spiral feature of the EEBCM facilitates vocabulary learning. Their experience of learning was in accordance with the viewpoints of Rea (1987), Pica (2000) and Nation (2001), that learners should receive multiple exposures to target words and that spiral learning indicates an incremental accumulation and recycling of language skills. Spiral learning allows learners to practice vocabulary in spaced repetition (Liao & Chen, 2012a), which enhances memorization and retention of vocabulary more effectively than does traditional massed repetition (Bloom & Sheull, 1981; Fields, 2005).

CONCLUSION

The development of the EEBCM involved the efforts of a group of L2 college teachers who perceived the inappropriateness of existing English curricula for their engineering students. After conducting a needs analysis of the target learners and a suitability study of available teaching materials (Liao & Chang, 2011), the EEBCM development team adopted a more EGP approach to ESP to accommodate the needs of the learners at a linguistic disadvantage.

The curriculum validation of the EEBCM was ensured by performing a construct validity assessment (Young, 2010), a single-class pilot evaluation (Liao & Chen, 2012b), and the criterion-related validity assessment conducted in this study. After undergoing the 6-week trial teaching period, the L2 technical university engineering students with pre-basic and basic level of English proficiency, particularly those at the A1 level, considered the EEBCM more helpful than the TEC in facilitating EGP and ESP skills development. Whereas most available ESP books for engineers on the market are designed for the learner with a high level of English proficiency, the EEBCM was particularly constructed to suit the needs of the engineering student with a basic command of English. In this study, self-efficacy (i.e., difficulty appropriateness) and task value (i.e., relevance to the learners' career goals) were found to be the major factors that contributed to positive learner perceptions.

In summary, the criterion-related validity assessment in the present study revealed that the EEBCM could scaffold the less successful L2 learners in making the transfer from the EGP to the ESP repertoire. Therefore, it is strongly recommended that measures be taken in future English curriculum development to sustain the self-efficacy of learners and to ensure that the changes in the level of the difficulty of learning are incremental and manageable.

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APPENDIX

Appendix A. Lesson Plan for the Trial Teaching of the Nanotechnology Unit

Objectives:
1. The students will be able to explain what nanotechnology is and its impact on the world.
2. The students will be able to recognize 80% or more of the key words/expressions in the unit and provide interpretations.
3. The students will be able to use adverbial clauses with 70% accuracy or higher.
4. The students will participate in class activities and demonstrate an appreciation of nanotechnology.

Time:
2 hr/week over 3 weeks = 6 hr

Schedule:

Period 1, Week 1: A 5-min warm-up provides the students with a general idea of the purposes of the trial teaching. The instructor then spends 15 min presenting the students with a brief introduction of the textbook. In the following 30 min, the instructor covers Sections 3-1 *Starting Out* and 3-2 *Conversation*.

Period 2, Week 1: Five minutes are spent on Section 3-3 *Pre-Reading*, and a lecture on and discussion of Section 3-4 *Reading* lasts another 40 min. The instructor then uses the last 5 min to assign homework, which is to practice the conversation demonstrated in Section 3-2.

Period 1, Week 2: The class begins with a 5-min review of the content taught in Week 1. In the following 10 min, the instructor randomly chooses three to four pairs of students to read the dialogue in Section 3-2 in front of the class. The students then work in groups for 10 min on the exercises in Sections 3-5 and 3-6. Immediately afterwards, the instructor spends 15 min to check and explain the answers to the students. To encourage student interest, the instructor has the students play a game called "Passing the Box" for 10 min until the end of the first period. The game is explained in the last section of this lesson plan.

Period 2, Week 2: Instruction for the first half of Section 3-7 *Grammar* lasts 30 min. The students then have 15 min to work in groups

to create their own sentences following the grammar rules taught in this class. In the last 5 min before the end of the class, the instructor assigns homework (a vocabulary review) to the class.

   Period 1, Week 3: The class begins with a 5-min review of the first half of Section 3-7 *Grammar*. A 20-min lecture on the second half of Section 3-7 *Grammar* is then delivered. After the lecture, the students practice exercises from Section 3-8 for 10 min. The instructor uses 15 min to check and explain the answers to the class.

   Period 2, Week 3: The students use 10-15 min to discuss questions provided in Section 3-9 *Discussion* with a partner; students either then volunteer or are selected by the instructor to offer their answers to the class. Feedback on the answers is solicited if time permits. The class discussion lasts for 20 min. In the last 15-20 min of the period, a review of the unit is conducted.

Passing the Box:

   In this game, a student is chosen as "It" to stand in front of the class, turning his/her back to the class. The other students pass a box containing paper slips, each with a vocabulary word from this unit written on it. When "It" yells "Stop!" the other students must immediately stop passing the box. The student holding the box draws a paper slip from the box, reads the word on it out loud, and provides its Chinese interpretation. This student then becomes "It," and the game continues.

Appendix B. The Questionnaire on Learner Perceptions of the Materials

INSTRUCTIONS: Please circle the number that best describes how you feel regarding the course materials. There are no "right" or "wrong" answers. Your opinion matters.

	Strongly Disagree	Disagree	Neutral/Don't Know	Agree	Strongly Agree
1. I think my four skills in English can be enhanced by using the teaching materials.	1	2	3	4	5
2. By using the teaching materials, I think I can effectively increase my English vocabulary.	1	2	3	4	5
3. The manner in which the materials are constructed helps me learn grammar effectively.	1	2	3	4	5
4. The teaching materials are able to enhance my English reading skills.	1	2	3	4	5
5. The teaching materials help me speak English better.	1	2	3	4	5
6. The varied formats of the exercises help me acquire a better understanding of the unit content.	1	2	3	4	5
7. I think the level of difficulty is appropriate.	1	2	3	4	5
8. If the class continues to use the materials, my general English abilities can improve.	1	2	3	4	5
9. The manner in which the materials are constructed helps me learn English vocabulary.	1	2	3	4	5
10. The teaching materials help me understand the grammar points.	1	2	3	4	5
11. My English reading ability can be enhanced with the help provided by the teaching materials.	1	2	3	4	5
12. The teaching materials are able to enhance	1	2	3	4	5

my English conversational skills.

13.	The teaching materials will help me become a better English reader.	1	2	3	4	5
14.	The teaching materials are too difficult or too easy for me.	1	2	3	4	5
15.	On the whole, the teaching materials are able to help me improve my general English skills.	1	2	3	4	5
16.	The teaching materials are able to enhance my English vocabulary.	1	2	3	4	5
17.	The teaching materials are able to enhance my English grammar skills.	1	2	3	4	5
18.	The exercises help me speak English more fluently.	1	2	3	4	5
19.	The teaching materials are appropriate for use by learners with a basic level of English skills.	1	2	3	4	5
20.	The teaching materials help me acquire ESP vocabulary.	1	2	3	4	5
21.	I think this type of teaching materials will help lay a foundation for me to become an engineer with a good command of English.	1	2	3	4	5
22.	The teaching materials are able to enhance my ESP conversational skills.	1	2	3	4	5
23.	The teaching materials are able to enhance my ESP reading skills.	1	2	3	4	5
24.	Using the materials increases my ESP vocabulary.	1	2	3	4	5
25.	The materials enhance my ESP skills.	1	2	3	4	5
26.	The materials will prepare me to read engineering documents.	1	2	3	4	5
27.	After I used the materials, I do not think my ESP vocabulary has increased.	1	2	3	4	5
28.	The varied formats of the exercises are able to help me improve my English in the field of engineering.	1	2	3	4	5
29.	The exercises are helpful in preparing me to converse in English in my future	1	2	3	4	5

engineering career.

30.	My capability in ESP reading is enhanced by the use of the teaching materials.	1	2	3	4	5
31.	The teaching materials are able to enhance my ESP vocabulary.	1	2	3	4	5
32.	Practicing the exercises in the materials improves my ESP speaking skills.	1	2	3	4	5
33.	On the whole, the teaching materials are able to help me improve my ESP skills.	1	2	3	4	5

工程英語橋接課程教材效度評鑑：由學生觀點切入

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本研究從學生觀點切入，針對一份專為初階英語能力工程類學生設計的專業英語橋接課程教材，進行效度評鑑。其中包含檢視本教材對於目標學習者學習一般英語、專業英語，以及在單字、文法、閱讀和口說能力發展，是否有所助益。同時，本文亦探討不同語言能力學生之觀點，以及此專業英語橋接教材難易度之適切性。研究對象包含英文程度為 CEF 歐洲語言參考指標 A2(基礎級)與 A1(入門級)之工程類大學生，共計 562 位。研究中以此教材對學生進行六週試驗性教學，並於課程結束後進行問卷施測、個人訪談和焦點團體訪談。蒐集所得之量化資料以成對樣本 T 檢定、獨立樣本 T 檢定、變異數分析及皮爾森相關係數進行分析；所獲質化資料則採用持續比較分析法進行資料分析。

研究結果顯示，參加試驗教學的學生普遍認為此專業英語橋接教材有助其英語能力之發展，尤其是語言能力 A1 程度的學生。從一般英語和專業英語的微技巧方面檢視，學生對此橋接課程教材也抱持正向觀點。而自我效能(難易度之適切性)和任務價值(與學生職涯目標之關聯性)為學生對此教材抱持正向態度之主要因素。

關鍵字：工程英語橋接課程教材、專業英語、教材評鑑、效度評鑑、自我效能、任務價值