

English as Second Language Curriculum from the Perspective of STEM in Chinese Engineering Undergraduates*

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This study investigated language learning beliefs in Chinese engineering undergraduates and find out the relationship between language learning beliefs and current teaching materials and curriculum, aiming to enhance engineering undergraduates' learning effectiveness and teachers' teaching strategies. In addition, suggestions and recommendations from the perspective of STEM for English as second language curriculum and teaching strategies are provided. A total number of 560 engineering undergraduates' language learning beliefs are investigated with Horwitz' Beliefs about Language Learning Inventory (BALLI) from 8 universities in China. A mixed-method methodology was developed, one that uses both quantitative and qualitative tools. More specifically, multivariate regression analysis was applied to analysis database. The findings in our survey revealed that, firstly, the overall situation of Chinese engineering undergraduates is not so satisfactory. And the prior knowledge of them is in the medium level. Furthermore, factors that affect students' learning beliefs were apparent, such as foreign language aptitude, difficulty of language learning, nature of language learning, learning and communication strategies, motivation and expectations. We concluded by exploring the language learning beliefs in Chinese engineering undergraduates and the appropriate way in curriculum design from the perspective of STEM education, interdisciplinary curriculum design were encouraged applied in English as second language in engineering education.

Keywords: engineering undergraduates; English learning beliefs; learning Strategies; English curriculum; STEM education

1. Introduction

STEM education aims to find an appropriate way to cultivate engineering students, and international engineering talents is essential to the development of the area on engineering. Richard Leakey argued in his book *the origin of humankind* that language is the shell of thought [1]. Cultivation in engineering undergraduates' ability of English as second language is also priority in STEM class. Interdisciplinary integration is the core feature of STEM education from the perspective of language, which means learners need to learn knowledge of multiple subjects and integrate them organically in the process of learning [2]. The content of each discipline plays a different role, thus to form a whole project. The ability to connect multiple disciplines is the core concept and problem of interdisciplinary [3, 4]. Therefore, learners are actually learning in the exploration activity which is mainly about understanding the concepts of the subject and solving the core problems. In other words, the English curriculum design is quite important for engineering students. But few researchers care about engineering students' English curriculum. In order to fill the

research gap, the present study aims to explore English as second language curriculum design for engineering students. Studying on students' language learning beliefs can make researchers and teachers know about the situation of students' inner thinking of English learning [5]. Therefore, research on the students' English learning beliefs benefit teachers by understanding students from an internal perspective and helping students building the appropriate learning beliefs, meanwhile, teachers may have a teaching reflection on their own and contribute to the development of English teaching, also, it will do great contribution to the design of English curriculum design in a more scientific way.

1.1 General Situation of the English as Second Language Learning Beliefs in Chinese Engineering Undergraduates

English as second language curriculum were designed specially different from general college English in China, however, the overall situation language learning beliefs of Chinese engineering undergraduates is far more satisfactory. College English Test Band 4 and College English Test Band 6 are authoritative measure tool to exam college students' English as second language level in China [6]. From the exploration result we know

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that only 20% students passed College English Test Band 4 and 6.79% students passed College English Test Band 6 in the sample group. Exploring the learning beliefs of the students from internal view is significant for teachers to understand students' learning strategies and plan some appropriate activities in class [7]. Many scholars have mentioned that learner's language learning beliefs which have formed before may have an impact on their learning strategies and the way of ESL learning. As a result, conducting the research on English learning beliefs may help teachers to have a better understanding of the students from an internal angle. At the same time, teachers can reflect their teaching behaviors and contribute to English teaching.

1.1.1 Definitions of Language Learning Beliefs

It is generally agreed that individual language learners hold different beliefs about how language is learned. Individual beliefs about language learning may consciously or unconsciously influence learners' approaches in language learning. As Horwitz [5] claimed, it is important to understand learner beliefs in order to know learner approaches on language learning and to plan language teaching instruction in a better way.

Horwitz [7] defined learning beliefs as language learners' preconceived ideas or notions on a variety of issues related to second or foreign language learning. Beliefs about language learning consist of "general assumptions that learners regard themselves as learners, the factors influence language learning and the nature of language teaching". These beliefs are varied by the degrees of validity and numerous origins, and differ radically from current opinions of second language scholars.

Horwitz is regarded as one of the most influential scholars in this aspect in the present study, thus, we employed Horwitz's understandings of language learning beliefs. Therefore, we made a conclusion about language learning beliefs' definition as follows, language learning beliefs are learner' all the beliefs and standpoints of all aspects in language learning which include five main beliefs, namely, foreign language aptitude, difficulty of language, nature of language learning, learning and communication strategies, learning motivations and expectations.

1.2 Interdisciplinary Education in English Teaching in Chinese Engineering Undergraduates from the Perspective of STEM

Science technology, engineering, and mathematics knowledge between the four courses in a common cross correlation, this for STEM provides necessary conditions for the formation of the current integration course [8]. There are many different under-

standing of different STEM curriculum connotation. Sanders (2009), defines STEM integrated curriculum as exploring STEM between two or more subject areas, or any STEM and its his school disciplines of teaching and learning method. Based on the connection between subjects and real world problems, some subjects or all subjects in STEM are included in a certain classroom, a certain unit or a certain class. In this definition, Moore attaches special importance to the integration of STEM contexts by teachers to teach a certain or multiple subjects in STEM. Honey et al. (2014) summarized the integrated STEM curriculum as "In complex phenomena or situations, students use knowledge and skills in STEM subjects to complete specific learning tasks" [9, 10]. The human-defined integrated STEM curriculum has certain similarities, especially Don't emphasize the importance of course context for course integration. Kelley and Knowles (2016), also rounded up STEM, the combined curriculum is understood as "combining STEM practice in real situations, building to establish inter-disciplinary links for the purpose of promoting student learning, two are taught or more approaches to STEM content" [11]. Above STEM integration, the definition of the course, although expressed in different ways, emphasizes the relevance in the real situation, break the boundaries of the four STEM subjects, and bring each of them discipline establishes knowledge connection to achieve the effect of interdisciplinary integration. In addition, the integrated STEM curriculum does not simply combine four subjects. Moreover, it is not "one size fits all" to set all four subjects. To a certain class, but need to find a specific topic to learn. The correlation points between the subjects to realize the interdisciplinary integration of STEM [12, 13]. In a word, Defining STEM integration curriculum is not a difficult task, but implementing STEM integrating curricula is the real challenge in STEM education. And how to apply STEM integration in language teaching is worth studying.

2. Methodology

This chapter gives a detailed introduction of how the study is conducted about Chinese engineering undergraduates' language learning beliefs. It consists of the following aspects: Research questions, research subjects, instruments used in the survey, procedures for data-collection and analysis of the data.

2.1 Research Questions

The present research is intended for exploring the general situation of Chinese engineering students' English learning beliefs. It enriches cultivation of

engineering students and the training of international engineering talents, and finds out potential problems exist in Chinese engineering students' English learning beliefs. Then our study can not only help engineering students to learn English more effectively but also do benefit for teachers and researchers have good suggestions for curriculum design in engineering English class. Our research questions are listed as follows.

- (1) What's the overall situation of Chinese engineering students' English learning beliefs?
- (2) What's the crucial element that affects students' English language learning beliefs? And how they affect students' language learning beliefs?
- (3) How to adjust the English curriculum for the Chinese engineering undergraduates?

2.2 Participants of the Research

A total of 560 Chinese engineering students are invited to take part in the present research and 10 of them are randomly chosen as interviewees for the interview. Participants come from 8 universities in China which includes Southwest University, Chongqing University, Guangxi University, and Guangxi University for Nationalities, Guangxi University of Finance and Economics, Chongqing Normal University, Yunnan Normal University, Chongqing Technology and Business University and Sichuan University of Arts and Science. Among them, 287 (51.07%) students are male and 275 (48.93%) students are female.

2.3 Instruments of Research

There are two instruments in our study which are questionnaire and interview. These two instruments will be described in the following content, respectively.

2.3.1 Questionnaire

Questionnaire is designed according to BALLI (ESL/EFL version) and modification is made based on participants' feedback [14]. And the redundant or misleading questions are removed. We translated the English version into Chinese version in order to avoid measurement error and for the participants' convenience. The questionnaires are consisted of 38 items based on the BALLI assess learners' beliefs in six areas: (1) Foreign language aptitude (7 items), (2) The difficulty of language learning (5 items), (3) The nature of language learning (7 items), (4) Learning and communication strategies (8 items), (5) Motivation and expectations (6 items) and (6) Influence of English teacher and teaching materials (6 items). All these six sections use a five-point Likert scale

with 1 refers to strongly disagree and 5 stands for strongly agree.

Pre-test was carried out in order to make sure the reliability and validity of questionnaire. Data in the pre-test were analyzed by SPSS, and Cronbach's alpha reliability of the translated version of the BALLI is 0.90. In another word, the present questionnaire is reliable and acceptable.

2.3.2 Interview

Our study employed semi-structure interview for collecting qualitative data. And 10 participants are chosen randomly as interviewee for finding more information and having a deeper investigation about their English learning beliefs. The questions are written in Chinese for convenience of communication. Six questions are contained in the interview.

2.4 Procedure of Data Collection

The pre-test investigation was carried out and there were 50 participants were participated in the survey but the total number of the valid questionnaire sheets is 41. And collected data were analyzed by SPSS, and we found out that Cronbach's alpha reliability is 0.90. After modifying some items which characterizes low Cronbach's alpha reliability, then we delivered the questionnaires to the engineering undergraduates formally. A total of 560 questionnaires were collected and the number of valid questionnaires is 485. Then data was analyzed by SPSS statistics software.

As for the interview, interview about English learning beliefs was performed after collecting data of questionnaires. Then 10 students were chosen as interviewee randomly, including males and females. We carried out the interview based on the semi-structure interview handout, which contains 6 questions. Interviewees are willing to communicate with researchers, and the interview is quite smooth and successful. Then we cleared out the notebook concerning the content in the interview later on. All the information in the interview was recorded objectively and systematically.

The data collection in the questionnaire and interview will be discussed and analyzed systematically in next chapter.

3. Results

3.1 Structural Validity Analysis of the Measurement

Factor analysis model was applied for the validity analysis. The adaptability analysis of the factor model was carried out for the questionnaire data before the factor model analysis were applied. The analysis results are shown in Table 1.

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.903
Bartlett's Test of Approx. Chi-Square		8358.505
Sphericity	df	861
	Sig.	0.000

It can be seen from the data in the Table 1 that the KMO value of the questionnaire data is 0.903, and the value is greater than the bartley globe test with a significance level of 0.05, indicating that the questionnaire data are very suitable for applying the analysis of factor analysis.

3.2 Data Analysis

3.2.1 Preprocess of the Collected Data

Missing value, duplicates, etc. were deal with data preprocessing, the option which is incomplete or regularity were being processed before data were analyzed, then missing value in this study is 0. Identifying outliers and outlying cases in collecting data were analyzed, outlying cases were eliminated, and then normality, linearity and homoscedasticity were checked. The skewness and kurtosis values is close to 0 in the sample, which indicates that this is a sample of normally distributed data. Then from the data analysis result we can find that the mode is always less than the mean and median, which means that it's positively skewed distribution. And the Detrended Normal Q-Q plot shows the differences between the observed and expected values of a normal distribution. The points were in a cluster in a horizontal band around zero with no pattern, in

another word, the distribution is normal. Thus we can conduct our following analysis.

3.2.2 The Overall Situation of Sample's Language Learning Beliefs

A one sample T test was conducted to evaluate whether the mean of the English learning belief scores for engineering students was significantly different from 140, the accepted mean for college students in general. The sample mean of 126.47 (SD = 16.43) was significantly different from 140, $t(484) = 102.53$, $p = 0.00$. The 95% confidence interval for the English learning beliefs mean ranged from 55 to 57.94.

Fig. 1 shows the distribution of English learning beliefs index. Most of the samples' language learning beliefs ranged between scores of 111 to 129. The results support the conclusion that the English learning beliefs index for engineering students are not satisfactory.

First of all, all aspects of students' English learning beliefs are at an intermediate level. According to the questionnaire data, the average score is only 3.36. Therefore, the current situation of students' beliefs in English learning is not satisfactory. In terms of foreign language ability and motivation as well as expectation, their average score was only 3.2. Thus it can be seen that students have opinion that they have no talent in English learning and lack of motivation and expectation in learning foreign languages.

3.2.3 Prior Knowledge of Samples

The total number of sample is 560 Chinese engineering undergraduates. College English Test Band

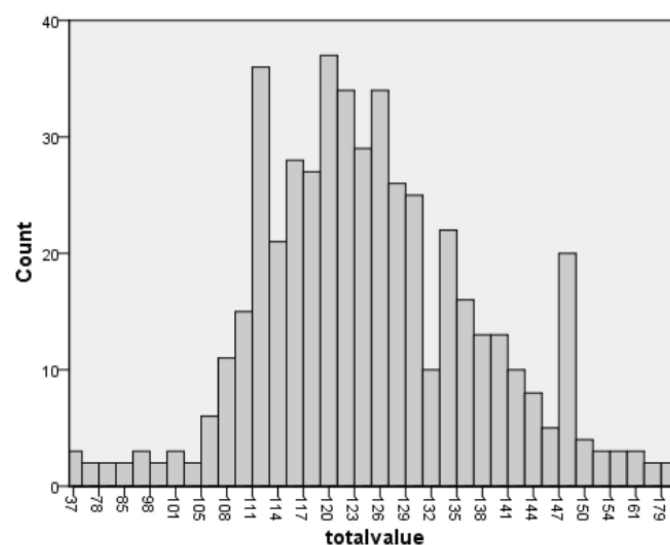


Fig. 1. Distribution of the English learning belief scores.
Count: number of samples.
Total value: scores of language learning beliefs.

Table 2. Statistics of college students passing CET-4 and CET-6

Option	CET4	CET6
yes	112	38
no	448	522
Fill in the total number of	560	560

4 and College English Test Band 6 are authoritative measure tool to exam students' English as second language level. From the Table 2 we know that only 20% students passed College English Test Band 4 and 6.79% students passed College English Test Band 6, which means Chinese engineering undergraduates' language prior knowledge was in low level.

3.2.4 Factors that affect Chinese Engineering Undergraduates' Language Learning Beliefs

This study aims to find engineering students' teachers and teaching materials for learning English as criterion variables, the influence of cognitive, language learning strategies in foreign language learning and communication strategies, and foreign language learning motivation and expectation as a predictor variable for stepwise multiple regression analysis, from the macro level to build the engineering students teachers and teaching material regression equation of the impact in English learning.

In the study, the null hypothesis is that learners' foreign language ability, difficulty of foreign language learning, nature of foreign language learning, motivation and expectation of foreign language learning, foreign language learning strategies and communication strategies have no prior relationship with the influence of textbooks and teachers on foreign language learning.

According to the result analysis in Fig. 1, $F(5, 479)$ is significant ($p < 0.001$), indicating that the linear model is significant, it can reject null hypothesis that all Bs equal to zero. About 62% of the variance of the in FLi index is associated with foreign language learning ability (FLa), difficulty of learning foreign language (FLd), the essence of foreign language learning (FLe), foreign language

learning strategy and communication strategy (FLsc), foreign language learning motivation and expectation (FLme).

The results of multiple regression analysis are shown in the Table 3.

From Table 3 we can learn that, teacher and the teaching material of foreign language learning (the FLi agreed) is the criterion variable, the influence of foreign language ability, the difficulty of learning foreign language, the essence of foreign language learning, foreign language learning strategy and communication strategy, foreign language learning motivation and expectation are the predictor variable for stepwise multiple regression analysis, all variables prediction for teachers and textbooks regression coefficient significantly impact on foreign language learning. Standardized regression coefficients (betas) were 0.09, 0.13, 0.29, 0.3 and 0.13 respectively, indicating the positive predictive effect of learners' foreign language ability, difficulty, nature of foreign language learning, motivation and expectation, learning strategies and communication strategies on teachers and textbooks. Based on this, the standardized regression equation is constructed as follows: the influence of teachers and textbooks on foreign language learning = $0.09z$ (foreign language ability) + $0.13z$ (difficulty of foreign language learning) + $0.29z$ (nature of foreign language learning) + $0.3z$ (foreign language learning strategy and communication strategy) + $0.13z$ (motivation and expectation of foreign language learning). The standardized regression equation is as follows: the influence of teachers and textbooks on foreign language learning = 0.08 (foreign language ability) + 0.16 (difficulty of foreign language learning) + 0.27 (nature of foreign language learning) + 0.24 (foreign language learning strategy and communication strategy) + 0.13 (motivation and expectation of foreign language learning) + 1.59 .

It can be seen from the regression equation of the learners to understand the nature of foreign language teachers and the teaching material have crucial impact on foreign language learning. Followed by the foreign language learning strategy and communication strategy. It's encouraged by the

Table 3. The influence of teachers and textbooks on learning beliefs

The dependent variable	The independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
FLi	(Constant)	1.589	0.720		2.207	0.028
	FLa	0.084	0.039	0.089	2.146	0.032
	FLd	0.160	0.046	0.127	3.472	0.001
	FLn	0.269	0.041	0.287	6.559	0.000
	FLsc	0.244	0.040	0.295	6.025	0.000
	FLme	0.126	0.043	0.127	2.910	0.004

research result that engineering undergraduates' understanding of the nature of foreign language learning are guided by teachers in an appropriate way.

Students' learning strategies, difficulty of learning foreign language and foreign language learning motivation and expectation should be taken into consideration in the curriculum.

When teaching materials' impact on foreign language learning (the FLi agreed - 1) is the criterion variable, foreign language ability, the difficulty of learning foreign language, the essence of foreign language learning, foreign language learning strategy and communication strategy, foreign language learning motivation and expectation are the predictor variable for stepwise multiple regression analysis, all prediction variables of teachers and teaching materials regression coefficient significantly impact on foreign language learning. Standardized regression coefficients (Beta) were 0.12, 0.1, 0.28, 0.27, 0.12, according to learners' foreign language ability, the difficulty of learning foreign language, the essence of foreign language learning, foreign language learning strategies and communicative strategies, foreign language learning motivation and expectation effect on foreign language learning to the teaching material for positive prediction effect.

Based on this, the standardization of building regression equation is shown in Table 4: teaching materials' influence on foreign language learning = $0.12Z$ (foreign language ability) + $0.1Z$ (foreign language learning difficulty) + $0.28Z$ (nature of foreign language learning) + $0.27Z$ (foreign language learning strategy and communication strategy) + $0.12Z$ (foreign language learning motivation

and expectation). And not standardized regression equation is: teaching material impact on foreign language learning = 0.08 (foreign language skills) + 0.08 (foreign language learning difficulty) + 0.18 (nature of foreign language learning) + 0.15 (foreign language learning strategy and communication strategy) + 0.09 (foreign language learning motivation and expectation) + 0.77 .

As can be seen from the above regression equation, from the perspective of the influence of textbooks on foreign language learning, foreign language learning strategies and communicative strategies are of vital importance, followed by the nature of foreign language learning. For engineering students, in the compilation of English textbooks, foreign language learning strategies should be taken into consideration. Besides, learner analysis is necessary in the curriculum design, as well as the mastery of basic knowledge.

When teacher's teaching strategies' influence on foreign language learning (FLi2) is the criterion variable (see Table 5), foreign language ability, the difficulty of learning foreign language, the essence of foreign language learning, foreign language learning strategy and communication strategy, foreign language learning motivation and expectation as a predictor variable for stepwise multiple regression analysis, only the difficulty of learning foreign language, the essence of foreign language learning, foreign language learning strategy and communication strategy prediction variables on teachers and teaching material regression coefficient significantly impact on foreign language learning. The second multivariate regression was conducted based on the difficulty of foreign language learning, the nature of foreign language

Table 4. The influence of teaching strategies and teaching materials on learning beliefs

The dependent variable	The independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
FLi1	(Constant)	0.774	0.527		1.469	0.143
	Fla	0.075	0.028	0.116	2.635	0.009
	FLd	0.084	0.034	0.096	2.487	0.013
	FLn	0.182	0.030	0.281	6.056	0.000
	FLsc	0.154	0.030	0.270	5.196	0.000
	Flme	0.085	0.032	0.124	2.683	0.008

Table 5. A regression of the influence of textbooks on learning beliefs

The dependent variable	The independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
FLi2	(Constant)	0.815	0.384		2.121	0.034
	Fla	0.008	0.021	0.116	0.408	0.684
	FLd	0.076	0.025	0.096	3.093	0.002
	FLn	0.087	0.022	0.281	3.984	0.000
	FLsc	0.090	0.022	0.270	4.162	0.000
	Flme	0.041	0.023	0.124	1.773	0.077

Table 6. The second regression of the influence of textbooks on learning beliefs

The dependent variable	The independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
FLi2-1	(Constant)	0.840	0.385		2.182	0.30
	FLd	0.093	0.023	0.175	4.068	0.00
	FLn	0.096	0.021	0.242	4.513	0.00
	FLsc	0.106	0.020	0.304	5.394	0.000

learning, foreign language learning strategies and communication strategies. The analysis results are shown in Table 6.

The standardized regression coefficient (Beta) is 0.18, 0.24 and 0.3 respectively, indicating that the influence of foreign language learning difficulty, nature of foreign language learning, foreign language learning strategies and communication strategies on foreign language learning is a positive predictive effect. According to this, the standardization of building regression equation as follows: the teachers' influence on foreign language learning = $0.18Z$ (foreign language learning difficulty) + $0.24Z$ (nature of foreign language learning) + $0.3Z$ (foreign language learning strategy and communication strategy). And not standardized regression equation is: the teaching material impact on foreign language learning = 0.09 (foreign language learning difficulty) + 0.1 (nature of foreign language learning) + 0.1 (foreign language learning strategy and communication strategy) + 0.84 .

It can be seen from the regression equation that learners' understanding of foreign language essence and the use of foreign language learning strategies and communication strategies have the greatest influence on teachers' foreign language learning, followed by the difficulty of foreign language learning. In the foreign language class for engineering students, learners' understanding of foreign language essence and use of teaching strategies are priority, creating authentic situations by using foreign culture to strengthen learners' understanding of foreign language essence, and adjust teaching strategies reasonably according to specific situations is necessary.

4. Discussion

4.1 The Overall Learning Belief Level Of Engineering Students

By summarizing the above standardized regression equation, we have the following findings.

On the whole, there was a significant correlation between the level of 0.01 and 0.05 in foreign language learning ability, difficulty, nature of foreign language learning, foreign language learning strategy and communication strategy, and foreign language learning motivation and expectation. The

influence of textbooks on foreign language learning shows significant predictive effects on foreign language learning ability, foreign language learning difficulty, foreign language learning nature, foreign language learning strategies and communication strategies, and foreign language learning motivation and expectation. Then teachers' influence on foreign language learning shows that there are no significant predictive effects on foreign language learning ability, motivation and expectation, while there are significant predictive effects on foreign language learning difficulty, nature of foreign language learning, foreign language learning strategies and communication strategies. The overall situation of Chinese engineering undergraduates' language learning beliefs is not satisfactory.

4.2 What's the Crucial Element that affects Students' English language Learning Beliefs? And how they affect Students' Language Learning Beliefs?

4.2.1 From the Perspective of the Foreign Language Ability

From the perspective of the foreign language ability to analysis teaching material' impact on foreign language learning, after analysis we draw conclusion that engineering students' foreign language ability, the prior knowledge of the individual learning of the all-round development of language learners' language ability plays a vital role. Those who are good at language learners are able to actively learn, because they have deep understanding of the process of language learning, thus they have a spontaneous attitude, this attitude can make learners to control their own learning. As far as foreign language ability is concerned, many students think that some people are born with a special ability to learn a foreign language, but they don't think they have such ability. Thus in English courses for engineering students, moderate difficulty are the priority to take into the curriculum design.

4.2.2 From the Perspective of the Foreign Language Learning Difficulty

Foreign language learning difficulty has a significant predictive effect on the influence of textbooks

on foreign language learning and teachers on foreign language learning. We found that in the group of samples, most students hold a neutral attitude towards these items in the category of language learning difficulty, believing that English is a medium difficulty language. The biggest influence on foreign language learning is the difficulty of foreign language learning. Many students believe that they will eventually speak English well. They think that speaking and understanding are more difficult than reading and writing. There are still a large part of the learners have confidence in learning English well based on the design of the teaching materials should be step by step. Clear objectives should be laid in the English curriculum, sometimes language is used as a tool in the engineering class for communicating.

4.2.3 From the Perspective of the Nature of Foreign Language Learning

Nature of foreign language learning to the teaching material and to the influence of foreign language learning, teachers' influence on foreign language learning is presented significant forecasting effect. From the perspective of the understanding the nature of foreign language learning, teaching material impact on foreign language learning, through the analysis we found that the higher the degree of learners' understanding of the nature of foreign language learning, the better language learning belief is. Namely, learners pay more attention to the culture of English countries. They think that it's important to learn vocabulary and it's better to learn English in English-speaking countries. Practical and interesting English teaching materials can stimulate learners' interest in learning English, it will demand teachers may have a high level of teaching strategies, and the ability to active learning atmosphere, thus to provide effective learning guidance. It is concluded that the design of English teaching materials should be practical and interesting. Moreover, materials and topics about engineering are suggested used in the curriculum design so that to arouse engineering students' interest. The case of STEM education, PBL orientated curriculum design is encouraged in engineering students' English class [15].

4.2.4 From the Perspective of the Foreign Language Learning Strategies

Foreign language learning strategies to the teaching material and the influence of foreign language learning and teachers' influence on foreign language learning are presented significant forecasting effect. From the viewpoint of foreign language learning strategy and communication strategy, the analysis of the effect of teaching material of

foreign language learning and teachers' influence on foreign language learning, we believe that the appropriate foreign language learning strategies could stimulate learners' memory of knowledge and understanding. Most engineering learners think that standard pronunciation is important in learning English, they won't speak English unless they think they express correctly and they don't think speak English is easy. Besides, they think that listening to English tape or watching English movies are very important to learn English. In the process of English teaching, English teachers only pay attention to impart knowledge, such as reading skills, vocabulary, grammar, etc. To a large extent, students' communicative strategies and oral English training are ignored, and English teachers pay little attention to language output. This requires us to pay attention to learners' pronunciation in the design of the textbook, teachers pay attention to learners' pronunciation in teaching. Creating situations in class, so that learners have chance to speak English, learners' strategy determines their learning methods, thus affecting the final learning effect. STEM education can do a lot in creating situation in class, English content may involve varied subjects, and form a proper curriculum design, and students' learning strategies can be trained [16].

4.2.5 From the Perspective of the Foreign Language Learning Motivation and Expectation

Foreign language learning motivation and expectation to teaching material's influence on foreign language learning is significant forecasting effect. But teacher to foreign language learning has no significant prediction effects. From the angle of foreign language learning motivation and expectation teaching material impact on foreign language learning, the higher of learners' foreign language learning motivation is, the stronger the thirst for knowledge. Learners are easy have a sense of accomplishment if they characterized the ability of autonomous learning. The design of the teaching material should meet the demand of learning [17]; most of them learn a foreign language is mainly in order to find a good job, thus the content of the textbook to meet the needs of learners' inner need. Most engineering students' language learning need belongs to extrinsic motivation, how to stimulate the extrinsic motivation into intrinsic motivation remains a challenge. Under the circumstances of STEM class, engineering students' task is to solve problem in teamwork, in the process of solving problem, talk to others is essential because it's the only way to communicate thoughts with others [18, 19]. The desire to express themselves, the intrinsic motivation they may have.

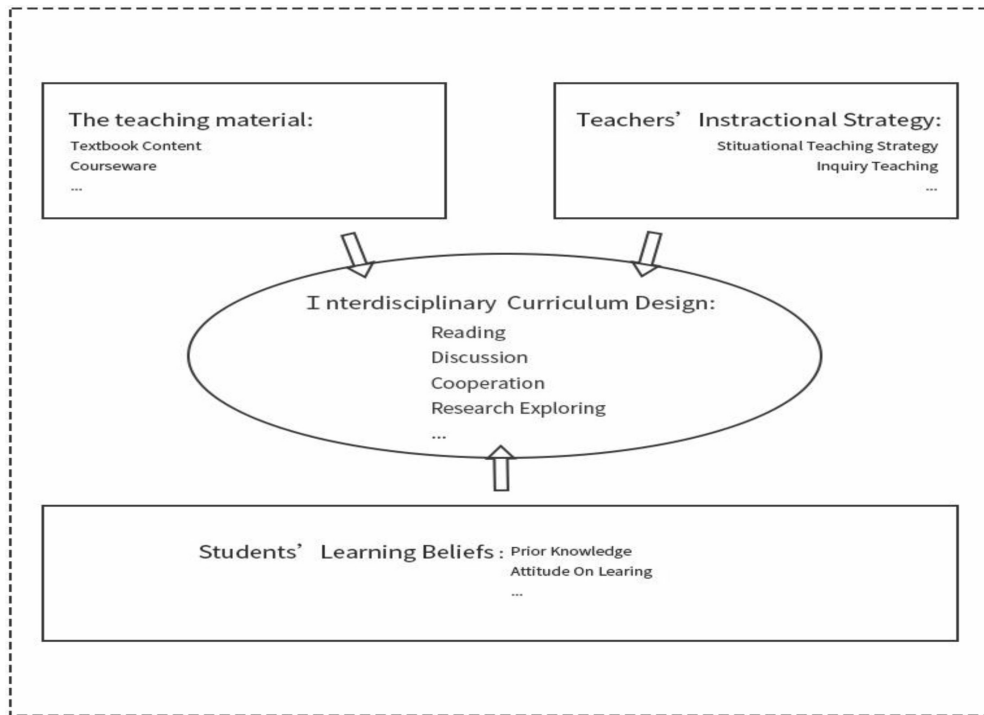


Fig. 2. English Curriculum Design Model for Engineering Students.

4.2.6 Suggestions for English as Second Language in Engineering Class from the Perspective of STEM

English curriculum design model for engineering students are provided as shown in Fig. 2. It is suggested that strive to improve the flexibility of our teaching plans and curriculum design, to accommodate both the external and internal motivations of students and to meet the needs of different engineering students. Only in this way can more students be attracted. It is of great significance to help students to correctly understand their own language learning beliefs and adjust appropriate learning strategies.

We may also need to examine the task and difficulty of the course from a new perspective. There is still space for improvement in the coherence of content and the degree of difficulty among subjects [20]. In addition, how to solve the problem of insufficient practice and further improve teachers' teaching efficiency is also worth our in-depth exploration, all of which may affect students' interest in learning, thus affecting the maintenance of learning motivation. As a curriculum planner, students' feedback on the curriculum should be taken into account, and textbooks should be improved gradually with the improvement of students' abilities. If subject knowledge, critical thinking and language skills are to be taught in intensive reading classes, a consistent set of teaching practices and assessment criteria needs to be followed

[21]. Studies have claimed that STEM activities that combine formal and informal learning can considerably improve students' learning interest and engagement [22]. STEM education can generate different teaching approaches, take PBL method for example, students work in a group not only contains the spirit of collaboration and critical, what's more, the chance to communicate in a second language with partners is improved [12].

Teachers' flexible implementation in class can guide students' language learning. In intensive reading class, language teaching should emphasize the combination of autonomous learning and cooperative learning [23]. Obviously, students are encouraged to have the ability to teach themselves. Although there is group discussion and teamwork in students' learning experience, the practical action of collaborative learning is not well implemented, which is actually an obstacle to learning efficiency. Teachers should give full play to the importance of the combination of autonomous learning and collaborative learning, and further examine the implementation as a supervisor [24]. In a word, it is advisable that teachers should know students' English learning beliefs, and then help students to form positive learning beliefs and make appropriate teaching plans for students. It is beneficial for teachers to improve their sense of teaching effectiveness because teachers' beliefs will affect the learning environment that they create for students and affect students' learning progress.

5. Conclusion

This paper investigated Chinese engineering undergraduates' language learning beliefs then find out a better way to adjust English as second language curriculum. From the perspective of STEM education, interdisciplinary curriculum design can be applied in English as second language in engineering education. We have discussed reasons for, and highlighted the concerns about the approach and suggestions on the English curriculum in engineering students.

A total number of 560 Chinese engineering undergraduates which comes from 8 universities were involved in our research. This research was conducted by an interdisciplinary team with a range of skills and from different disciplinary. What's more, an innovative methodology was developed and applied, combining qualitative and quantitative survey to examine the language learning beliefs in engineering undergraduates. The analysis was

conducted by the Horwitz' Beliefs about Language Learning Inventory (BALLI). The interdisciplinary approach are suggested in the design of the English as second language curriculum in engineering undergraduates [21]. This research has focused on engineering education, we believe that other disciplines may benefit from such an analysis, especially based on the perspective of STEM in education. This study has demonstrated the theoretical relevance of conceptions about engineering students' language learning beliefs and the curriculum from the perspective of STEM. Also, it has provided original empirical findings for the Chinese engineering students' language learning belief which as an important part in the cultivation of engineering students. While this research is not without limitations, our diverse team, from language teaching, educational technology, and the computer science, hoping that our findings and suggestions will benefit the cultivation of engineering students in a comprehensive way.

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