

# The Design of Innovative College English Evaluation System Based on STEM Education Concept

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**Abstract**—The paper begins with the theoretical analysis of STEM education concept, the main framework of STEM evaluation system, and the STEM evaluation patterns with multiple subjects. Based on this advanced education concept and successful teaching practice, the innovative college English macro evaluation framework and micro evaluation scale are designed, taking good advantage of network learning platform with scientific evaluation system and perfectly combining the beneficial assets of traditional and modern evaluation strategies. On-line evaluation pattern stresses the students' preview and prior knowledge reserves through self-study and cooperative learning among students by watching micro lectures and doing subsequent exercises to have general outline and adequate preparations for the new materials; off-line evaluation emphasizes the teachers' observations and face-to-face interaction with quiz, question, and discussion to assist students in mastering precise knowledge and self-constructing the new knowledge database. This innovative college English evaluation system is characteristic of multiple, precise, and integrated evaluation elements, contributing a lot to the enhancement of college English teaching efficiency and learning effects.

**Keywords**—college English teaching, STEM, framework, on-line and off-line, evaluation system and scale

## I. INTRODUCTION

The Chinese College English Curriculum Requirements (2007) proposed that teaching evaluation is a significant part of college English teaching process and an effective means to collect information for teaching decision-making, promoting teaching and learning together. The application of multi-evaluation strategy should be underlined [1]. With the popularity of high-tech application in the educational process, it is a must to establish the College English Evaluation System featured by scientific, systematic, precise, multiple and integrated characteristics in order to

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realize the positive function and goal of evaluation system: to be beneficial to language learning and application. The pioneering research of integration of advanced STEM evaluation system into college English teaching is an initial and innovative attempt at English teaching exploration in China. To advance the introduction of the brand-new education evaluation thinking and modern evaluation elements to China is a shortcut to transform our traditional, singular, conclusive and elementary college English evaluation system to the modern, multidimensional, formative and first-rate one.

There are four parts in this paper to discuss how STEM educational concept and evaluation framework promotes the innovation of the multiple and precise college English evaluation system. The first part introduces the causes to establish multi-evaluation system from the national level. In the second part, the paper analyzes the educational background of STEM development, the main framework of STEM evaluation system, and its evaluation patterns with multiple subjects. Based on the theoretical analysis of STEM education system, the third part, as the main body of the whole paper, illustrates the macro college English evaluation framework and one of the detailed micro evaluation scales with on the basis of the framework with clarified and detailed demonstrations in tables. The fourth part as the conclusion re-emphasizes the distinctive features and advantages of this multiple and precise college English evaluation system with the addition of the huge benefits brought by this system for college English teaching and learning on both sides in the long run.

## II. THEORETICAL ANALYSIS OF STEM EVALUATION SYSTEM

### A. The Education Background of STEM Development

STEM, in full science, technology, engineering, and mathematics, field and curriculum centered on education in the disciplines of science, technology, engineering, and mathematics. The STEM acronym was introduced in 2001 by scientific administrators at the U.S. National Science Foundation (NSF). The organization previously used the acronym SMET when referring to the career fields in those disciplines or a curriculum that integrated knowledge and skills from those fields [2]. Nowadays, US STEM education

has become the core of the developing process of education reform of K-12, aiming at cultivating more inter-disciplinary talents for American sustainable development in order to ensure the long-standing US beneficial position in global competition [3]. The American government is firmly convinced that the national success consists in the technological innovation and development, and the key to cultivate the next generation's creativity is education, and in particular, the STEM education [4]. This term is typically used when addressing education policy and curriculum choices in schools to improve competitiveness in science and technology development. It has implications for workforce development, national security concerns and immigration policy. When the US National Science Foundation used STEM as the proper noun to describe the relevant events, policies, programs and practice for these four subjects, and hence the term of STEM began to be widely employed and disseminated in and out of America. At present, many governments and institutions are bringing STEM education into their curriculum systems in order to enhance the students' driving power of creativity and innovation in scientific technology and information construction. With the booming development of STEM education, the research of STEM evaluation turned to be the focus of the educators and scientists. There are three highlights in American curriculum requirements after issuing NGSS in 2013, which include the emphasis of core concept and interdisciplinary integration; the change from making a point of scientific exploration to scientific and engineering practice; the concept of advanced learning theory and disciplinary coordination [5]. These theoretical directions provide solid foundation for establishing the basic principles of STEM learning evaluation: the evaluation design based on the strict systematic process, the combination of comprehensive formative and conclusive evaluation for students' learning achievements, and the complex evaluation system inclusive of the common monitoring and coordination mechanism inside and outside the classroom [6]. Today, STEM education has been integrated into the education reform in many advanced countries [7].

#### *B. The Main Framework of STEM Evaluation System*

In any STEM classroom, a credible evaluation system must be multidimensional, for the STEM learning goal itself is multidimensional [8]. To successfully evaluate STEM learning process and effects, the instructors need optimize their original evaluation system with better effects & efficiency and less errors simultaneously. Consequently, they propose that the first step should quantify the learning goals, determining different levels of cognition in advance. The way to determine the learning goal is to focus on the learners' leaning performance, and each learning goal must be clarified with one target. The second proposal is to use double tests (pre-class and after-class) to judge learners' prior knowledge and after-learning improvement. There are also two modes of presentation of evaluation scale covering targeting and self-constructing type. The targeting questions have definite answers characteristic of multiple-choice

question, matching question, true or false, and fills-up topic. The self-constructing questions, however, need to define the levels of qualification generally including the evaluation of discourse, paper, short answer, portfolio, mission, and program. There are various relevant elements to evaluate those self-constructing questions with multiple evaluation subjects.

#### *C. The STEM Evaluation Patterns with Multiple Subjects*

The American colleges with adequate STEM teaching practices believe that project-based learning, as an active self-constructing learning pattern compatible with the anticipation of the graduates, is the most popular and important teaching pattern. Accordingly, the STEM evaluation system transformed from the traditional test paper exam to the multiple one with the emphasis of performance evaluation including the portfolio evaluation. There are self-evaluation and peer evaluation according to the evaluation subjects. In the worldwide STEM teaching practice, five new evaluation patterns have been applied, which cover self-evaluation, peer-evaluation, common-evaluation, performance-evaluation and reflection log [9]. In general, the first two evaluation patterns belong to the formative evaluation, while the other two patterns are conclusive evaluation. The common-evaluation refers to the teacher-and-student evaluation judging the learning results with integration. The performance-evaluation means observing whether the students fulfilled the complex and vital learning tasks actively, and making judgment on their performance to solve the practical problems with learned knowledge and skills. The reflection log is written by the students to conclude their learning process and reflection aimed at reflecting on their learning methods and effects. The teaching practices indicate that these five patterns of evaluation are complementary with different characteristics, which can be used together.

#### *D. The Main Elements of STEM Evaluation System*

According to the delicate research into the enormous STEM teaching practice abroad, we can conclude the main elements constituting STEM evaluation system recorded in the following Table I covering such four elements as the pattern, the framework, the advancement, and multiple evaluation scales.

### III. DESIGN OF MULTIPLE AND PRECISE COLLEGE ENGLISH EVALUATION SYSTEM

#### *A. The Current Situation of National College English Tests and Evaluation Practice in China*

As to Chinese College English teaching, it has gone through the developing process of around four decades. It was in 1987 that the Ministry of Education began to formally implement national standardized college English test including Band 4 and Band 6 which continued to be the only nationwide tests for college English up to today. In recent years, the question types and contents of College English Tests have been reformed many times to be compatible with the modern function of language

proficiency and internationalized trend. The evaluation contents and forms are more difficult and diversified. As college English teachers, it's our responsibility to establish an innovative evaluation system getting rid of the disadvantages of traditional system and adding more

modern elements to the obsolete one. The STEM evaluation concept and mature system provide us abundant inspirations and revelations to construct a multiple and precise college English evaluation system relying on network platform, teaching software and on-line micro lectures.

TABLE I. THE MULTIPLE ELEMENTS OF STEM EVALUATION SYSTEM

Evaluation patterns	Evaluation framework	Evaluation advancement	Multi-evaluation	Evaluation scale
Evaluation items: 11 items	Qualify learning goals	Initial stage: elementary & conclusive	Materials relevant to learning effects: files, notebook, reflection, interview, group discussion	Goal-planning Expressive tasks to fulfill (15)
Evaluation subjects: Ts & Ss	Adopt dual tests before and after class	Development stage: formative evaluation system		Collection of learners' designing manuscripts
Evaluation types: formative & conclusive	Design evaluation scales: targeting & self-construction questions	Top stage: free-styled evaluation	The dual tests before and after class; interview test	Evaluation of learners' performance based on four levels of scale
Evaluation modes: tradition & expression				

Based on the survey of the provincial college English teachers through interviews and questionnaires, we conclude that the majority of colleges still adopt traditional college English evaluation system taking conclusive evaluation as decisive evaluation means and teachers as evaluation majority, examining students' retention as major evaluation objective without stressing the development of their higher-level cognition abilities. In the modern era of information and globalization, this lagging evaluation pattern has huge gap with those advanced evaluation systems, which urges our college English teachers to reflect on our prior evaluation deficits to conduct creative and valuable experiments and construct the integrated college English evaluation system including multiple evaluation principles, types, subjects, approaches & questions, tools & media, and so on.

*B. Principles of College English Evaluation Framework Learned from STEM Advanced Education Concept*

- Qualifying and refining teaching goals: the general

learning goal and unit learning goal should be qualified and detailed from five dimensions of language learning to determine the design of distinguished cognition levels including the initial cognition (memory, understanding and application) and the superior cognition (analysis, appraisal and creation).

- Dual tests before and after class: to conduct pre-class test with 10 important vocabulary the students learned before in order to know about the students' levels of stored vocabulary and adjust teaching plan accordingly; to have after-class test with 20 new vocabulary learned from the text in order to master the basic learning effects and design the definite review goal and strategy.
- Design of multiple and precise evaluation scale: to construct a precise college English evaluation scale for each unit with targeting questions (Multiple Choice, Matching Question, True or False, and Fill-up Question) and self-constructing questions (Writing, Short Answers, Portfolio, Practical Tasks and Program Evaluation).

TABLE II. COLLEGE ENGLISH MACRO EVALUATION FRAMEWORK

Evaluation types	Evaluation subjects	Evaluation approaches & questions	Evaluation tools & media
Online evaluation: the students' self-evaluation & inter-evaluation	Network system, conclusive evaluation	The present online learning system with targeting questions	Chaoxing learning platform with multiple & precise evaluation system
		The newly-developed online evaluation system fit for students with targeting questions	ACT Aspire online evaluation system and college-developed evaluation system
	Network system, formative evaluation	To conduct interactive online communication & discussion, and peer evaluation (self-constructing topics)	The application of QQ group, WeChat group, and online conference room
The off-line evaluation: teachers' evaluation, T & Ss cooperative evaluation	Network system, the combination	To complete preview and review after self-study of Micro lecture before and after the class	The application of the national excellent micro class and the local recordings of micro lesson
	The teachers' conclusive evaluation	Pre-class paper quiz of main learned vocabulary (targeting question)	The multimedia software; Chaoxing evaluation system
	The teachers' formative evaluation	In-class questions and observations (the questions are relevant to thesis, structure and vocabulary)	The multimedia software and PPT.
	Cooperative evaluation between T & Ss formative evaluation	The students' notebook and assignments	The teachers' independent evaluations and peer evaluation
	The teachers' formative evaluation	Short answer questions with interview by lottery	The clip of hot issues in politics and news by Apowersoft
	Cooperative evaluation, formative	Design of scenarios, and micro videos according to thesis	The video and clipping equipment
The teacher's conclusive	The student's reflection writing	The application of Internet	

### C. Construction of Macro College English Evaluation Framework

Owing to the popular-applied network and learning platform, it is necessary to construct on-line and off-line college English evaluation system taking advantage of different evaluation features. For on-line evaluation, the evaluation subject mainly refers to the networking system and the evaluation tool is the Chaoxing learning platform (yun.chaoxing.com) and ACT Aspire on-line evaluation system. It involves the formative and conclusive evaluation and their combination.

The assessed abilities include memory, understanding, application and analysis. As to the off-line evaluation, it attaches the importance on the formative evaluation, taking conclusive one as the complement. It covers 6 types of multiple and precise evaluation activities, such as dual paper tests, in-class observation and questions, interview questions, scenarios, group discussions, and reflection writing. Table II presents the detailed information about the evaluation framework.

Equipped with college English macro evaluation framework, we design the micro evaluation scale for each unit of college English I (New Horizon College English

edition). The following Table III is the detailed evaluation contents with 5 online and off-line questions for unit one including pre-class quiz for prepared knowledge for the text, after-class quiz for newly-learned knowledge to examine teaching and learning effects, in-class online cloze test through the understanding of the text by means of filling up the blanks with many new words, after-class online oral tests for examining the students' speaking ability through logging in to the learning platform, and the writing assignments as well. Table IV is another detailed evaluation scale for multiple oral tests with scenario, speaking, good remember, and new vocabulary contest. These four types of oral tests are classified into four classes in accordance with the different levels of difficulty to fulfill them. The first class is scenario with the highest score of 15 if it is perfectly designed and performed, and speaking belongs to the second class with the full score of 10 on account of the prepared dialogues. Good to remember tends to be fulfilled by one student to memorize the definition of some police terms, such as police officer and criminal investigation, so its full score is only 9. The lowest class is a new vocabulary contest in which one student asks his counterpart to answer the meanings of the new words in English or Chinese correctly and promptly.

TABLE III. COLLEGE ENGLISH (UNIT ONE) MICRO EVALUATION SCALE

Evaluation question (percentage)	Evaluation contents
Pre-class quiz of old vocabulary (10%)	Run into; anticipation; downturn; less advanced; essential framework; take the responsibility of doing sth. Criticize; be curious about; encounter; flexibility; communication; unsteadily
After-class quiz of new vocabulary (10%)	Excursion; condense; exceed; deficit; exposure; adequate; competent; adjust; beneficial; asset; be obliged to do sth.; be allergic to; be serious about; distinguish between; thrust sb. upon sth.; from scratch; look upon as; adjust to; be attracted to sth.; make sense to do sth.
In-class test of cloze (10%)	And that was it. The <u>1</u> of Greece and the glory of Roman <u>2</u> were <u>3</u> in a <u>4</u> non-statement. My students' "whoa!" was <u>5</u> only by my head-shaking distress. There are many stories about the <u>6</u> in the proper use of English. Surely students should be able to <u>7</u> between their/there/they're or the <u>8</u> difference between complimentary a complementary. They unfairly bear the <u>9</u> of the <u>10</u> for these knowledge deficit because there is a sense that they should know better.
After-class online oral test (20%)	1. According to the text or in your own opinion, what is the most effective way to learn English? 2. To tell a story about you and English (English class and English teacher, etc.)
After-class on-line writing assignment (30%)	Write an essay "English Grammar, a headache to me" with the structure of "Introduction + Body (Example1+2)+ Conclusion". Write an essay "Learning English through imitation or repetition" with the structure of "Introduction + Body (example 1) + Conclusion".

TABLE IV. COLLEGE ENGLISH MICRO EVALUATION SCALE FOR ORAL TESTS

Oral tests	Scenario (1 <sup>st</sup> class)	Speaking (2 <sup>nd</sup> class)	Good to remember (3 <sup>rd</sup> class)	New vocabulary contest (4 <sup>th</sup> class)
5	Well-designed script (1-5)			
4	Fluent and skilled expression (1-4)	Fluent and skilled expression (1-4)	Correct pronunciation & intonation (1-4)	
3	Correct pronunciation & intonation (1-3)	Correct pronunciation & intonation (1-3)	Fluent and skilled expression (1-3)	Correct pronunciation & spelling (1-3)
2	Length and degree of difficulty of the script (1-2)	Length and degree of difficulty of the dialogues to make (1-2)	Length and difficulty of the text to remember (1-2)	Degree of difficulty of new vocabulary (1-2)
1	Vivid performance (0-1)	Good cooperation (0-1)		Fluency and speed of the response (0-1)

#### IV. CONCLUSION

The multiple and precise college English evaluation system combines the assets of traditional and modern evaluation systems distinguished by simultaneous operation of on-line and off-line evaluation, formative and conclusive evaluation, teachers' and peer evaluation, which attaches great importance to evaluation precision and validity. This multi-dimensioned evaluation can assess the students' language proficiency correctly and thoroughly, arousing their learning aspiration and determination at the same time. A span of teaching practice with the fresh evaluation system proved that the leaning effects of each unit were enhanced remarkably, and the multiple learning evaluation was much more precise, impartial and rational. As long as college English teachers are carrying out teaching exploration and reforms continuously in line with the international teaching trends, they are bound to design the well-founded evaluation system beneficial to English teachers and learners, and above all, to the development of college English teaching in the long run.

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