CHAPTER 4

RESULTS, ANALYSIS, AND DISCUSSION

This chapter aims to answer the thesis objectives as well as presents the results, analysis, and discussion. There are four main sections: firstly initial finding of sample groups, secondly the three stages development of the remedial framework during the academic year 2008 – 2011, thirdly the sample groups' quality, and lastly the experimental reports. To confirm the effectiveness of the hypothesizes, tracking the software engineering students' learning rate year 2008 to 2011 is final stage in this chapter.

4.1 Initial Finding of Sample Groups

The target groups of the thesis were new software engineering university students with the poor English proficiency in the academic year 2008 to 2011. Their English abilities are graded by the university entry requirement (English subject). This section captures the initial findings of students' behavior to English class and the learning environment before the subjects enroll the English remedial course.

Students' behavior to English class emphasizes both the body language and facial expression or their reaction to English study. The initial findings of students' behavior in 2008 – 2011 can be classified in three groups namely the first group talkative with their Thai friends both in and out of class, played mobile game in the class time, less responsibility and easy to get bored; the second group polite, a bit quiet, really concentrate and came to class earlier than the time; the last group loved to try out their English skills though they have the difficulties in their English speech production. In 2010, both Thai and Chinese enrolled in the course. Most of the target group stayed away from Chinese student; however, only one or two Thai students tried to greet Chinese students even though they had the difficulties in words communication, they use body language to help better communication.

Learning environment pointed out the learning atmosphere and class design. Initial findings to the English learning environment class were students looked passive, tension and bored to the traditional classroom during the implementation in 2008. However, shifting the typical environment to the computer laboratory in 2009, construction zone in 2010 and physical learning environment in 2011, students looked more active, relaxed, happy and eager.

The initial findings from both the students' behavior and the learning environment provided some background information of the target groups prior to the three stages development of the remedial framework from 2008 to 2011.

4.2 The Three Stages Development of the Remedial Framework during the Academic Year 2008 - 2011

The aims of the thesis are to remedial the poor English proficiency students and bring them to the international program requirement using the proposed remedial framework (constructionism and error analysis) as well as CEF active English. The poor English proficiency quota and direct admission students were chosen to enroll in English remedial course, not the admission ones as this group came in later the English course.

The remedial framework was developed grounded on constructionism and other cognitive learning ideas as well as refined to suit the Thai learning context and be able to serve the industrial knowledge requirements. The three stages development of the remedial framework is shown in Figure 4.1.

Figure 4.1 The three stages development of the remedial framework from 2008 to 2011

As constructionism is an active philosophy in science education, to apply in language area, the preliminary study in 2008/2009 was undertaken to find out the probability. Later in 2010, the proposed remedial framework was integrated other four cognitive learning ideas to close the learning gaps between prior and new knowledge and was first implemented. In 2011, the framework was refined in the learning environment design and core course content. Prior to the experimental reports, the selection and the quality of the sample group were discussed in the following sections.

4.3 Sample groups' Quality

The target groups in this thesis were software engineering university students who enrolled in the international bachelor degree software engineering program in 2008 to 2011 at College of Arts, Media, and Technology, Chiang Mai University, Thailand. Subjects were classified in two main target groups: experiment and control.

Experimental group captured the new software engineering (SE) university students who enrolled in the English remedial course based on constructionism during summer semester in 2008 to 2011. Meanwhile the control group did not get the English remedial course treatment. As this course opened specifically for the new SE students whose English admission scores did not pass SE international program requirement, the main target went to poor English proficiency students more than the better English proficiency students.

The control group was classified to three subgroups based on the admission types (namely quota, university admission and direct admission). Each group explains the different English proficiency levels. Control-quota represented the English proficiency of students from seven up north provinces. Control-university admission presented the English proficiency of high school students in Thailand. Control-direct admission gave an overview of CAMT university students' English proficiency. The English proficiency levels of all four groups are presented in Figure 4.2.

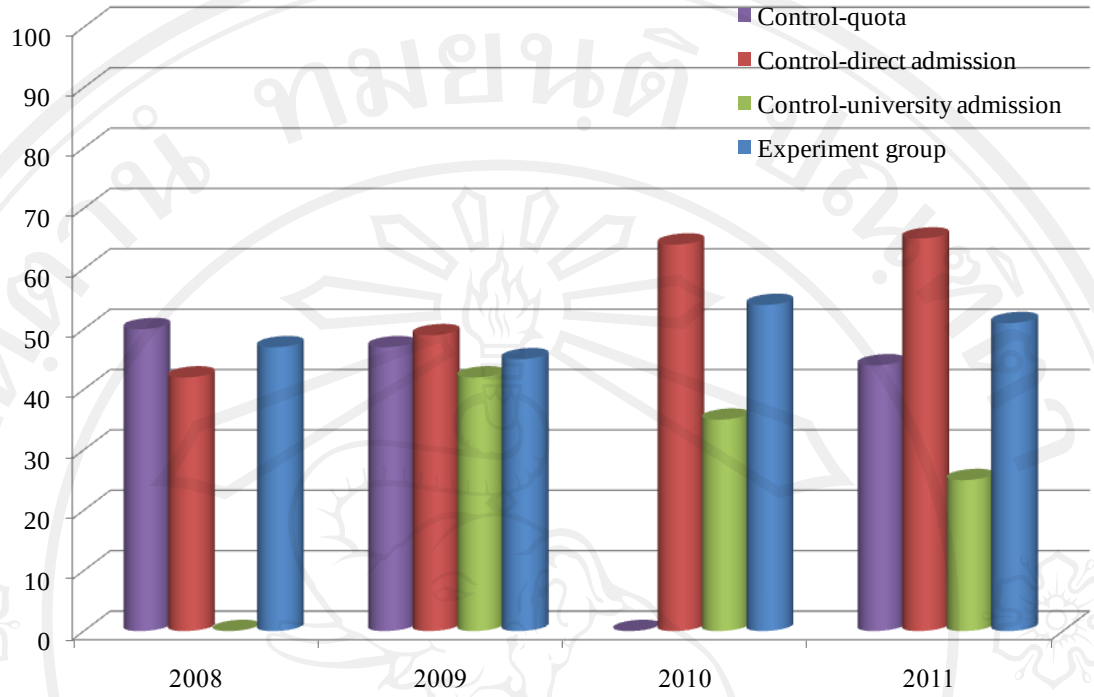

Figure 4.2 The four groups of SE university students to represent the different English quality levels.

From Figure 4.2, direct admission students performed the best of all. The quota students' English proficiency was slightly higher than the experimental group in the two prior years (2008-2010) and later in 2011 the experimental group's English skills were getting better. Of all four groups, university admission students got the lowest English proficiency level throughout year 2009 – 2011 (Figure 4.2).

The overview of students English proficiency level illustrated the English quality level of each sample group prior to the implementation as well as the experimental reports provided the results and key findings throughout the three stages development of the remedial framework (Figure 4.1).

4.4 Experimental reports

This section presents the results to the three stages development of the remedial framework (Figure 4.1) and classifies in four main parts: firstly the analysis of data gathered from the preliminary study during 2008/2009, secondly the results and analysis from the initial implementation during 2010 and, thirdly the results of the refined framework based on a completed survey and implemented in 2011. Finally results track the target group's English learning proficiency from 2008 – 2011 both professional CEF and common English.

4.4.1 The Preliminary Study 2008/2009

The preliminary study aimed to investigate and assess the students' problems with written English ability in order to design the constructionism based remedial framework in a Thai context and raise their English proficiency to the level required of an international university program.

From the outset, this research studied the English proficiency problems of SE students at the College of Arts, Media, and Technology (CAMT). The various problems were captured from direct interviews with SE instructors at CAMT. This knowledge capture of students' problems emphasized written skill is the most serious problem for SE students. As SE is an international program at CAMT, written English skill is a key requirement for writing the final report of the graduation project, and when writing examination answers. However, the identification of problems suggests SE students cannot explain their thoughts in the written English form. This problem creates the difficulties for teachers when grading students' work. The obstacle in writing also influences students' speech production (Chomsky, 1965).

To remediate these language difficulties, the preliminary stage of this research had two main aims: firstly to assess the feasibility and potential of using constructionism in language education, and secondly, to understand and assess the students' written English problems in depth. An in depth understanding of their written problems was necessary to create an effective remedial framework. To accomplish the first aim, data were collected from students via multiple choice tests and a short written paragraph of 150-200 words. Before constructing the main remedial framework, results from this pilot study were integrated into an initial constructionism based framework: an active science education philosophy, to create lesson plans with a total course duration of 45 hours. After the preliminary study in 2008/2009, the pretest and posttest scores were analyzed using a paired t-test to assess statistical significance. The result is shown in Table 4.1 and illustrates that there is no statistically significant difference in students' English proficiency between pretest and posttest during this pilot study.

Table 4.1 The preliminary paired t-test result

	Effectiveness	**N**	**Mean**	**S.D.**	**T value**	**P-value (Sig.)**
2008	Pretest	13	45	13.64	1.3062	.2160
	Posttest	13	47	11.41		
2009	Pretest	29	52	15.97	0.5171	.6017
	Posttest	29	50	26.49		

This result implies that constructionism alone, does not bridge the gap from prior knowledge to new knowledge. In language education, language production needs

five senses to decode the native language and encode to the target language (Baddeley, 1997). Time for practice is one variable which influences the improvement level in English proficiency. In contrast, math and science education emphasizes logical thinking from real and direct experience.

Chomsky (1981) researched on the hierarchy of language supporting that written language involves deep structure processes and this also influences the surface structure, i.e. speech production. The deep structure includes vocabulary, semantics, and lexis which are the central components of language learning. Meanwhile, the surface structure focuses on phrases, sentences and paragraphs from arranging words. Any weaknesses in the root (deep structure) level of language causes errors in the language system production at higher (surface) levels.

As shown in Table 4.1, the direct application of constructionism to language education is futile and this can be inferred from the differences in the students' preliminary 2008/2009 pre and posttest results, which are not statistically significant. Pretest and posttest results provided an overview of students' English proficiency in terms of improvement and failure: however; the pre and posttest results alone do not reveal the English learning difficulties in depth. Another way to analyse weaknesses in students' writing is to assess the root cause of written problems through the text. Students' written paragraphs were therefore analyzed at the lexical, semantic, grammatical, and discourse levels using error analysis to investigate second language strategy. Both the 2008/2009 results are shown in Figure 4.3 and 4.4.

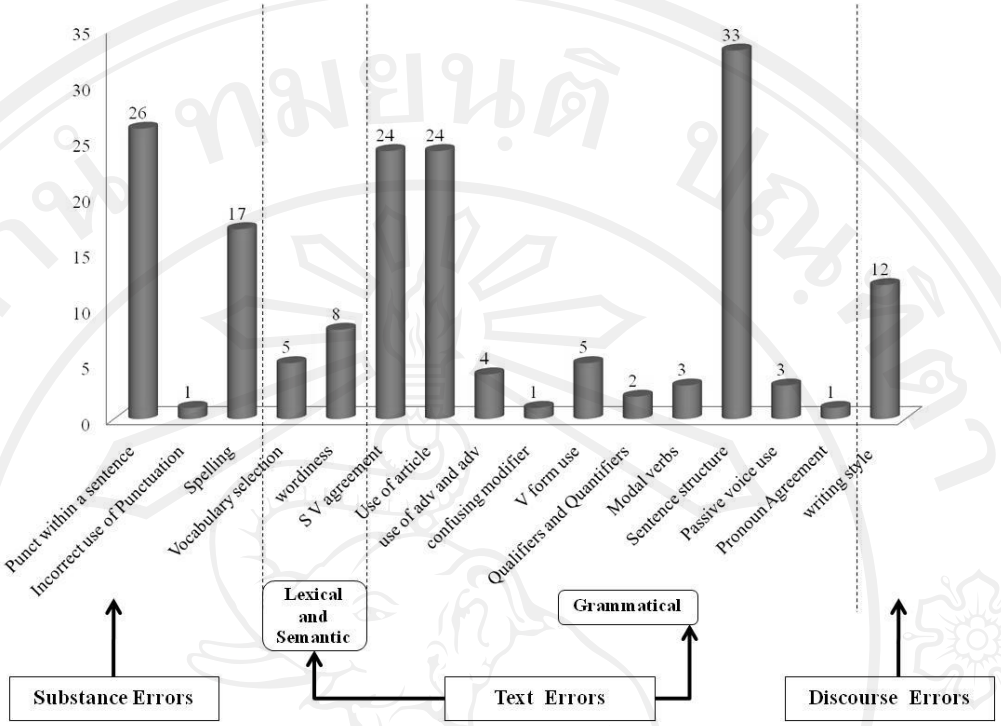

Figure 4.3 Number and type of English errors in SE students' written paragraphs (2008)

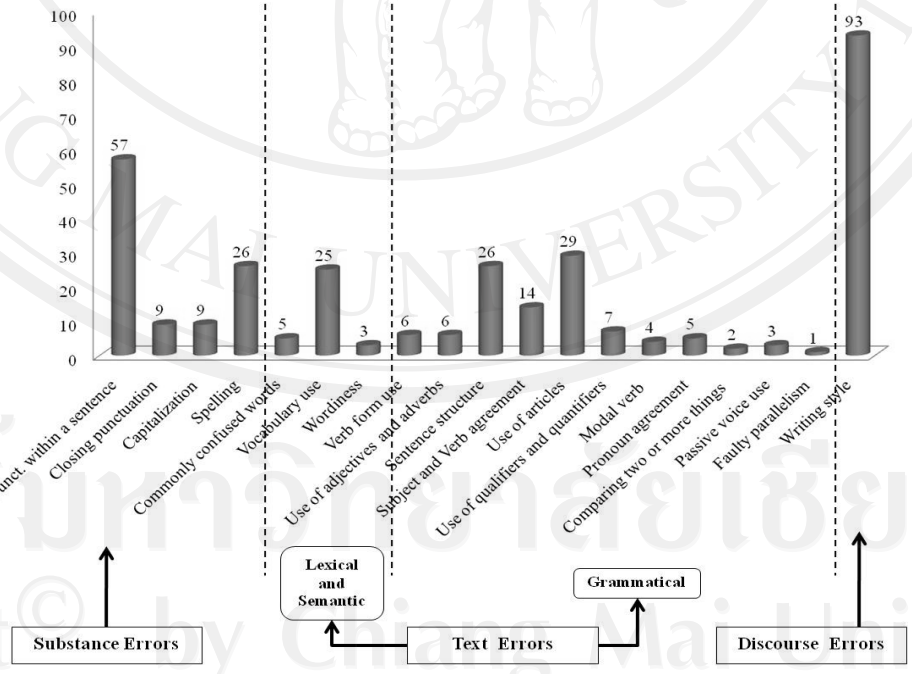

Figure 4.4 Number and type of English errors in SE students' written paragraphs (2009)

In 2008, the most frequent errors were categorized as text level. In particular, sentence structure, followed by punctuation within a sentence, subject and verb agreement, use of article, spelling, and writing style or discourse error. Meanwhile, in the 2009 analysis, the highest errors were categorized as relating to writing style, substance errors: punctuation within a sentence, use of articles, sentence structure, spelling, vocabulary use, subject and verb agreement and others.

The frequency errors are considered as key language learning obstacles which students must overcome to improve written English skill. The numbers of errors in 2008 and 2009 represent the key research problems in developing the remedial framework to the next phase. Although the error types in phase 1 and 2 were varied, the repeated errors are the ones that should be focused on in future phases. This is because the repeated errors signalize students' key difficulties in L2 learning. In this preliminary study, the twelve repeated errors were classified into three levels: substance, text and discourse. The key problems within each of these levels were as follows; (i) substance: punctuation with a sentence, spelling; (ii) text: vocabulary selection, subject and verb agreement, use of article, use of adjective and adverb, qualifiers and quantifiers, modal verb, sentence structure, passive voice use, pronoun agreement, and (iii) discourse: writing style. The most repeated errors can be categorized as intralanguage and a few fall into interlanguage category such as vocabulary selection, and punctuation.

The analysis indicates that most students' written problems are influenced by intralanguage with a few effects from interlanguage. The written problems identified

during the preliminary 2008/2009 analysis were taken as key student requirements when constructing the remedial framework for the next phase and batch of students.

Findings: The Preliminary Study (2008/2009)

The two batches of preliminary phase students implied that constructionism alone did not provide the SE students with all they required in their language education. There were some gaps in bridging new knowledge and prior knowledge. In order to eliminate this obstacle, the knowledge requirements should be designed to serve the target groups' specific learning difficulties and issues. In this thesis, the knowledge requirements for the target group focused on computing, and the software industry to support the AEC 2015 labour market where SE students will become knowledge workers in the software industry. In addition, through the problem analysis, some aspects such as the learning environment, core course contents, and time duration for building written projects needed to be refined. After the preliminary investigation during 2008/2009 the results were combined to create the remedial framework.

4.4.2 The 1st Implementation During 2010

This section presents the analysis from the first implementation of the remedial framework in 2010. The initial findings from the 2008/2009 pilot study are taken as key themes to strengthen the remedial framework by integrating constructionism with the three theories of cognitive learning, cone of learning, and the learning pyramid, in order to build a knowledge hub, and a new learning environment.

During the initial part of this step, students interacted with teachers and peers to review their background knowledge in all four English skills: reading, writing, listening, and speaking, before undertaking activities with a focus on learning by doing. Throughout the learning process, students experienced a direct learning environment to enhance their English proficiency and learning retention. English proficiency in this environment captures the different language levels in building vocabularies in students' software engineering knowledge domain, and enables students to compose simple sentences and written paragraphs. Learning retention focuses on characterising the students' remaining knowledge after two to three weeks without study.

This section presents the analysis and results which confirm the potential of this initial remedial framework. The results and analysis focus on two aspects: students' experience and retention average.

Students' experience

Students' experience encompasses teaching and learning, course content, delivery methods, classroom facilities, and fulfillment expectancy. In this study, students' experience was assessed via a survey at the end of the English for pre-college course. The survey was in the form of a questionnaire taken from the Quality Assurance (QA) department at the College of Arts, Media and Technology, Chiang Mai University. This survey consisted of eight items, which were then ranked by the students on a scale from 1-5. The results of the students' experience are illustrated in Table 4.2.

The scores reveal that the students' experience on this course varied between

'very good' to 'excellent'. Inferences can be made from this result that suggests the course encouraged students in terms of attitude and motivation when participating in the learning activities.

Table 4.2 23 students' satisfaction level according to eight issues in the CAMT questionnaire

No	Issues	**Level of satisfaction** (%)				
		Excellent	**Good**	**Fair**	**Poor**	**Very poor**
		(5)	**(4)**	**(3)**	**(2)**	**(1)**
1	Teaching knowledge of facilitators/ instructors	70%	30%	0%	0%	0%
2	The organization of lessons	48%	48%	4%	0%	0%
3	Delivery style	57%	39%	4%	0%	0%
4	Teaching materials	65%	26%	9%	0%	0%
5	Open-ended questions	74%	22%	4%	0%	0%
6	Time management in the class	57%	35%	9%	0%	0%
7	Expectation fulfillment of the students from this course	48%	43%	9%	0%	0%
8	Overall reflection on the course	61%	39%	0%	0%	0%

Results and Discussion

As noted in chapter 3 section 3.3.2, students took three tests: pretest, 1st posttest and 2nd (longterm) posttest. A paired t-test was then used to determine if the difference between the pretest and 1st posttest scores of 23 students who regularly attended the course was statistically significant. This was to ascertain whether the framework was effective at improving students' written English skill. The long term posttest (2nd posttest) is associated with learning retention and thus forms the basis of analysis later in the learning retention section. Table 4.3 shows there were significant differences at the 95% confidence interval (and higher). A further analysis of mean scores using

ANOVA illustrates an overview of students' abilities and their improvements before and after taking the remedial framework.

Table 4.3 Paired t-test analysis results showing the difference between pretest and posttest scores of 23 students

	N	Mean	S.D.	T value	Df	Sig.
Pretest	23	13.03	8.2	-8.037	22	.000*
Posttest	23	24.30	8.4			

*p $\leq$ .005

To explore students' progress in depth, analysis of variance (ANOVA) was used to analyze the variance of students' language structure proficiency as determined by assessing the significance of the difference between mean scores of vocabularies, sentences, and writing, both between and within pretest and posttest groups. Results showed statistically significant differences in the values of pretest, 1st posttest, and 2nd posttest (long term posttest) scores as shown in Table 4.4, all of which were significant at the 95% confidence interval.

Table 4.4 ANOVA results on vocabulary, sentences, and writing

		Sum of Squares	Df	Mean Square	F	Sig.
Vocabulary	Between Groups	330.464	2	165.232	21.109	.000*
	Within Groups	516.609	66	7.827		
	Total	847.072	68			
Sentences	Between Groups	357.594	2	178.797	6.371	.003*
	Within Groups	1852.174	66	28.063		
	Total	2209.768	68			
Writing a paragraph	Between Groups	47.479	2	23.740	4.262	.018*
	Within Groups	367.600	66	5.570		
	Total	415.079	68			

* $p \leq .05$

The ANOVA has shown that the difference in mean scores between the pretest, posttest and second posttest is statistically significant at the 95% confidence interval. To further analyze this difference, it was necessary to interpret the raw mean scores themselves. Figure 4.5 shows the mean scores for each test (pretest, posttest and second posttest) and according to each variable (vocabulary, sentences, and writing a paragraph).

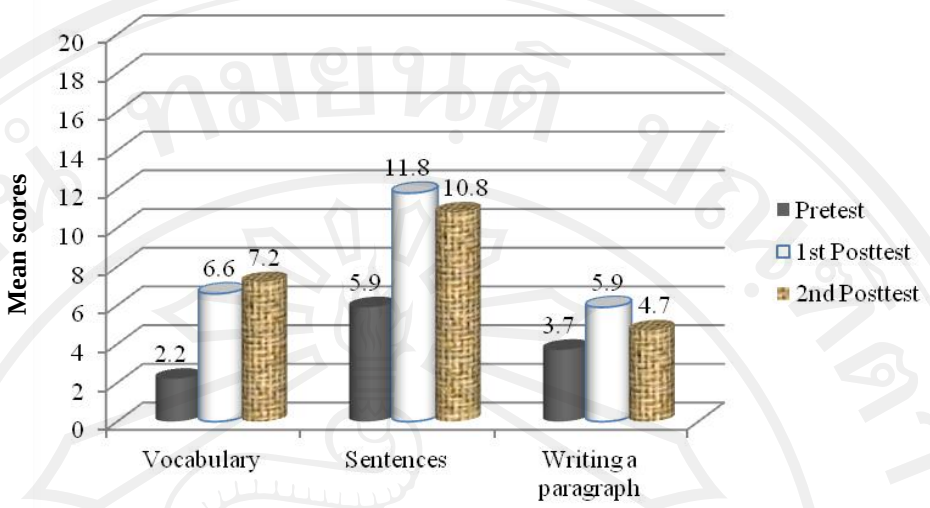

Figure 4.5 Comparison of means for vocabulary, sentences, and writing in the pretest, 1st posttest and 2nd posttest

In terms of vocabulary, the ANOVA result and analysis of the mean scores suggests that students have improved, particularly in the second posttest, and by a sizeable amount relative to the pretest.

For sentences, the ANOVA and mean scores again show improvement when compared to the pretest, particularly in the 1st posttest, but also in the second posttest. Judging by the ANOVA results and raw mean scores, sentences appear to show the biggest improvements out of the three variables.

Writing a paragraph also shows a statistically significant improvement and follows the same pattern as sentences. In analyzing the ANOVA results along with the raw mean scores, the posttests show the remedial framework has facilitated effective improvements for students in terms of learning vocabulary, sentences and writing a paragraph. As might be expected, the 1st posttest exhibits the largest gains in terms of mean score improvement.

In terms of the three variables (vocabulary, sentences, and writing a paragraph),

sentences show the highest mean improvement followed by vocabulary and writing a paragraph.

In addition to writing competency, the oral presentation elements of content, language use, and presentation were also analyzed using the ANOVA technique (Table 6). While the focus of this thesis and the remedial framework is on improvements in writing, students' oral presentation elements were also assessed to ascertain whether improvements in writing skill crossed over to improve other skills. The oral presentation criteria were taken from the Faculty of Humanities, English Department, Chiang Mai University (CMU). The analysis results are shown in Table 4.5 and again show a significant difference in mean scores between the pretest and two posttests for content, language use and presenting.

Table 4.5 ANOVA results on presentation criteria (content, language use, presenting)

		Sum of Squares	Df	Mean Square	F	Sig.
Content	Between Groups	1.852	2	.926	15.028	.000*
	Within Groups	4.436	72	.062		
	Total	6.288	74			
Language use	Between Groups	2.396	2	1.198	16.512	.000*
	Within Groups	5.225	72	.073		
	Total	7.621	74			
Presenting	Between Groups	1.110	2	.555	8.094	.001*
	Within Groups	4.937	72	.069		
	Total	6.047	74			

*p ≤ .005

English study is an innate development, which requires sensory skills to drill and practice, and time is therefore an important variable in this study. A three week

course for students is relatively limited in terms of promoting both syntax, and semantic competence. Writing is the most difficult of all four English skills, whilst speaking is relatively simple (Bergh, 2007). While the course was relatively short, the second posttest (three weeks after the course end) was used to determine students' retention levels.

Retention Average

Retention in learning is the ability to retain facts in the long term memory and is a key indicator for practical learning (Cepic, 2011). Students learn best when they use perceptual knowledge, and the physical environment in this study allowed students to be exposed to self-directed activities. The construction zone generated new ideas, and meaningful thought with repetition ingrained in students' memories.

Three weeks after the course completion, the 23 students' retention was tested with the same posttest paper. The paired t-test result produced a P-value of .683, which is not significant at the 95% confidence interval. This result is expected, and illustrates that after three weeks, there was no statistically significant difference between the test results. As the results from the initial post-test and second posttest (long term) were not significantly different, it can be inferred that the students' retained the knowledge from the course three weeks after it had finished. The t-test results are illustrated in Table 4.6.

Table 4.6 Paired t-test analysis of students' long term retention (3 week posttest)

	N	Mean	S.D.	T	Df	P-value (Sig.)
After three weeks						
1st Posttest	23	24.3	8.4	.413	22	.683*
2nd Posttest (Long term retention)	23	23.8	8.3			

*p ≥ .05

Following the t-test, the average retention rate for the second posttest (long term) was calculated according to the retention rate formula shown in Figure 4.6. The raw posttest score for each of the students was added together, then divided by the total possible test score, and multiplied by the number of students taking the test. This number was then multiplied by 100 to show the average retention rate as a percentage. In this study, the retention rate was calculated as 78%, and when linked to the learning pyramid (National Training Laboratories, 1947), the rate falls within the 'practice' participatory teaching section of the pyramid. This retention rate confirmed that active learning promoted practical knowledge and ingrained memory in the long term.

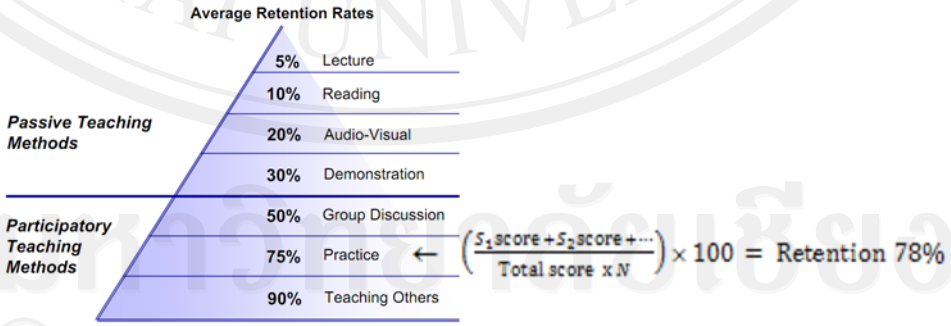

Figure 4.6 Equation to calculate average retention rate and subsequent comparison of calculated long term retention rate to the learning pyramid

In addition this research emphasized an effective ‘collaborative knowledge sharing’ framework through ‘learning process value’. Learning process value is described by the Thai Ministry of Education (MoE) as the measurement of students’ satisfaction with a particular course. According to the Thai MoE, the ‘learning process value’ in each semester should be equal to or greater than 25 %. The second posttest scores were used in calculating the learning process value using the formula in Figure 4.7 and the results were ranked according to the Thai MoE’s quality levels. These results are shown in Table 4.7. The average value was 22.53%, with 11 out of 23 students scoring as excellent in the learning process value, one student scoring ‘good’, three students ‘fair’, and seven students scoring as ‘poor’. According to the results, one student had very poor quality learning process value.

$$\left(\frac{\text{Each Student score in 2nd postetest}}{\text{Total score}}\right) \times 30$$

Figure 4.7 Equation to calculate learning process value

Table 4.7 Ranking long term retention of the 23 students according to quality level derived from the ‘learning process value’

Quality level	**Range**	**Results**
Excellent	26-30	11
Good	20-25	1
Fair	15-19	3
Poor	0-14	7
Very Poor	< 0	1
	Average	22.53 = Good

To track students' written English proficiency, in addition to the pretest and posttest, students' written paragraphs were analyzed using error analysis at the end of the course. As shown in Figure 4.8, the eight most frequent errors fall into the level of substance and text errors. These errors are parallel structure, punctuation, subject and verb agreement, run-on, spelling, gerund, fragment, and capital letter. Both levels influence written communication, however text level affects written communication significantly more than substance level. Text errors involve word selection, sentence structure and word order. The wrong word selection or the misplacement in a sentence structure can cause a faulty meaning transfer. Substance level errors emphasize the sentence marker such as capitalization, punctuation, and spelling which rarely affects the meaning as readers are usually able to infer meaning despite misspelling and misuse of markers.

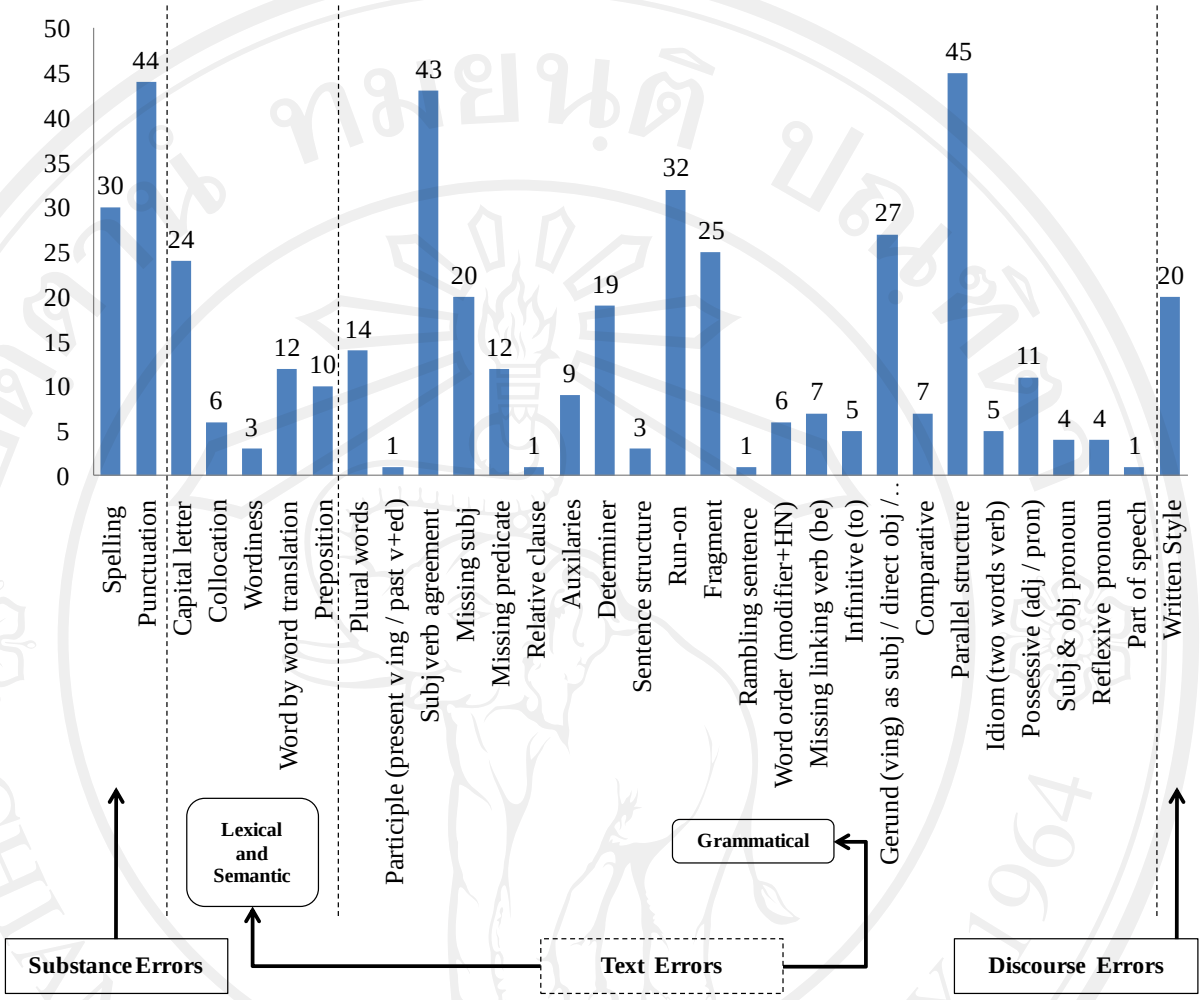

Figure 4.8 Number of written English errors in SE students' paragraph (2010)

Findings of the 1st Implementation 2010

A key limitation of this study was the course duration. English study is an innate development, which needs sensory skills practice and time is therefore an important variable in this study. A three week course is a relatively short time and limited in terms of promoting both syntax, and semantic competence, especially given writing is considered the most difficult of all four English skills, whilst speaking is relatively simple (Bergh, 2007).

In order to achieve effective learning and reduce students' errors, the teacher

should strongly consider students' background skills, learning environment, social interaction community (Liao, 2010), and graphical tools for the organization of knowledge. In considering English as the global language of business, and Thailand's issues with learning English, new teaching and assessment methods should be adapted and the remedial framework presented in this paper provides a useful starting point to promote discussion, highlight key student errors and shift teaching styles in Thailand from memorization and recall to higher levels of learning.

4.4.3 The Refined Construcionism Framework 2011

Based on the results of the implementation during 2008, 2009 and 2010, the remedial framework was refined based on aspects of core course contents, the learning environment and a linguistic assessment tool using error analysis. Since the key point of the remedial framework emphasizes 'teach less, think more' (Papert, 1981), the core course contents have to cover and serve the software labour market requirements. To produce the graduates' qualification to fit in software knowledge society, the core course contents should be interviewed and taken directly from expert experience in the software engineering industry. Then, these specific skills and knowledge requirement from experts are brought together and created the core contents for software engineering students.

This section is further separated into two parts: the first illustrates the domain knowledge recommended by the software engineering professionals for software employees, and the second part presents the outcome of the refined remedial framework.

Part one: Domain knowledge recommendations from software employees.

To gather SE domain knowledge requirements, data were collected from SE professionals via direct interview and questionnaires. Twenty questionnaires were sent by post to software companies in Thailand where the SE department at the College of Arts, Media, and Technology has a connection with the internship program. 15 out of 20 questionnaires were sent back. In terms of ownership, Table 4.8 illustrates that twelve companies are classified as being under Thai ownership; one under foreign ownership; and two were cooperative ventures between Thai and foreigners.

Table 4.8 The classification of fifteen companies used to gather SE domain knowledge requirements to the course

Type of companies	Number	Percentage of total
Thai owner companies	12	80
Foreign owner companies	1	7
The cooperation of Thai and foreign owners	2	13
Total	15	100

The importance of English in the workplace is corroborated by statistics in Table 4.9 which show 34 % of employees have foreign bosses, 27 % of companies employ multinational staff, and 13% are sub-branches of foreign companies under the cooperation of Thai and foreign countries, and co working with sub-branches in another countries.

Table 4.9 The classification in using English in the workplace

Aims in using English in SE companies	No.	Percentage
1. sub-branches of foreign companies	2	13
2. under the cooperation of Thai and foreign countries	2	13
3. have the foreign bosses	5	34
4. Co working with sub-branches in another countries	2	13
5. multinational staff	4	27
Total	15	100

The frequency of English skills used in daily routine were collected from a five point scale questionnaire (5 is always used and 1 is rarely used). The mean score was used to analyze data as shown in Table 4.10. The analysis illustrated that English skills such as listening are seldom used in contemporary work environments, with speaking, writing and reading being sometimes used, and the most often utilized skill being translation.

Table 4.10 The ranging of English skills in daily used are presented using mean score

English skills	$\bar{X}$	Level of usage
1. Translation	3.27	often
2. Reading	3.00	sometimes
3. Speaking	2.73	sometimes
4. Writing	2.67	sometimes
5. Listening	2.33	seldom
Average	**2.73**	**seldom**

While all English skills are important in daily work, the most significant one is written skill which is important for two reasons: firstly it is one of the productive skills which integrate multiple cognitive abilities including working memory into the process of analyzing, encoding and crystallization of the information from reading and listening tasks to a meaningful written form. Written skill is one of the hardest for English as foreign language (EFL) students to effectively learn, and thus learning to write should naturally enhance speaking and reading skills (Chomsky, 1965). The second reason is that English tends to be the working language in companies and most employers of software engineering graduates expect to document software in English and thus have high expectations of their written skills.

Following clarification of the need for written English skill, the questionnaire results from the fifteen software professionals highlighted the nineteen types of document commonly required by software employers. The five scale questionnaire was analyzed using mean score and ranked the 19 document types according to frequency as shown in Table 4.11. The most frequent document type is email, followed by instructions, manuals, writing reports, meeting agendas, and writing a description.

Table 4.11 The frequency level of each written task recommended by SE professionals

Written tasks	$\bar{X}$	Frequency use
1. Email	3.33	often
2. Instructions	3.00	sometimes
3. Proposal	2.93	sometimes
4. Definition of products	2.93	sometimes
5. Business letters such as reply letter, and ordering product	2.87	sometimes
6. Manual	2.73	sometimes
7. Suggestions	2.67	sometimes
8. Writing reports	2.67	sometimes
9. Curriculum vitae	2.54	sometimes
10. Describe graph	2.54	sometimes
11. Minute of the meeting	2.53	sometimes
12. Meeting Agenda	2.47	seldom
13. Writing a summary	2.40	seldom
14. Advertisement	2.38	seldom
15. Take notes	2.33	seldom
16. Analyze the data and document	2.23	seldom
17. Newsletters	2.23	seldom
18. Contracts	2.23	seldom
19. Writing the description	2.20	seldom
Average	**2.30**	**seldom**

The results from Table 4.11 are taken as course contents and used to refine and adapt remedial framework from 2010 to shift the remedial framework from general to domain specific English. Future adaptations to the framework will subsequently refine the framework on a yearly basis in order to catch up with the trends of the software engineering industry knowledge society.

The outcome of the refined remedial framework in 2011.

This section presents the outcome and results of the refined remedial framework through an assessment of students' writing via error analysis. Most ESL studies capture learners' English skill improvement through a focus on comparing overall pretest and posttest scores. The results in this chapter so far have focussed on pretest and posttest scores, which has provided an overview of the framework's success during 2008/2009, 2010 and 2011. The next section of the results aims to contribute to an understanding of specific skills in terms of strengths and weaknesses in order to determine language proficiency and failure. It is important to determine strengths and weaknesses in order to understand how the remedial framework can raise students' English levels to an international standard and to assess how wffective the 2011 constructionism based remedial framework is based on the modifications from the 2008/2009 and 2010 phases. Table 4.12 illustrates the number of pretest and posttest errors according to the three levels of James' (1998) error analysis framework and shows students' written improvement in quantitative terms.

Table 4.12 The number of language errors in the pretest and posttest, and the corresponding level of improvement for 23 students enrolled on the 2011 course

Error type	Pretest No. of Errors (A)	Posttest No. of Errors (B)	Improvement A – B		Percentage of Total Errors (%)
			Raw difference	% difference	
I. Substance error					
Capitalization	(4) 13	5	8	61%	14
Small letter	3	0	3	100 %	5
Punctuation	10	(4) 10	0	0 %	0
Typographic	6	3	3	50 %	5
Dyslexic	9	7	2	22 %	3
II. Text Error					
a. Lexis					
Suffix	5	5	0	0 %	0
Vowel	1	4	-3 *	300 % *	-5
Consonant	7	2	5	71 %	8
Borrowing	1	0	1	100 %	2
Calque	(5) 12	(3) 13	-1 *	8 % *	-2
Omission	1	2	-1 *	100 % *	-2
Overinclusion	5	2	3	60 %	5
Misselection	1	0	1	100 %	2
Misordering	3	7	-4 *	133 % *	-7
Blending	2	0	2	100 %	3
Semantic					
Semantic word selection	10	(1) 16	-6 *	60 % *	-10
Preposition partner	3	5	-2 *	67 % *	-3
b. Grammar					
b.1. Morphology					
Third singular –s	4	3	1	25 %	2
Plural –s	(2) 15	(5) 9	6	40 %	10
Past tense –ed	1	0	1	100 %	2
b.2 Syntax					
Noun Ph	(6) 11	3	8	73 %	14
Verb Ph	(1) 21	(2) 14	7	33 %	12
Prep Ph	5	4	1	20 %	2
Det Ph	(3) 13	(6) 8	5	38 %	8
Quantifier Ph	3	2	1	33 %	2
Complementizer Ph	1	0	1	100%	2
b.3 Clause					
Superfluous	2	2	0	0 %	0
Omitted	9	7	2	22%	3
Blend or hybrid	2	2	0	0 %	0
Sentence					
Coordination	6	4	2	33 %	3
Subordination	7	3	4	57 %	7
b.4 Intersentence					
Conjunction	9	5	4	44 %	7
III. Discourse Errors					
Coherence	8	3	5	63 %	8
Total	209	150	59	28.23 %	100
Average errors per paragraph	9.08	6.52			
* Signifies increase rather than decrease in errors between pretest and posttest					

Results from Table 4.12 illustrate through an analysis of the pretest, that 23 student compositions on the same topic yielded a total of 209 linguistic errors. The top six most frequent errors in the pretest were verb phrase, plural –s, determiner phrase, capitalization, and calque. All these error types fall within the text error level of James' (1998) error analysis framework. Each student paper, on average, contained 9.08 errors.

After three weeks of participation in the remedial framework, the posttest analysis showed the 23 English compositions had a total of 150 errors and, on average, each paper contained 6.52 errors. When comparing total pretest and posttest errors, the number of language errors reduced by 59 or in percentage terms, a 28.23 % decrease in errors.

Table 4.12 shows most types of error were reduced between the pretest and posttest, however students had particular difficulty in six lexical categories. These categories, ranging from highest to lowest are; semantic word selection, misordering, vowel, preposition partner, calque, omission, plural –s, noun ph, verb ph, and determiner ph. These results once again corroborate text error as being the most common level of error for the software engineering students. The reasons are:

- Lexis is the smallest unit in the language productive system, and is essential foundational knowledge to process language in written text and speech production. According to Chomsky's 'T model' a lexis or word is defined as a mental dictionary to carry syntax or grammatical structure to build phrases and sentences, and generate words and sentences in producing speech and written text. Thai students make their lexical error primarily as a result of interference

from their mother tongue language when attempting to construct written text in English.

- The influences of language interference include interlingual and intralingual factors. Interlanguage refers to the positive and negative transfer of two dialect languages. In the transfer process, mother tongue language sometimes crosses and overlaps the target language. The similarity between the two dialects produces positive effects, while the differences cause negative transfer or errors, for example borrowing, calque, semantic word selection, and blending. According to Selinker (1972), interlanguage is temporary grammar, which is systematic and composed of rules. These rules are the product of five main cognitive processes: language transfer, transfer of training, learning strategies, communicative strategies, and overgeneralization of L2 material. Interlanguage factors influence the students' errors because of the overlaps in L1 and L2 language.

  Intralanguage is the systematic deviation of students who are not proficient in second language rules. L1 learners who have just begun learning a second language produce significantly more errors than L1 learners who have reached a certain level in the target language. Literature shows the most common errors for second language learners are capitalization, small letter, punctuation, and grammar error subtypes. However, the in depth error analysis showed that text error (lexical and semantic) is the most significant obstacle in language production for the Thai students in this research.

- For second language learners, errors are inevitable. Even master L2 learners' written text shows 'fossilization', the scenario where people reach a certain level in their language ability and do not improve or progress further. The solutions are that learners (i) should have a positive attitude towards language improvement, (ii) have the ability to notice their language errors, and (iii) have time to reduce those errors. This self reflection will help students understand their own language ability and their skill improvement or failure in order that they can retain their English proficiency (James, 1998).

To further analyze the difference between pretest and posttest in the remedial framework, a visual analysis as shown in Figure 4.9 illustrates the quantitative number of errors in each test (pretest, and posttest), and relates it to the error analysis framework.

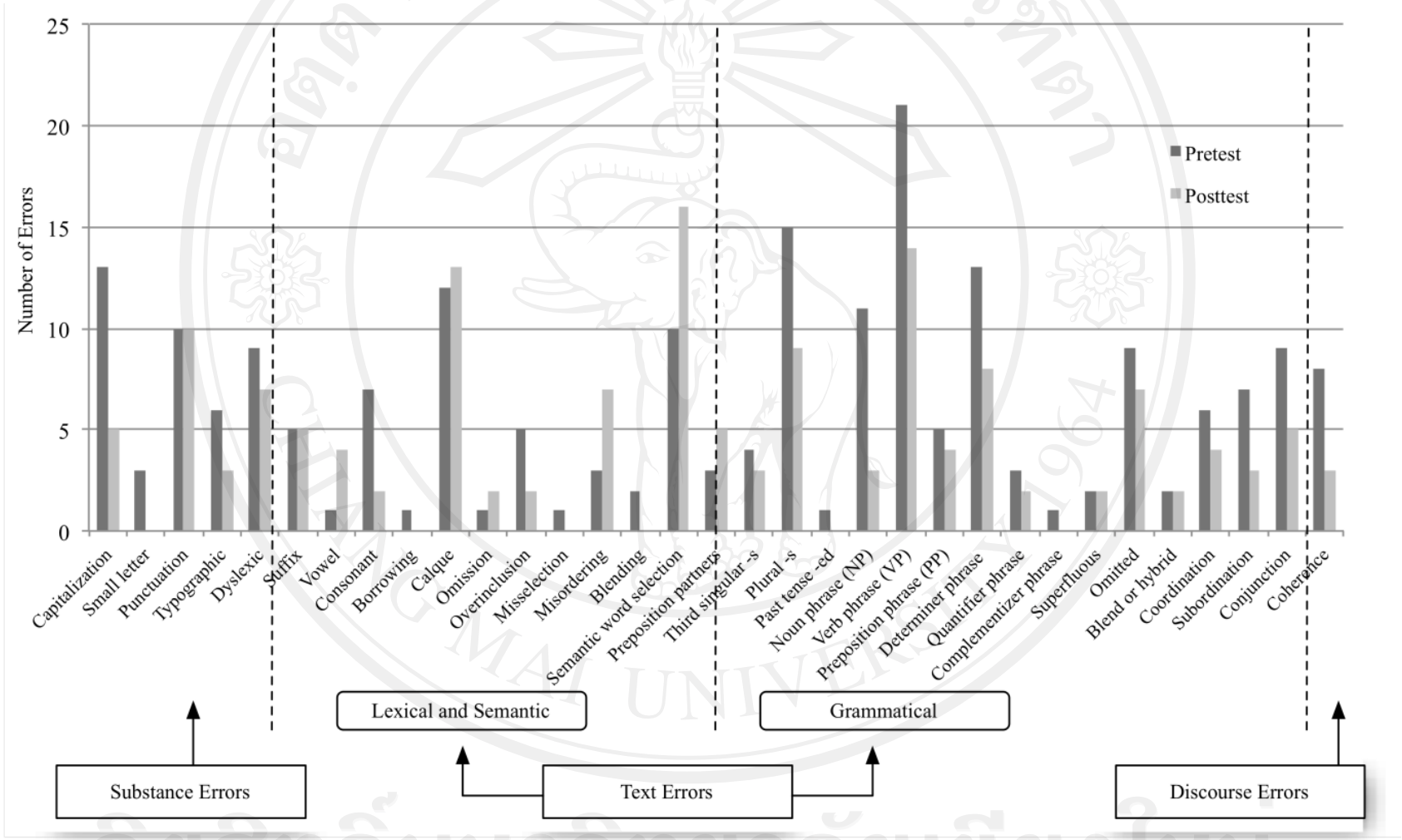

Figure 4.9 A visual comparison of errors between pretest and posttest

Figure 4.9 illustrates that of all three error levels, students found text errors most difficult and made the most number of errors in this category. Within this text error level, the category with the highest number of errors was grammatical, followed by lexis and semantic. The biggest drop in errors between pretest and posttest was in the misordering category.

Table 4.12 and Figure 4.9 both show an increase in errors between the pretest and posttest for some categories. These are all in the text error section. One explanation for the increase in these particular errors might be the average word length of the paragraphs the students wrote in the pretest and posttest. With an average of 102 words in the pretest and 111 words in the posttest, the increase in errors could be due to the increased word length. Therefore, to adequately assess any improvement in students written English through a reduction in errors requires a statistical analysis of the differences in error between the pretest and posttest.

To understand whether the reduced errors in the posttest were simply due to chance, or a result of the 2011 remedial framework, a paired t-test was used to determine if the difference between the pretest and posttest errors of the 23 students who regularly attended the course was statistically significant. Figure 4.10 shows the results and indicates that there were statistically significant differences (at the 95% confidence interval) between errors in categories of capitalization, consonant, noun phrase, verb phrase and coherence.

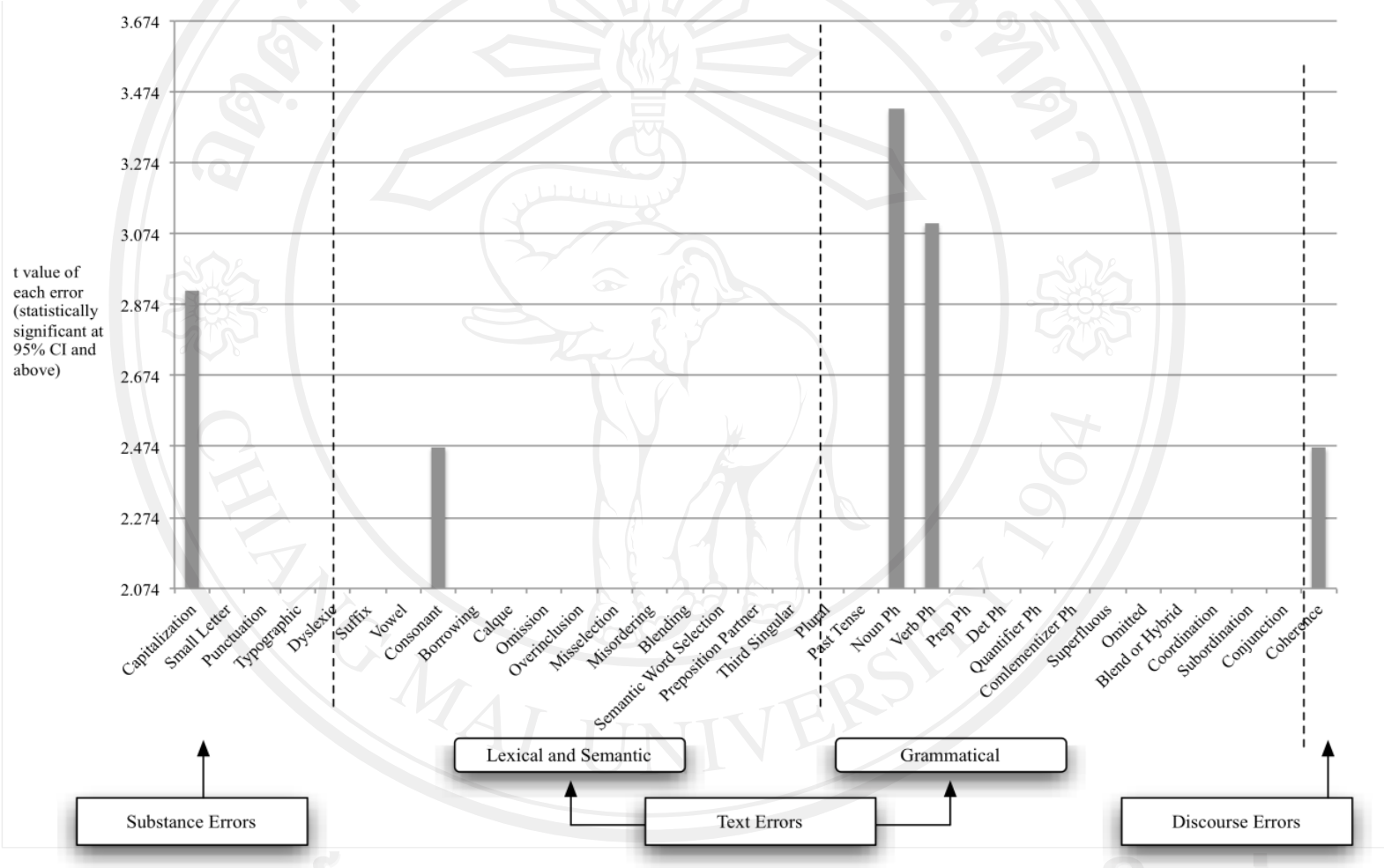

Figure 4.10 Paired t-test results showing statistically significant differences between pretest and posttest scores of 23 students. Note that only those t-values that are significant at the 95% CI and above are shown.

Figure 4.10 illustrates that five errors saw a statistically significant difference between pretest and posttest. These were capitalisation, consonant, noun phrase, verb phrase and coherence. There is a reduction in each level of text error, with three of the five errors contained within the text error category. The reduction in these errors (capitalization, consonant, noun phrase, verb phrase, coherence) are from the influence of intralanguage. These intralanguage problems could be solved with language treatment, such as reviewing the language structure, which should help improve written English proficiency of the target group in this study (Thai undergraduate software engineering students) to nearly master in L2. In the future, there is potential to build on this remedial framework based on these results.

4.4.4 Tracking the English learning rate of target groups 2008 – 2011

This chapter has so far presented results according to each stage of the remedial framework construction; namely the 2008/2009 phase, the 2010 phase and the 2011 phase. This section of the results tracks the students from each phase and more significantly, asseses their English progress in comparison to control groups, i.e. students who have not taken part in the remedial framework.

To test one of the key thesis hypotheses, and assess whether the remedial course design and its implementation improves and remediates students' English abilities over longer time scales, the SE students were split into four groups: the experimental group, control –quota, control-university admission and control-direct admission, each with different entrance, English teaching and test conditions, as illustrated in Figure 4.11. The experimental group (target group) enrolled on both the English remedial course, and a Summer Camp (English). Meanwhile another three

control groups enrolled only on the summer camp and went through the standard CMU (CAMT) process.

SE students' English abilities were tracked via their grades through four stages.

1. CMU admission – students grades in English were determined where possible from their entrance exam. This gave a snapshot of student English ability on entering CMU.
2. Knowledge input - students English ability is measured through their performance on any treatment. For example students on the remedial framework were monitored via the pretest and two posttests.
3. CMU (CAMT) process – This stage relates to the general teaching and input students received as part of their degree course. At this stage, the experiment and two control groups experienced the same input.
4. English proficiency (output) – at this stage students' English ability was measured via the Common European Framework (CEF) and the CMU English foundation exam.

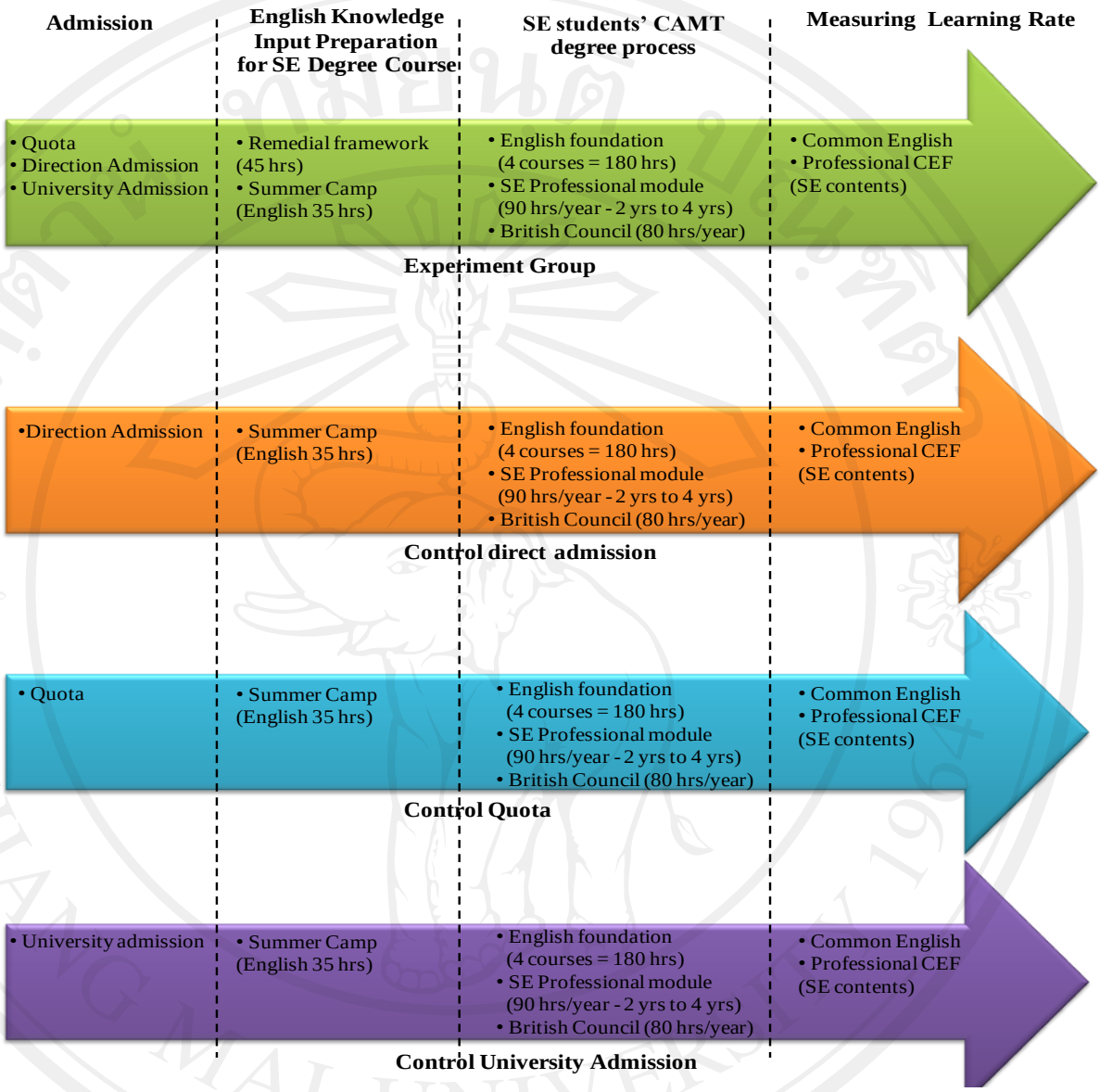

Figure 4.11 The four stages of tracking SE students' learning rates throughout their enrollment at CMU

As shown in Figure 4.11, CMU admission includes quota, direct admission, and the university admission. In order to become CMU university students, high school students must pass the CMU national examination requirement which comprises five subjects: Thai, math, English, science, and sociology. This thesis focuses only on English scores from 2008 to 2011, and takes this as descriptive data to

describe students' English proficiency prior to enrolling on the remedial framework (treatment).

Knowledge input represents the first stage of the English treatment which aims to prepare new university students in terms of English proficiency to meet the standard required for the software engineering program. During the summer semester, the experimental students enroll on the English remedial course for 45 hours over three weeks. They then enroll on the summer camp 35 hours for another three weeks. This includes not only English, but also physics, and calculus.

The CMU process includes teaching and learning based on the CMU curriculum which covers four years of study. Students study both subject specific and general courses. In terms of the CMU process, this thesis focuses on the four English foundation subjects: Eng 101, 102, 201, and 202, and the subject specific software engineering courses. The four English foundations for 180 hours represent treatment from the CMU (CAMT) process. Students must learn and apply the knowledge input to these four GE subjects while the major subject assesses how well students integrate their general knowledge in English to subject specific technical English.

To bring students' English proficiency to an international standard, during the CMU process, CAMT provides an English tutoring course 80 hours per year which is run by the British Council as well as SE professional modules 90 hours per year for 2^{nd}, 3^{rd} and 4^{th} year students. This British Council course emphasizes technical English skill to support the SE international program and uses the Common European Framework (CEF) as the standard measurement to assess students' English proficiency output. International Professors from Staffordshire University, UK, Lyon, France, Italy with connection to CAMT will take turn to SE module teaching.

As SE is an international program, besides the expected IT and professional skill, English is one of the key requirements for an international program in Thailand and for graduates to compete in the forthcoming AEC 2015. To compete in the ASEAN labour market, CAMT's leadership aims to prepare for the AEC in the next three years by setting out students' English proficiency policies in relation to the CEF, the European standard, and to describe achievements of learners of foreign languages. These policies require 1st year students to achieve at least B1 or achieve 400 hours of active English treatment (an immersive learning environment with native English speakers), and 4th year or graduates requiring at least C1. SE students learning rates throughout the tracking process (Figure 4.11) of each group of students are presented as below.

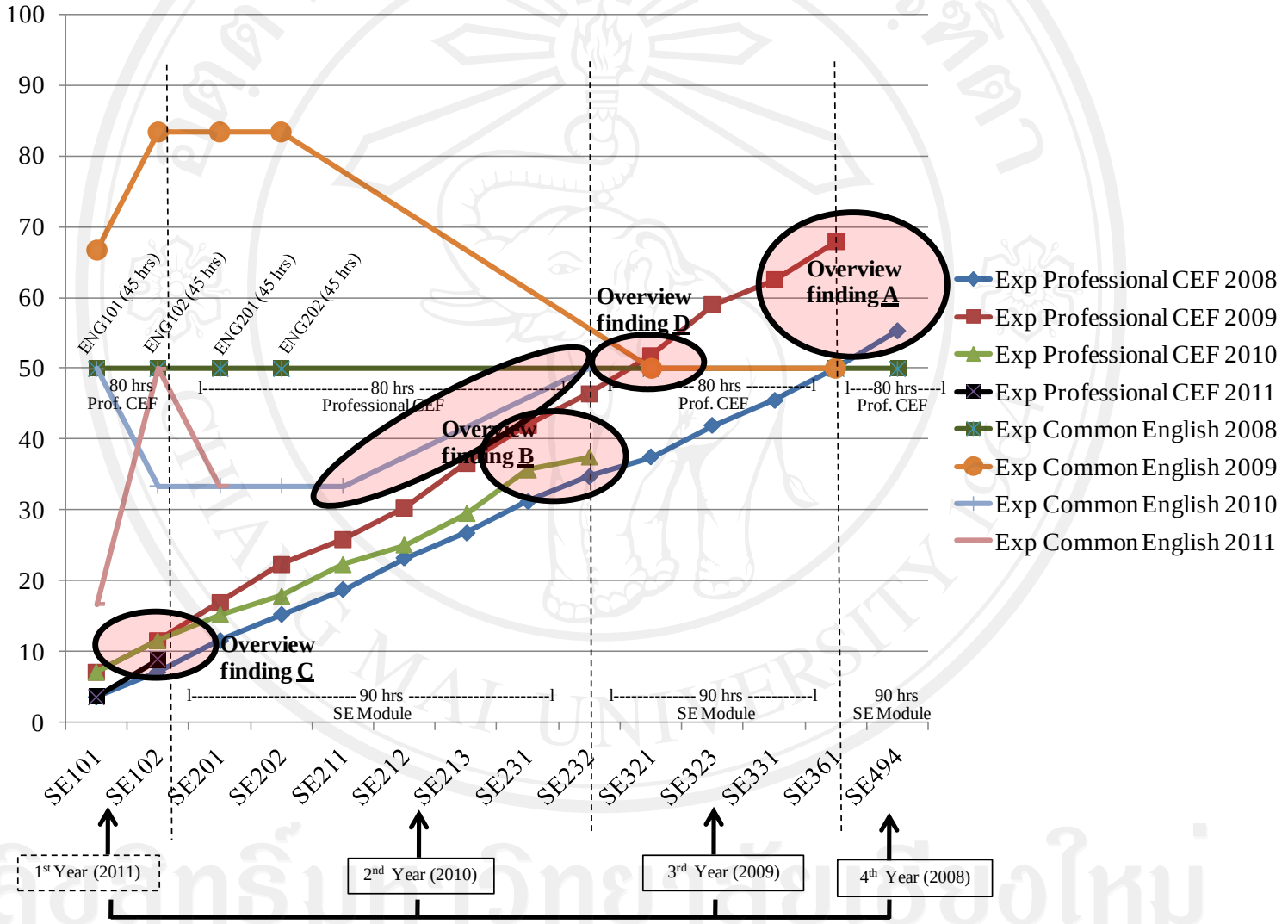

Figure 4.12 The comparison of an experimental group year 2008 to 2011

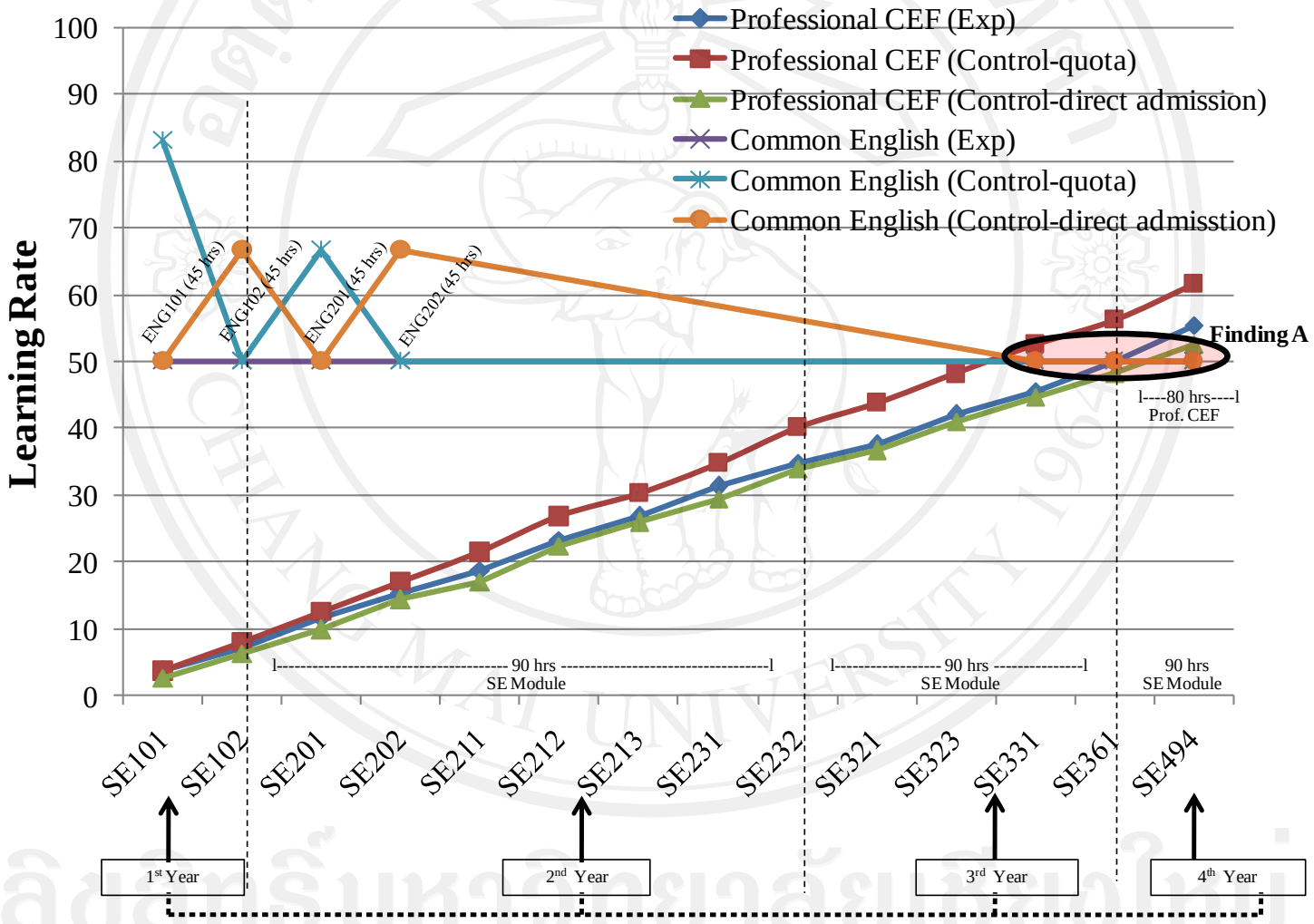

Figure 4.13 Software Engineering Students Academic Year 2008

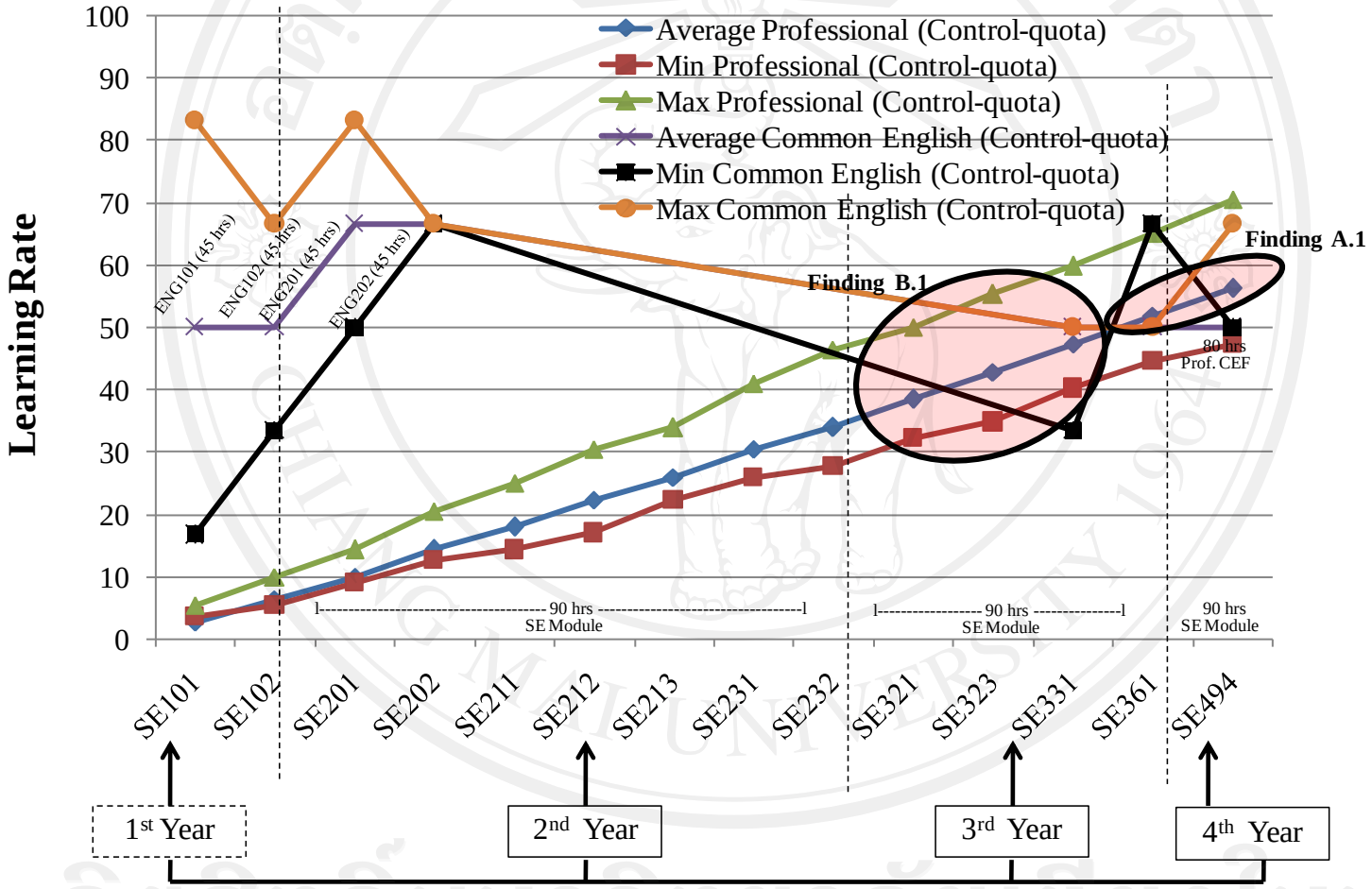

Figure 4.14 Average, Min and Max SE Students (Control-quota) 2008

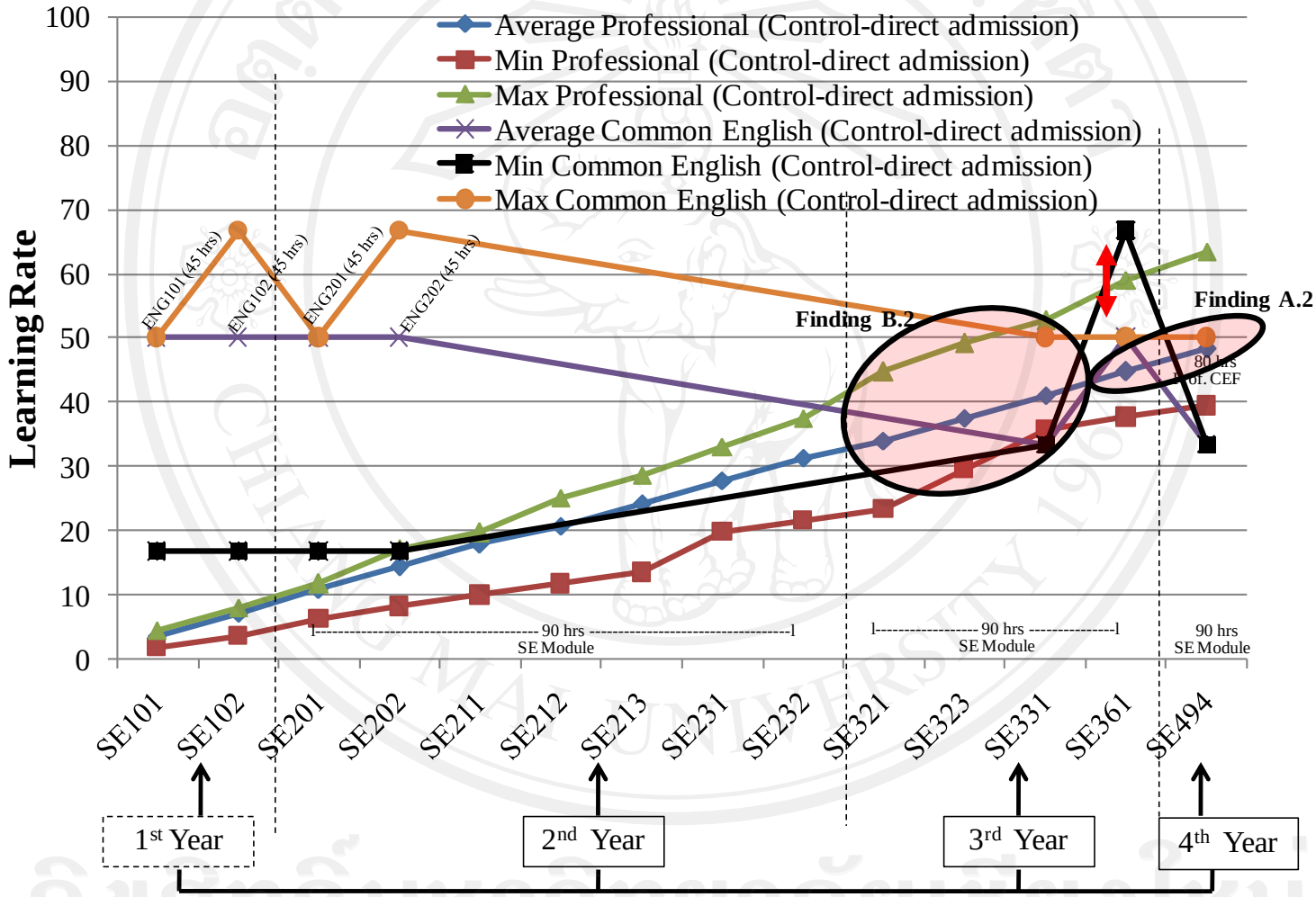

Figure 4.15 Average, Min and Max SE Students (Control-direct admission) 2008

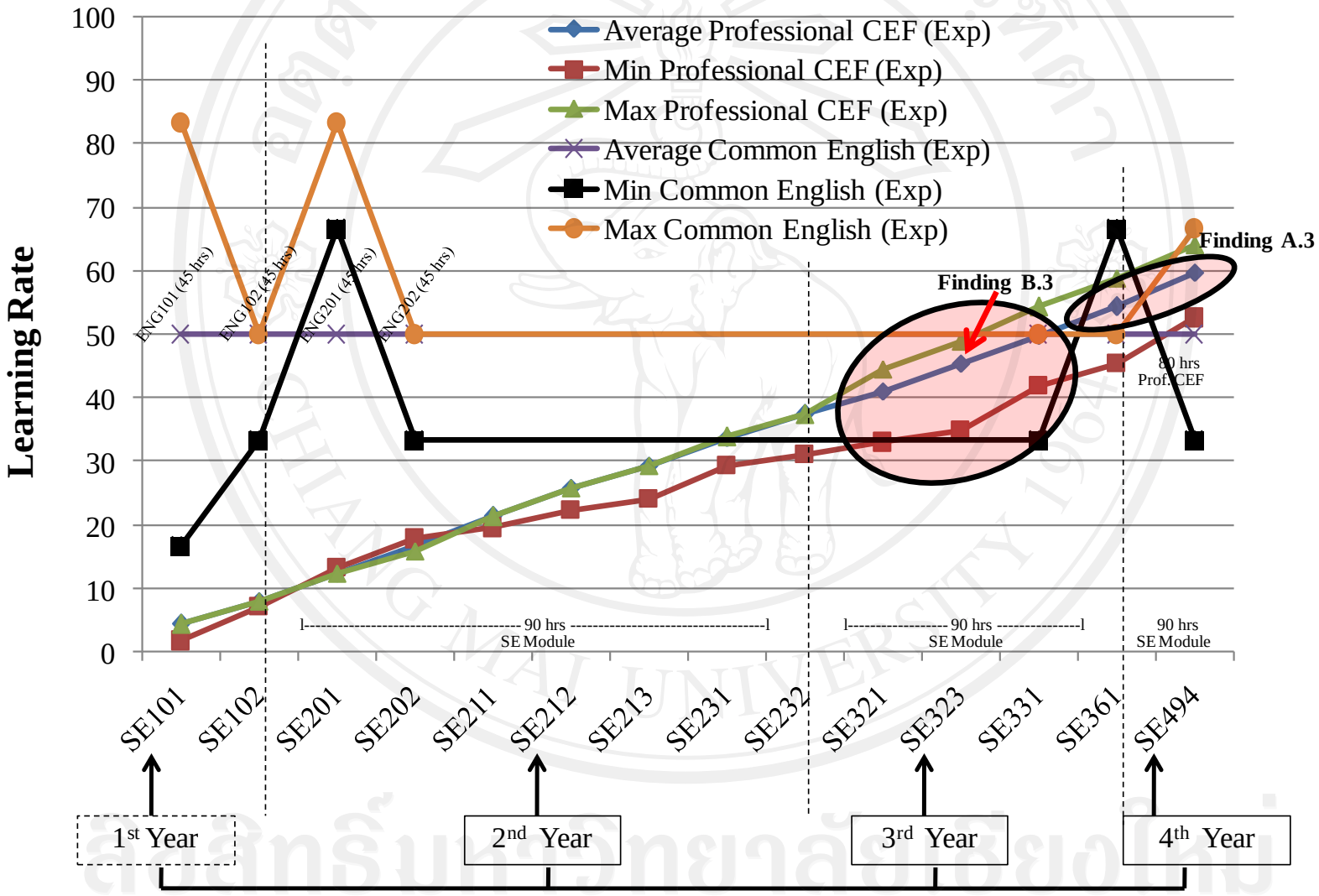

Figure 4.16 Average, Min and Max SE Students (Experimental Group) 2008

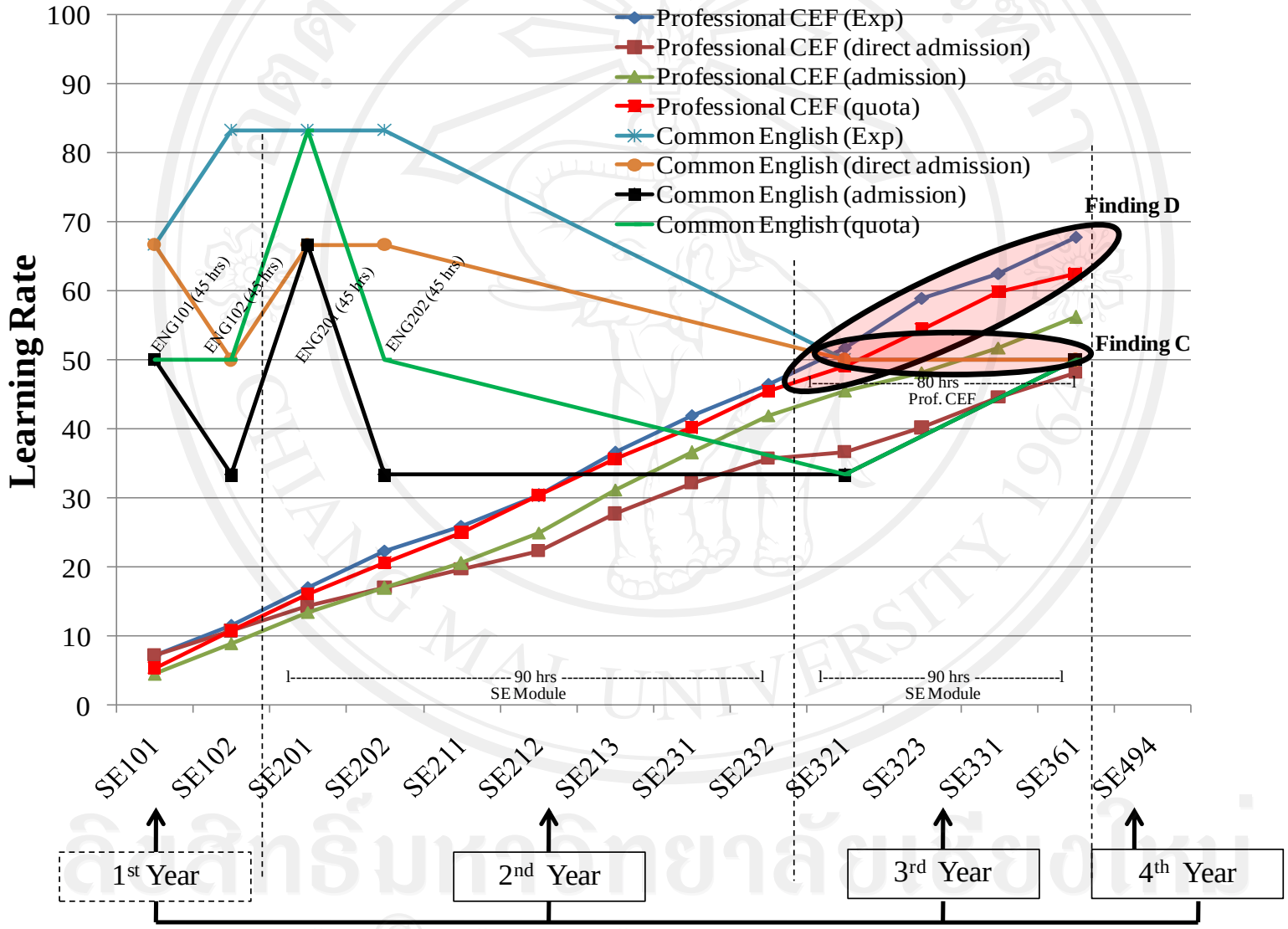

Figure 4.17 Software Engineering Students Academic Year 2009

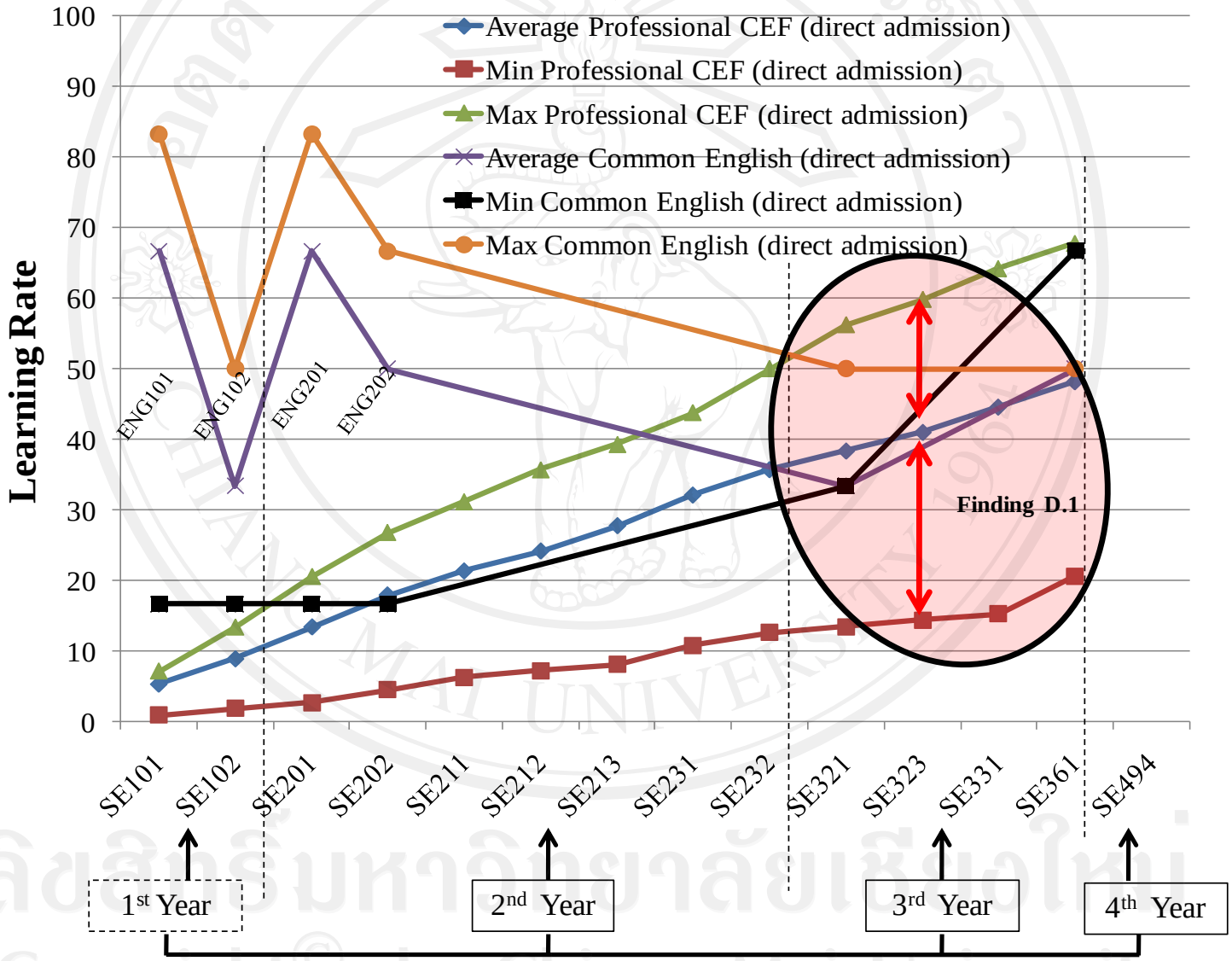

Figure 4.18 Average, Min and Max SE Students (Control-direct admission) 2009

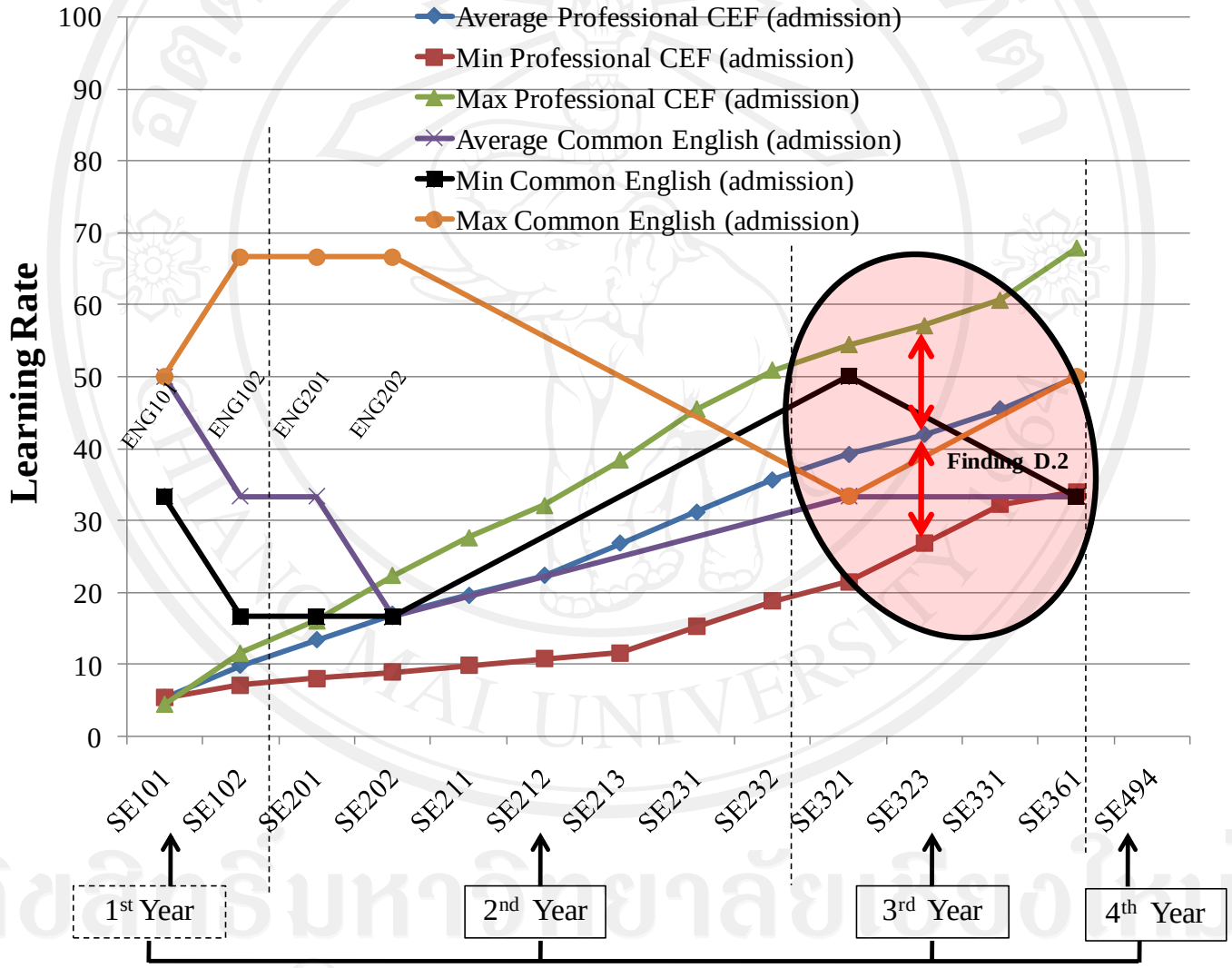

Figure 4.19 Average, Min and Max SE Students (Control-admission) 2009

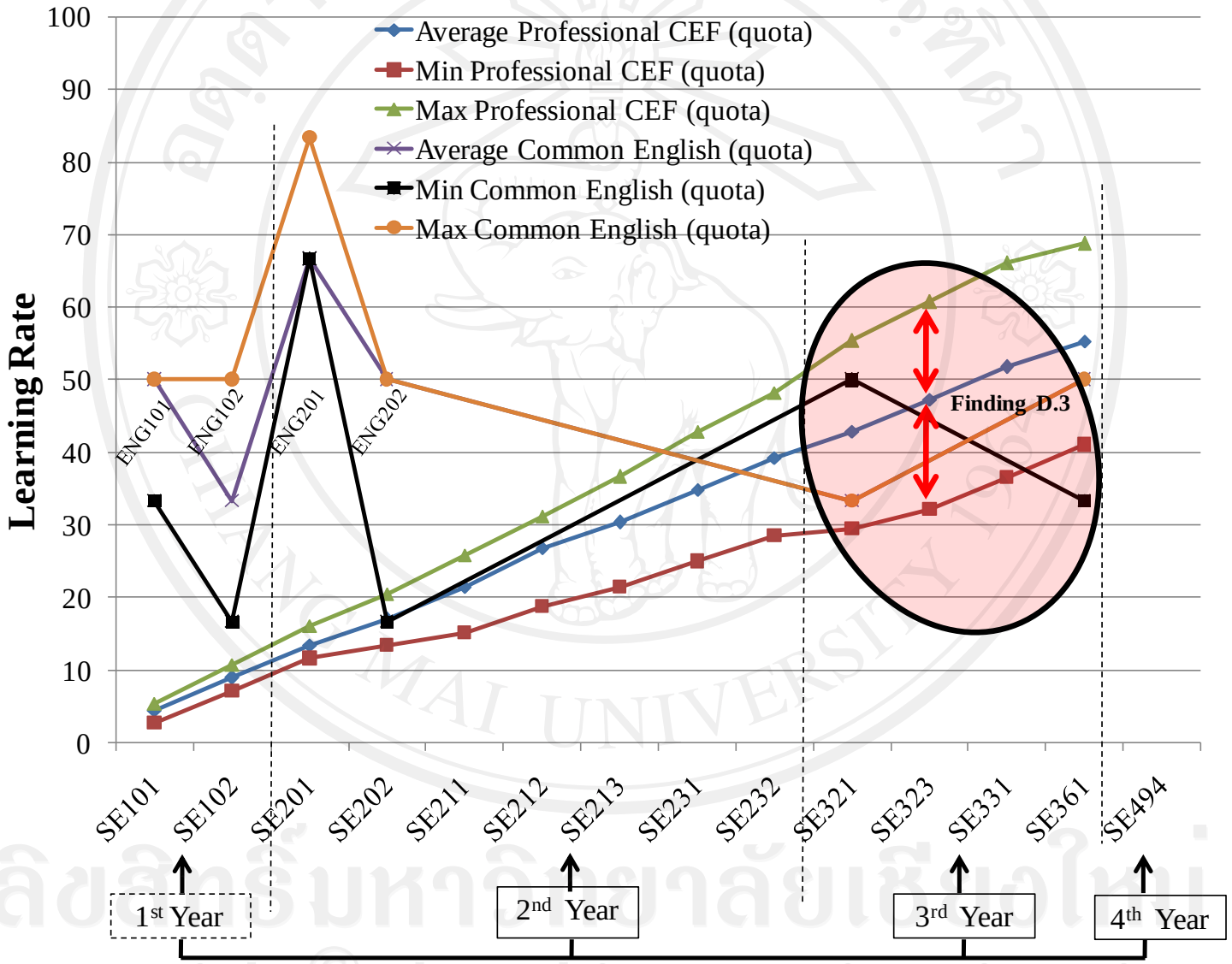

Figure 4.20 Average, Min and Max SE Students (Control-quota) 2009

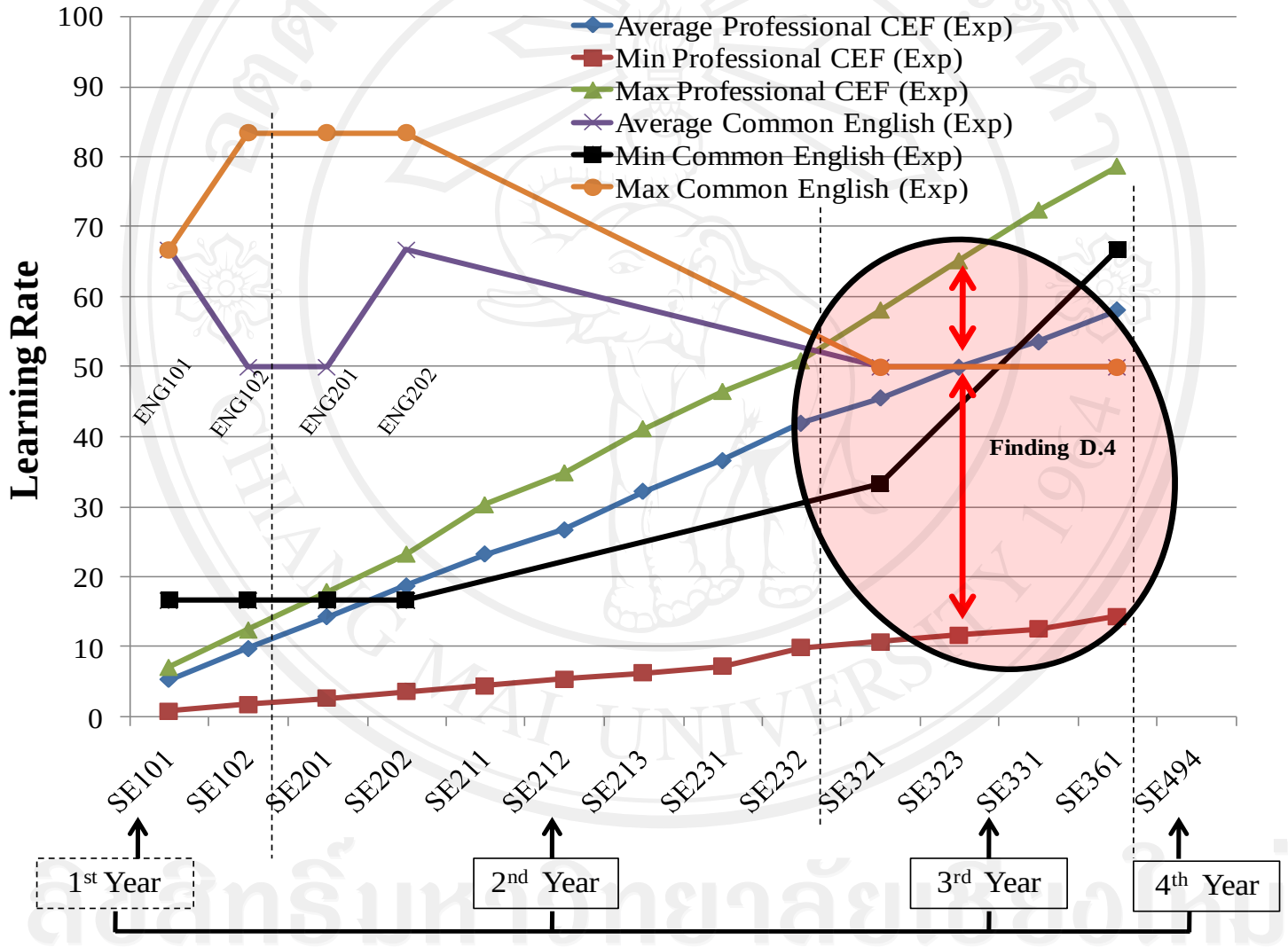

Figure 4.21 Average, Min and Max SE Students (Experiment Group) 2009

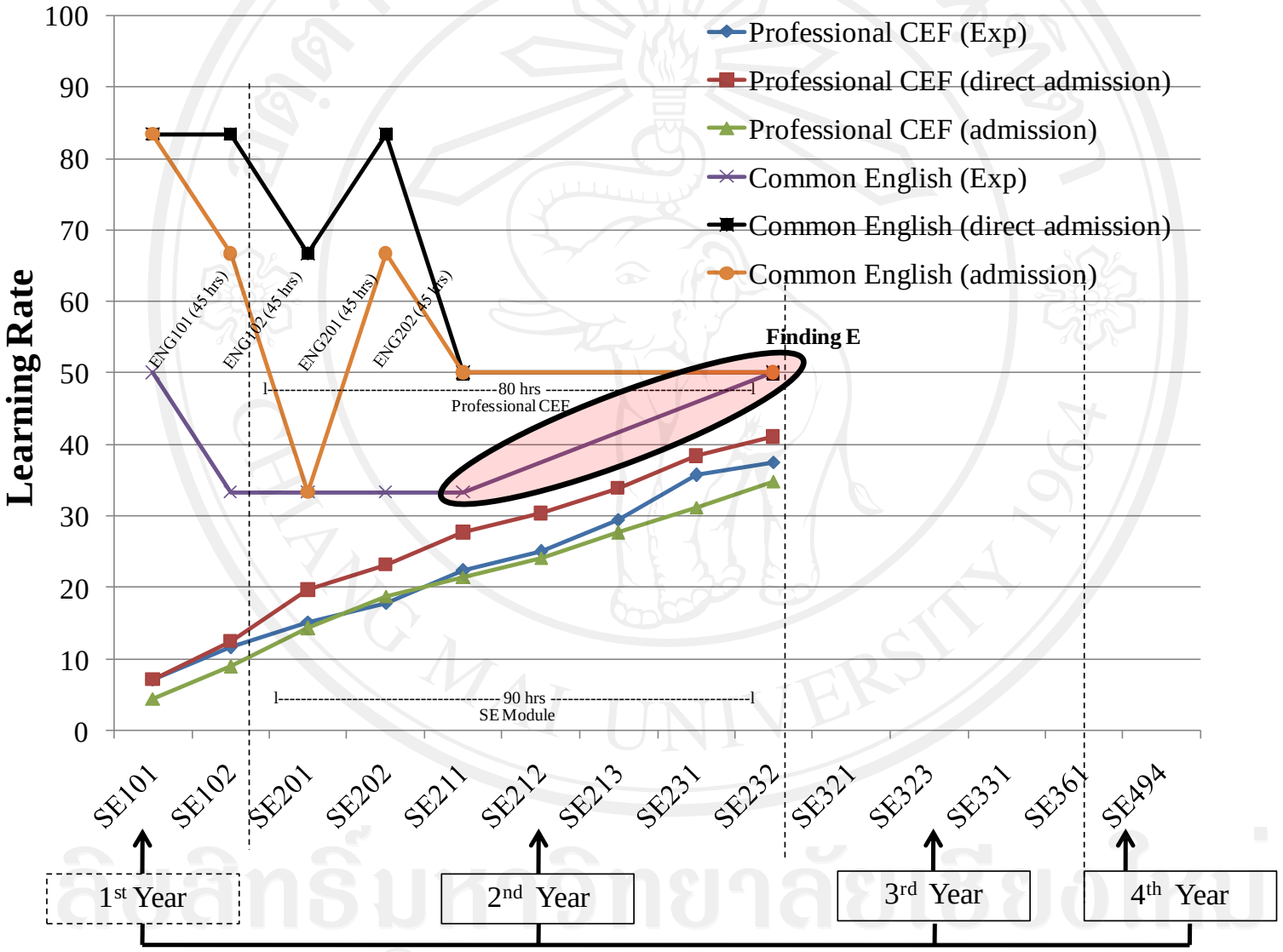

Figure 4.22 Software Engineering Students Academic Year 2010

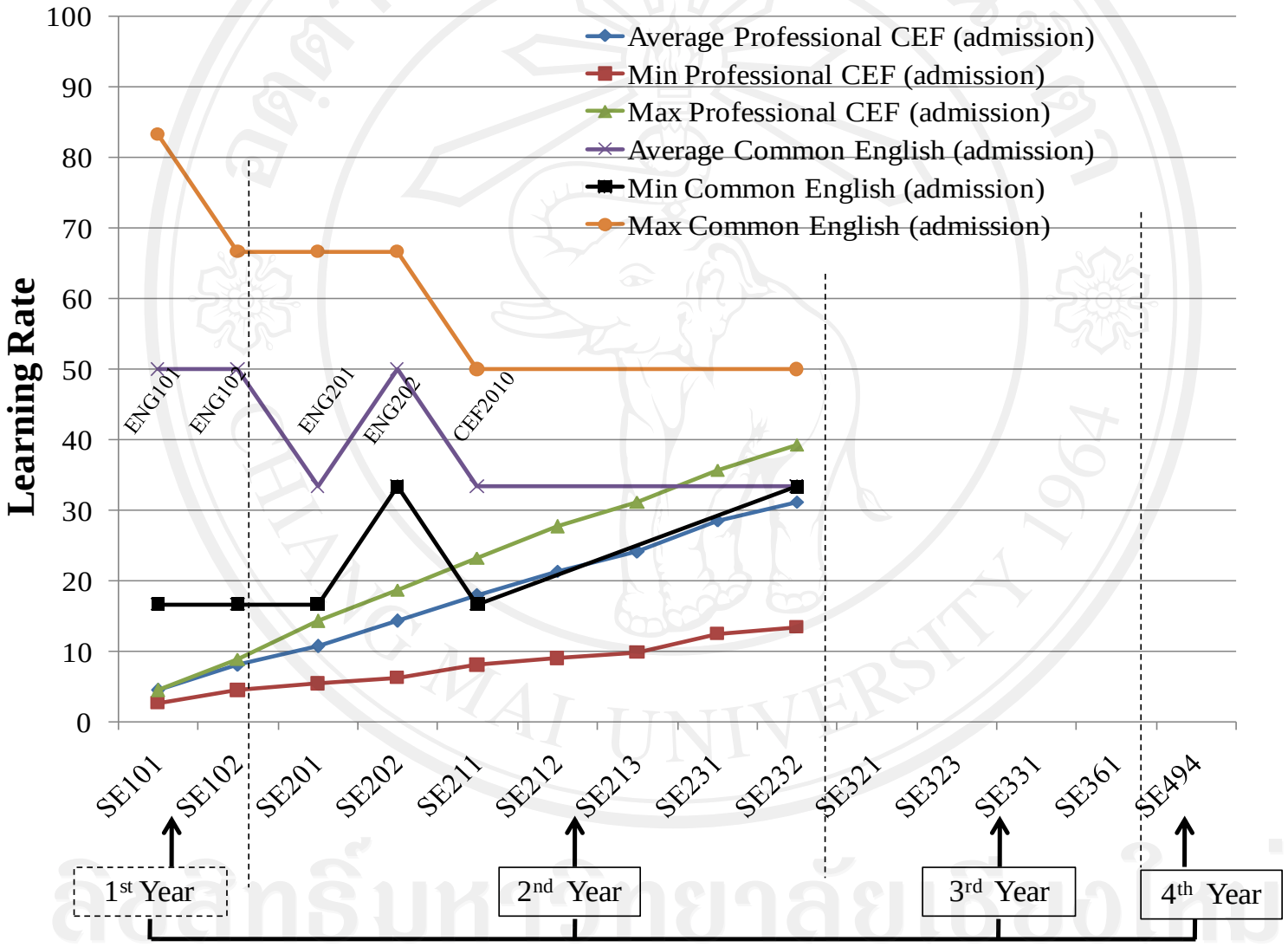

Figure 4.23 Average, Min and Max SE Students (Control-admission) 2010

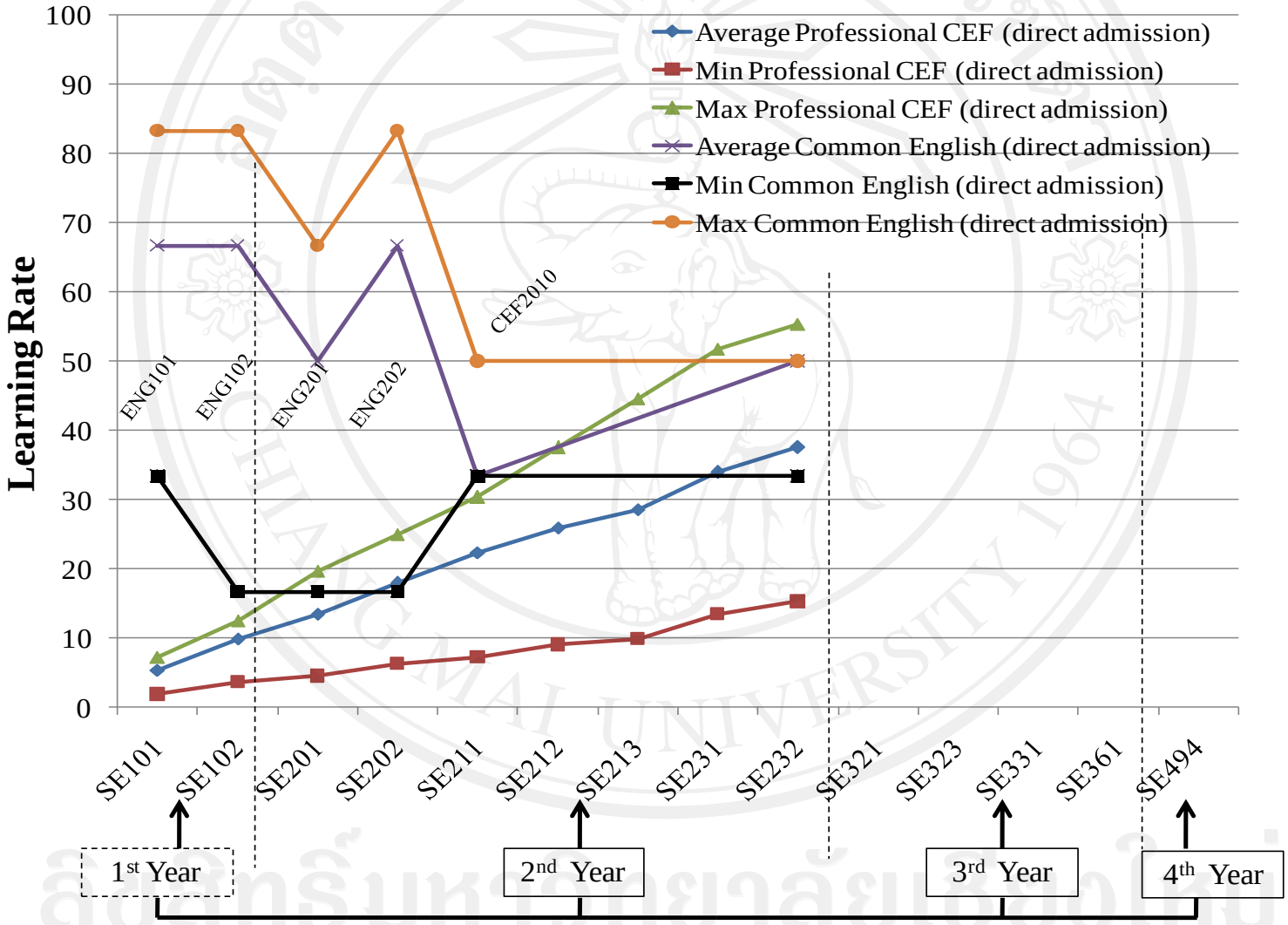

Figure 4.24 Average, Min and Max SE Students (Control-direct admission) 2010

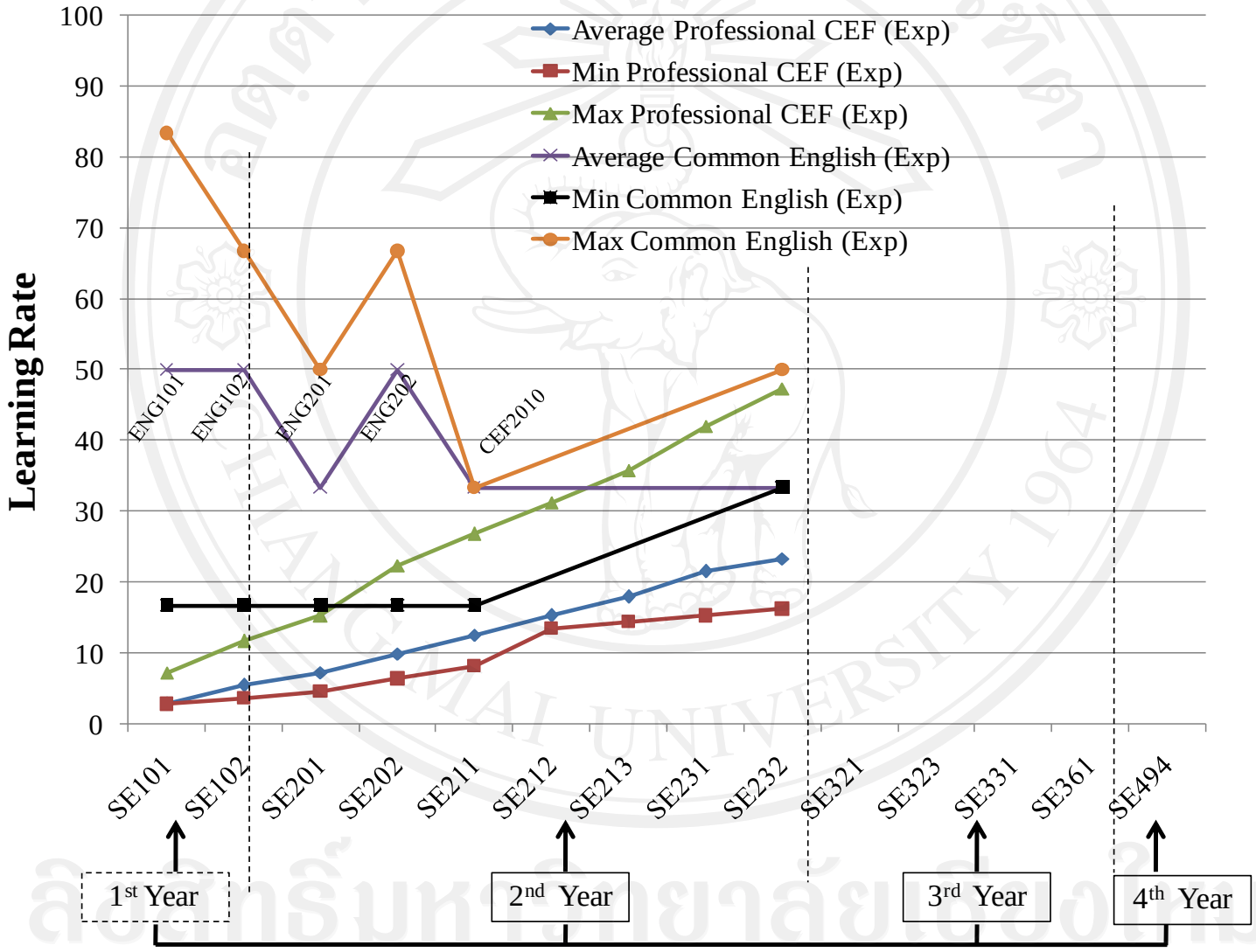

Figure 4.25 Average, Min and Max SE Students (Experiment Group) 2010

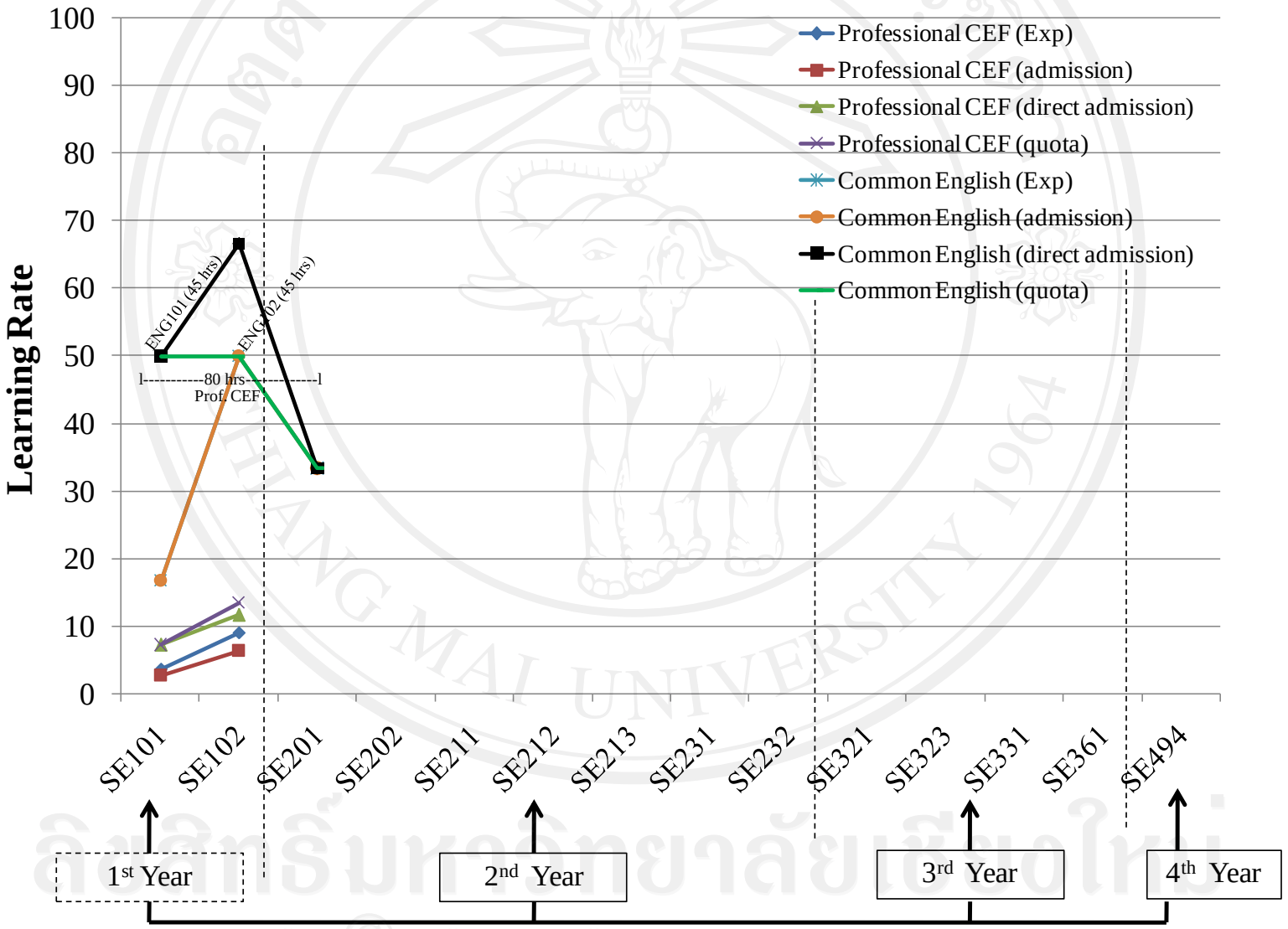

Figure 4.26 Software Engineering Students Academic Year 2011

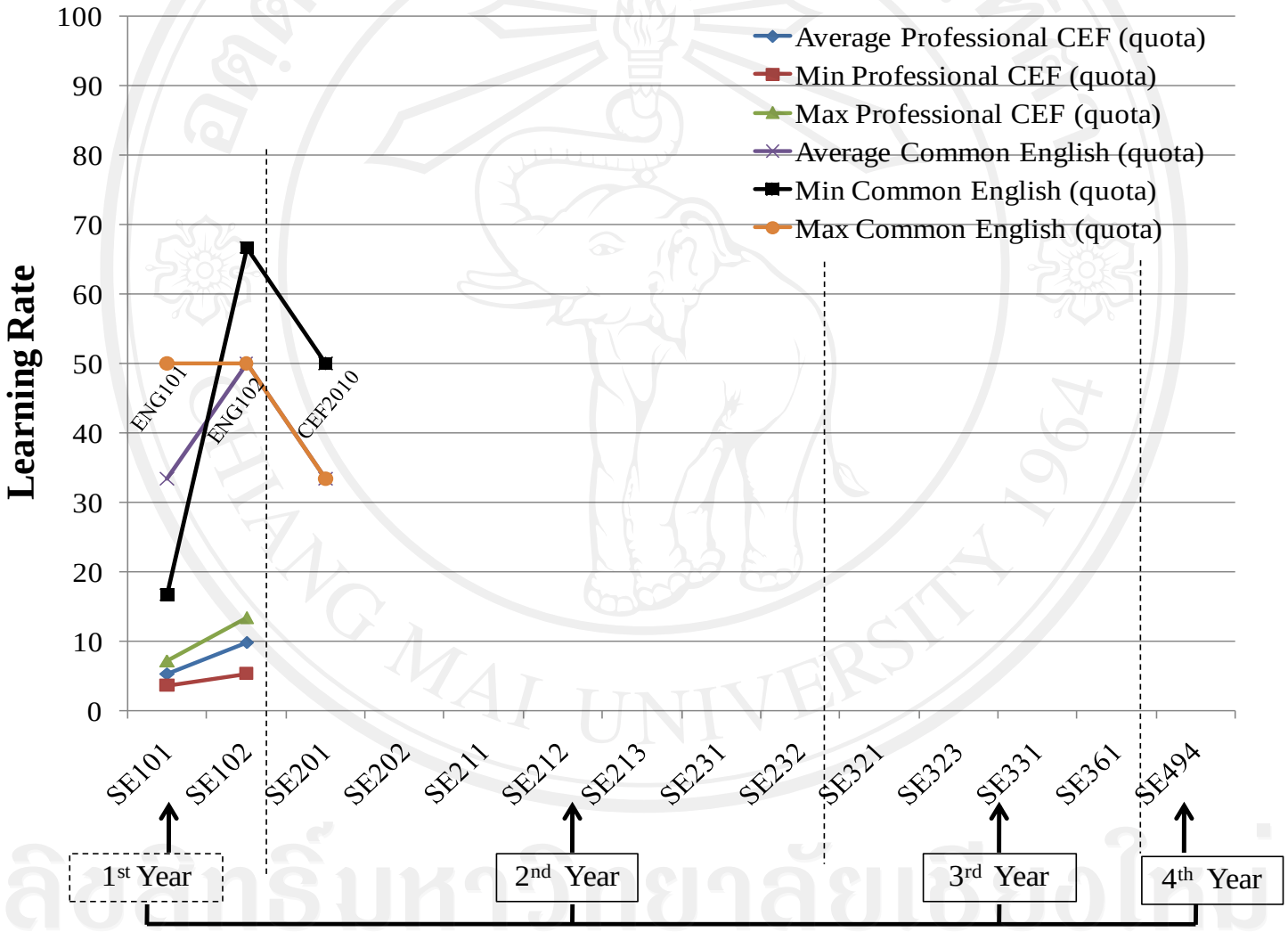

Figure 4.27 Average, Min and Max SE Students (Control-quota) 2011

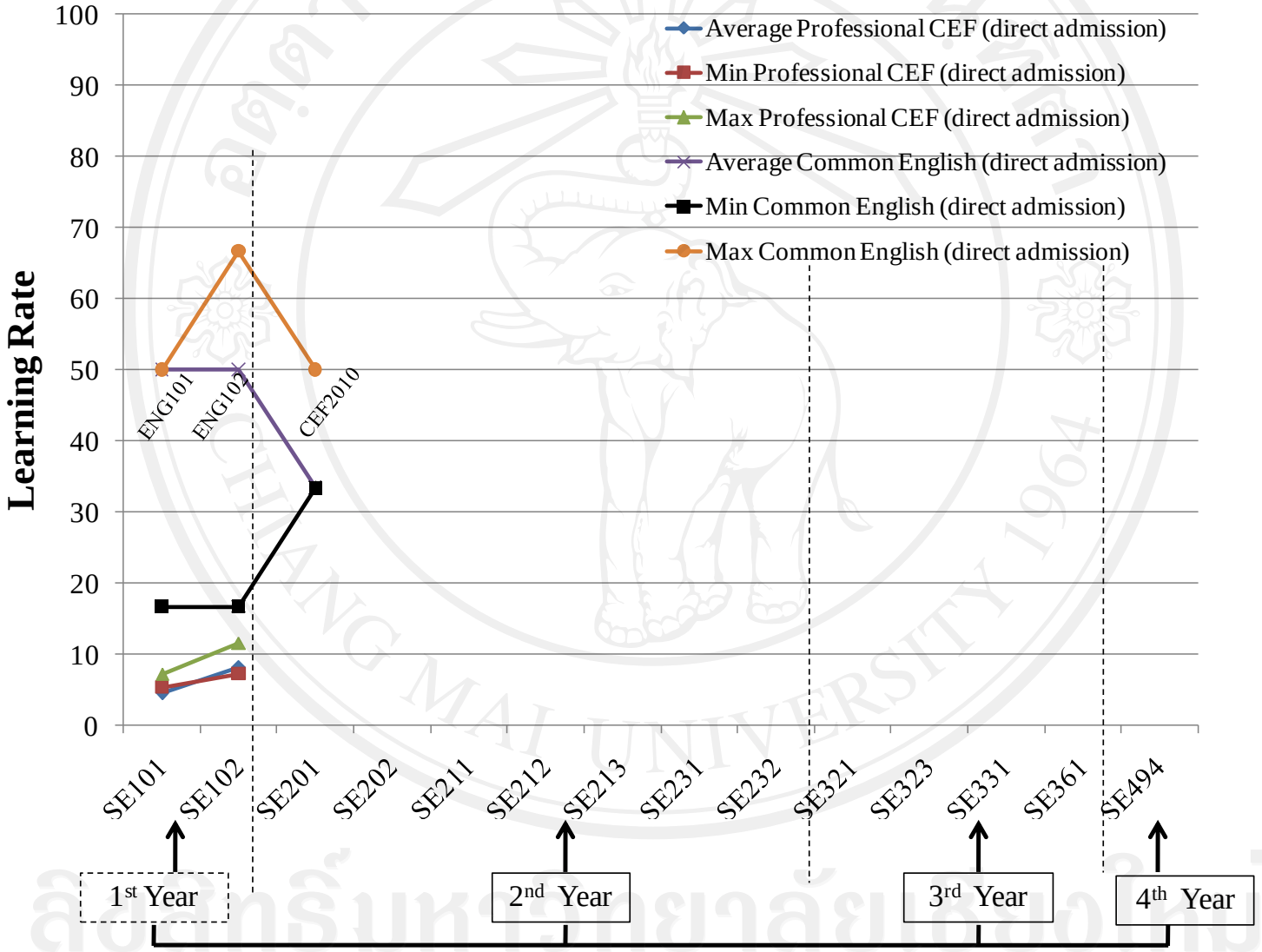

Figure 4.28 Average, Min and Max SE Students (Control-direct admission) 2011

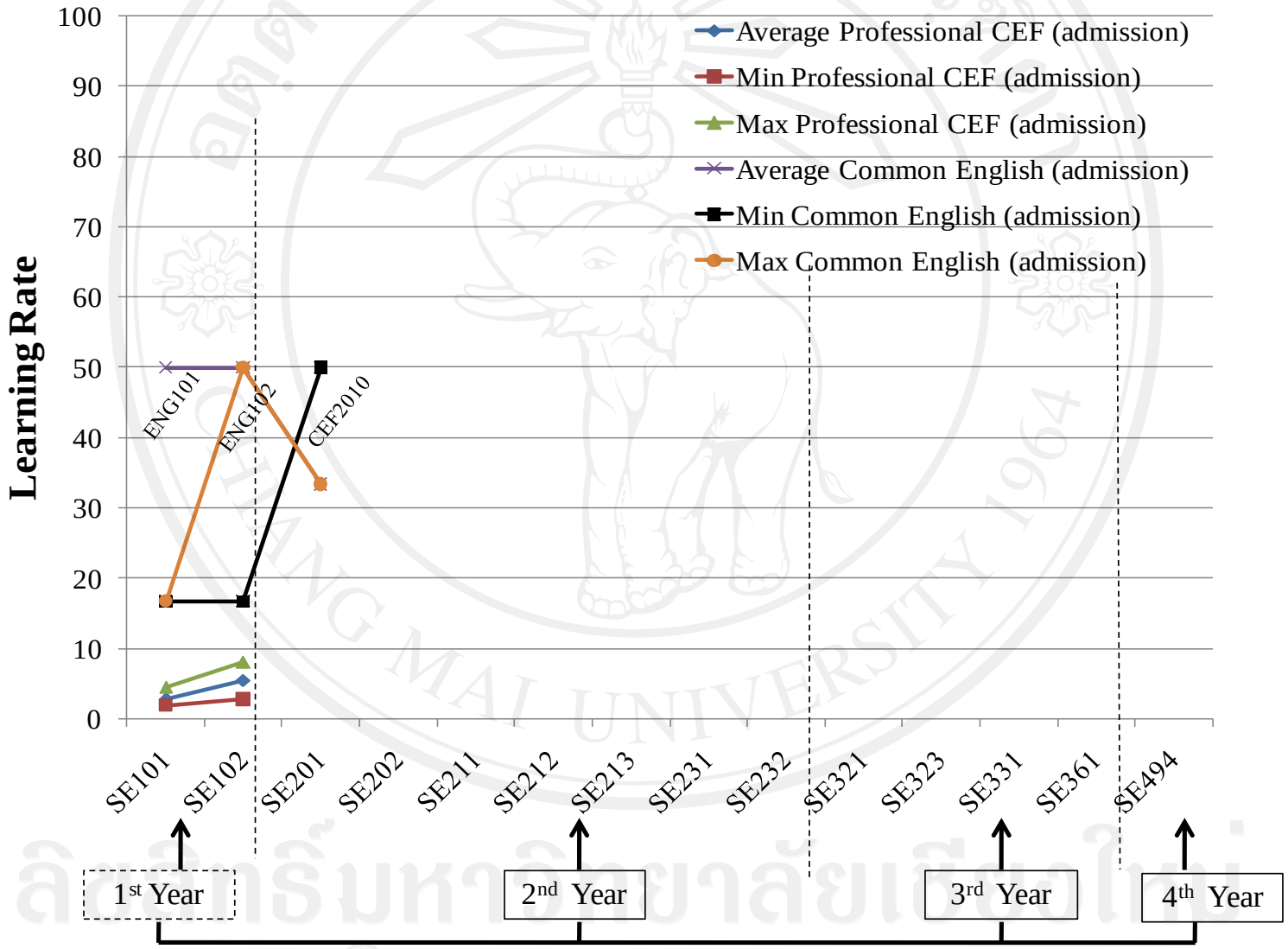

Figure 4.29 Average, Min and Max SE Students (Control-admission) 2011

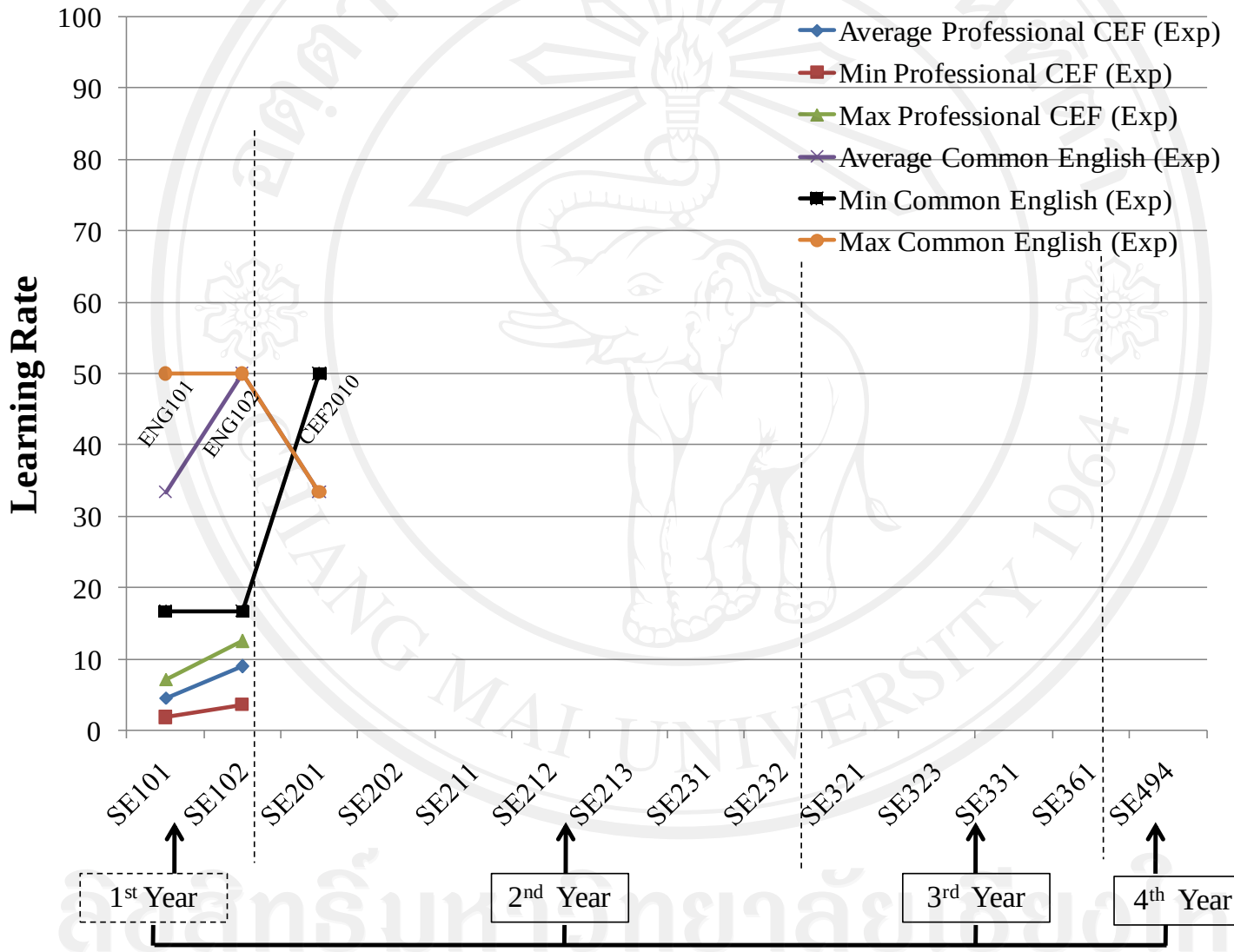

Figure 4.30 Average, Min and Max SE Students (Experiment Group) 2011

The hypothesis is that the remedial course (constructionism and error analysis) and CEF active English 400 hours (an immersive learning environment with native English speakers) bring 1st year university students' English proficiency to the international program requirement. Figure 4.12 presents the overview research findings of the experiment group year 2008 to 2011 to support the hypothesis which are:

- Overview A : The remedial framework (constructionism and error analysis) and CEF active English promote Exp professional CEF 2009 than prior year.
- Overview B : With 45 hours of remedial framework and 300 hours of CEF active English treatment, Exp Common English 2010 graph showed a lot learning improvement.
- Overview C : Learning is the continuing process, not clearly show much improvement during students first academic year.
- Overview D : Approximately 360 to 400 hours of English treatment (CEF and the remedial framework) can reduce the fluctuated learning rate and keeping it stable.

Besides, the key findings during the experimentation in 2008 to 2011 are:

- The hypothesis of CEF active English and the remedial framework (constructionism and error analysis) proposes that the treatment of 400 hours active English and English remedial course can bring students with the poor English proficiency level to the international program requirement as well as improve their communication skills both text and speech production. Finding A (Figure 4.13) showed that approximately 360 hours of CEF active English and

45 hours of the English remedial framework reduced the fluctuated learning rate of Common English as shown in Finding A.2 (Figure 4.15) as well as promoted the higher learning level as supported in Finding A.1 (Figure 4.14) and Finding A.3 (Figure 4.16).

- Papert (1980) believed that learning by doing and project based learning with the integration of technology to the problem solving situation (eg. industrial requirement contents) retain learned knowledge over time as well as enhance higher mental process. According to the distribution of scores (average, min and max), Finding B.1 (Figure 4.14) and B.2 (Figure 4.15) illustrated the normal distribution of scores while Finding B.3 (Figure 4.16) the average professional graph is nearly to the Max professional graph.

The distribution score shows experiment group with remedial treatment course and CEF active English treatment has more professional skill improvement than control-quota and control-direct admission. Finding B.3 (Figure 4.16) supported the remedial framework (constructionism and error analysis) hypothesis ‘enhancing more mental learning experiences’.

- Further to the sample qualification, of all four groups direct admission students’ English proficiency is the best. As constructionism and error analysis captures the higher mental process and the linguistic learning levels. Positive unexpected Finding D (Figure 4.17) showed that Exp group’ English professional CEF was the best of all during their third academic year.

Based on the score distribution (average, min and max), Finding D.1 (Figure 4.18), D.2 (Figure 4.19) and D.3 (Figure 4.20) professional CEF graphs of control-direct admission, control-admission and control-quota illustrate the normal distribution. Meanwhile, Finding D.4 (Figure 4.21) average score of experiment group spread out more to the max score.

- Finding C (Figure 4.17) illustrated approximately 360 hours active English (CEF) and 45 hours English remedial course reduced the fluctuated learning rate as well as keep it stable. This highlighted the CEF 400 hours hypothesis.

- Constructionism enhances more open ended learning experiences. Also the CEF hypothesis improves English proficiency. These hypothesizes are supported by Finding E (Figure 4.22). Common English (Exp) graph showed that approximately 300 hours CEF active English and the 45 hours remedial English course treatment can bring Experiment group with poor English proficiency to the international program requirement level.

The findings suggest that the proposed framework and assessment technique (error analysis) can improve Thais' English proficiency both professional English and common English by shifting from the grammar-based learning in the past 12 years education to reach higher levels of learning.

Chapter summary

This chapter presented the result, analysis and discussion of all four batches implementation in correlation to the methodology in chapter 3. To reconfirm the effectiveness of the remedial framework, students' English proficiency was being tracked during three stages: firstly since they entered the SE international program; secondly throughout CMU (CAMT) process, and lastly English proficiency output. The key findings were drawn out at the end of this chapter as well as supported by the Figures of conceptual improvement of SE students' English proficiency from year 2008 – 2011. The summary of the whole thesis was presented in the next chapter.