MINISTRY OF EDUCATION AND TRAINING

HANOI NATIONAL UNIVERSITY OF EDUCATION

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DEVELOP COMPETENCES IN TEACHING MATHEMATICS THROUGH ENGLISH FOR HIGH SCHOOL MATHEMATICS TEACHERS

Speciality: Theory and methods of teaching Mathematics

Code: 9 14 01 11

SUMMARY OF EDUCATION PhD THESIS

HANOI - 2018

The work was completed at: Hanoi National University of Education

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This Dissertation will be examined by Examination Board

At: ……

On ….....hour .....minute, day .....month 2018

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Preface

1. **Necessity of dissertation**

1.1. Emerging from the timely demand of global integration

Realizing the importance of English amid Vietnam's integrational and strategic period, has made the task of developing teachers' competence in teaching science subjects through English become an urgent need, especially teaching Maths through English.

1.2. Emerging from the practicalities and experiences of training teachers of Mathematics through English from other countries

We pay special attention to one of the methods of teaching subjects in a foreign language, which has been widely applied in Europe, as well as in many Asian and American countries – the CLIL method (Content and Language Integrated Learning).

1.3. Emerging from the practicality of training teachers of Mathematics through English in Vietnam during over the past decade

Despite various short-term traning courses held in different forms to foster Vietnamese teachers' professional competence, limited English still prevents them from meeting actual demands.

2. **Purpose of research**

The research aims to suggest the components of the competence to teach Mathematics through English, as well as measures to develop such components among Vietnamese teachers, with a view of meeting the country's demand for global integration in current time.

3. **Research object & subject**

+ Research object: The process of Teaching Mathematics through English using CLIL in high schools.

+ Research subject: Mathematics teachers' competence to teach Mathematics through English

4. **Contributions**

+ Theoretically speaking:

- Overviewed previous research results on developing teachers' competence to teach Mathematics through English using the CLIL method;
- Pinpointed the components of the competence to teach Mathematics through English;
- Suggested measures to develop such components using CLIL.

+ Practically speaking:

- Measures to foster the professional competence of teachers of Mathematics through English; supporting self-study as well as planned training;
- The two-episode, ready-to-use "English Mathematics Guidebook" as a product of the dissertation;

The first 310 page- episode includes the following contents:

- Instruction on how to pronounce phonemic sounds
- More than 900 common English- Vietnamese Mathematics words
- More than 800 common Vietnamese- English Mathematics words

The second 240 page- episode includes:

- Common English structures used in the classroom
- Instruction on reading mathematical formulas in English
- Common English structures used in Mathematics

- This dissertation acts as a helpful reference to teachers and students majoring in Pedagogical Mathematics, who have English competence and wishes to teach Mathematics through English in Vietnam.

5. Structure

The dissertation consists of three chapters (excluding the Preface & Conclusion):

Chapter 1: Theoretical & practical basis of developing Mathematics teaching competence through English.

Chapter 2: Measures to develop Mathematics teaching competence through English -a CLIL approach style for high school Mathematics teachers.

Chapter 3: Pedagogical experimentation.

CHAPTER 1: THEORETICAL & PRACTICAL BASIS OF DEVELOPING MATHEMATICS TEACHING COMPETENCE THROUGH ENGLISH

1.1. Overview of research on Teaching Mathematics through English

1.1.1. In the world

In order to meet the need of using English as an international language, from the 70s of the twentieth century, in addition to teaching English as a foreign language, learning and teaching some science subjects in English has been developed in many parts of the world, mainly in the form of bilingual teaching.

Starting from the 90s of the 20th century, a teaching method took great interests and was widely applied in various European countries, known as the CLIL method – Content and Language Integrated Learning. Ever since, many research working on CLIL have been established, while many countries have also succeeded in implementing CLIL into teaching various science subjects through English, including Mathematics.

In this dissertation, we will elaborate on how to develop teachers' capcompetence of Teaching Mathematics through English using the CLIL method.

1.1.2. In Vietnam

Vietnam has had its first steps in developing the country's resource of teachers who can teach science subjects, including Mathematics, through English. However, prominent results are yet to come.

That being said, there has yet to be specific guidelines for the program, nor for the method of teaching subjects in foreign languages from the authorities. This is the primary difficulty, causing a severe lack of qualified teachers who have the competence to teach maths through English.

In Vietnam,teaching of mathematics through English encounters tremendous difficulties like other countries. Language barrier and stagnant economic situation make the situation more depressing.

1.2. Some approaches to teaching Mathematics through English

1.2.1. Teaching foreign languages for students whose major is Mathematics

The second half of the twentieth century emerged the approach to teaching mathematics through foreign languages and teaching foreign languages for students whose major is Mathematics.

This approach is mainly used for the study and exchange of written content in mathematics through foreign languages among scientists in the country and internationally. It is also a prerequisite for some scientific exchanges in scientific conferences and seminars with international elements.

1.2.2. Teaching bilingual

Integration (English, French, German) is derived from Latin; Integration is an act or instance of combining into an integral whole.

According to Richards and Rogers (2014), CLIL instruction - Content and Language Integrated learning has the following characteristics:

- Equip students with cultural knowledge and language
- Students develop intercultural communication skills during school hours
- Students get more exposure to specialized language
- Increase motivation and confidence for students in both learned content and foreign language.

1.2.3. Content and Language Integrated Learning – CLIL

CLIL stands for Content and Language Integrated Learning.

Teaching Mathematics through English- a CLIL approach means instructing Mathematics through English while English itself is also learned during the process. This creates an intertwined setting of three languages: Vietnamese, English and Mathematics Language, in which the two latter are hoped to be studied more effectively.

1.2.4. Components of CLIL

The four components that constitute CLIL, all starting with “C”, include: content, communication, cognition and culture (Coyle, 2007; Coyle, Hood and Marsh, 2010). The integration of these four components has proven the effectiveness of the teaching goals and results.

a. Content- The subject content

b. Communication

Learners not only learn content of the subject (Mathematics) through a foreign language (English), but also communicate the subject matter (Mathematics) through a foreign language(English).

c) Cognition

CLIL instruction helps to improve critical thinking or cognitive skills, which is a challenge for learners. Critical thinking skills will in turn help students to learn subject matter in specialized subjects. These skills include argumentative skills, creative thinking, critical thinking and judgment.

d) Culture

Content and language integration gives us the opportunity to introduce a variety of cultural contexts. Learners need to be educated to have positive attitudes and be aware of the responsibilities of a global citizen as well as in the area in which they live.

1.3. Competence to Teach Mathematics through English

1.3.1. General matters about competence

1.3.1.1. Definition of "competence"

According to the Ministry of Education and Training, competence – as noted in the new National Curriculum Framework for General Education – is defined as "the competence to gather knowledge, skills and different mental attributes, e.g. passion, belief, determination, etc. to successfully perform a task in a certain context. Personal competence is assessed by the meanings and results of a person when solving a problem in life".

1.3.1.2. Teaching competence

Teaching competence is the system of personal attributes of each teacher, which they need to excel in teaching.

1.3.2. Components and criteria of competence to Teach Mathematics through English

1.3.2.1. Bases of criteria building for assessing Mathematics teaching through English

a) Consulting other countries' teacher aptitude assessment criteria

b) Ministry of Education and Training's Competence Standards for Teachers.

The Ministry of Education and Training proposed six standards, with 25 criteria about the professional standards of secondary school teachers, in which "teaching competence" contains the following criteria:

- Develop a teaching plan
- Ensure subject knowledge
- Ensure course curriculum
- Utilize teaching approaches
- Use teaching aids
- Build learning environment
- Manage teaching records
- Examine and evaluate students' learning outcomes.

c) Following CLIL

As discussed in Section 1.2, teaching science subjects in English aims to provide students with some basic knowledge (such as mathematics, physics, geography ...) through a foreign language (

English, French ...). To make it clear, language is used as a medium to impart knowledge, and develop both content and language aspects.

Teaching Mathematics through English involves both the approach to teaching mathematics and the approach to teaching English, so teaching Mathematics through English poses many challenges for both teachers and students. In Teaching Mathematics through English, mathematics and English are closely linked and interrelated to create integrity. The linkage can create an integrity entity, based on the internal consistency of the linking components, not the placement of the components side by side. Therefore, when teaching mathematics through English, the knowledge and skills of math and English are aligned and coordinated; On the one hand, Mathematics content is taught in English and on the other hand English is learned through Mathematics content. A good command of English will facilitate the learning process of mathematics. Conversely, the process of acquiring Mathematics content in English will help students develop English language competence; The four skills (listening, speaking, reading, and writing) are developed as students learn math through English.

Teaching Mathematics through English- a CLIL approach means instructing Mathematics through English while English itself is also learned during the process. This creates an intertwined setting of three languages: Vietnamese, English & Mathematics Language. A lesson teaching Mathematics through English using CLIL approach is a lesson neither in English nor in mathematics, it is an integration of both; Therefore, teachers of Mathematics through English not only use the approach to teaching mathematics, but also have the approach to teaching mathematics and the approach to teach foreign languages.

Because of the characteristics of teaching Mathematics through English using CLIL approach, teachers play an important role in the teaching process. Teachers need to change the habits of teaching math through the mother tongue - Vietnamese, to teach through foreign languages - English. Teachers also need to take their abilities and language limitations into account.

According to Eurydice (2006), in preparing for CLIL instruction, teachers must have expertise in one or more non-linguistic subjects and attain at least B2 level of proficiency according to The Common European Framework of Reference for Languages.

However, teachers who are good at teaching (mathematics) and good at foreign languages (English) are not proficient enough to teach using CLIL approach, because this approach requires teachers to integrate between math and English.

d) Teaching competence of Math teachers

According to the Ministry of Education and Training, we support NTD's (2014) view of teaching competence of math teachers, including the following five components:

(i) Understanding math content

(ii) Understand math program

(iii) Understand students' math learning

(iv) Design and practice teaching mathematics

(v) Reflect, evaluate and cooperate

1.3.2.2. Suggested components and criteria of competence to teach Mathematics through English

Based on the characteristics of Mathematics through English (see in 1.3.2.1) and the bases for suggesting components of academic competence (see in 1.3.2.2), we hereby suggest the components and criteria for teachers instructing Mathematics through English in the following table of 3.1:

Code	**Components and Criteria for Teachers teaching Mathematics through English using CLIL method**
T	**Self-study specialized English and English communication (in the classroom) to teach Mathematics through English**
T2	Self-learning from specialized English language resources and English communication is provided and applied at a simple level in accordance with the principles required for the approach to teaching mathematics through English.
T3	Be selective, self-regulated specialized English and English communication from the source material. Proper use of specialized English and English communication in teaching mathematics through English.
T4	Design material in specialized English and English communication. Flexible use of specialized English and English communication in teaching math through English
N	**Language abilities**
N2	- Basic language competence (four skills) to use English terminologies and structures to: explain, present, direct, elaborate, examine, etc. - Basic usage of English in class management (e.g. group supervision, time management, noise control, directing, interaction management & communication encouragement).
N3	- Use one's own language in teaching by changing: sentences, speed, intonation & volume - Use teaching skills (e.g. repetition, modelization, direct edition, etc.) to promote English communication among students - Provide questions and tasks that stimulate lingual and Mathematical intellect among students - Provide proper guideline questions to support students; know how to organize and manage the communication process within the CLIL class.

N4	- Deeply understand the mathematical ideas and lingual capcompetence of students, thereby choosing one particular idea for discussion. - Know when to provide information, when to explain, and when to let students face difficulties alone. - Request students to explain mathematical ideas in specialized English; accept students' presentation and encourage use of more diverse presentations of mathematical ideas through English.
K	**Competence to form and organize classroom activities**
K2	- Know how to create chances to connect new and old knowledge - Have an appropriate approach to any topic
K3	- Have a good approach to the lesson content
K4	- Integrate different subjects - Support students in exploring new knowledge and concepts
X	**Class atmosphere building**
X2	- Build a serious yet joyful studying atmosphere; encourage independence, individuality and freedom to express personal opinions
X3	- Provide proper means and materials to support CLIL learning process
X4	- Create opportunities for students to explore, raise questions, form and test hypotheses, as well as explain Mathematics and English contents - Create opportunities for extra knowledge gaining
Đ	Competence to assess and self- assess
Đ2	- Identify math and English content related to the lesson that students already know and do not know (directly and indirectly); can be done and not done and students need to learn.
Đ3	- Determine student's learning progress. - Understand how your teaching is affecting students. - Know if your teaching technique is effective - Know, evaluate, correct errors on math and English content in time for students.
Đ4	- Know how to help students in the right place, right time and right way. - Know the relative academic strength of a student with others in order to choose the appropriate activity for each one. - Adjust both Math and English content and the teaching approach to achieve teaching goals.

Table 1.3. Components and Criteria for Teachers instructing Mathematics through English

1.5. Chapter 1 conclusion

Many countries in the world have applied CLIL. This method emphasizes on the organic relation between class contents and language, requiring a deep level of understanding of the teachers to effectively apply the method.

Based on international research results, we have clarified four components of academic competence to teach Mathematics through English, based on four aspects: Understanding of CLIL, Lingual abilities, Competence to form and organize classroom activities and to maintain class atmosphere building. Each component comes with specific, detailed criteria.

Among various reasons for difficulties in implementing teaching Mathematics through English as well as teaching other subjects through English, one important reason is teachers' limited competence. The results of the survey show that although many teachers have recognized the role and importance of integrating content and language teaching in mathematics instruction, teachers have not really invested and there are no measures to train teachers' competence of teaching content and language integration. Many schools already conducted training but they are still confused in the process of training. It is necessary to select the content, employ appropriate measures and organize activities effectively. Therefore, in Chapter 2 we study to propose solutions that help to foster and develop the above competencies for teachers effectively.

CHAPTER 2: MEASURES TO DEVELOP MATHEMATICS TEACHING COMPETENCE THROUGH ENGLISH - A CLIL APPROACH FOR HIGH SCHOOL MATHEMATICS TEACHERS

2.1. Solution Group 1: Competence for self- studying English for those whose major is Mathematics and English communication and methods to develop this competence for students.

2.1.1. Purpose of Solution Group 1

This method aims to develop the component of lingual competence, supporting teachers with competence in teaching Mathematics and English who wishes to teach Mathematics through English through self-training or organizations.

2.1.2. Bases of Solution Group 1

2.1.2.1. Practical basis

2.1.2.2. *The role of self-study & skills required for self-study*

2.1.3. Execution method of Solution Group 1

2.1.3.1. *Solution 1.1: Teachers always pay attention to the presentation of each word in mathematics content based on an official English document and note down in Mathematics- English manual for regular use, which supports self study, developes teaching skills and provides students with a learning model.*

In order to express truly like a native person, there is no choice but to use their own ways of expression. When teaching Mathematics through English, we ought to use expressions provided by textbooks, reference books and other materials from English-speaking countries, such as: the UK, the USA, Australia, Singapore, etc.

Teachers can offer a few expressions from different books or coutries so that students can compare.

2.1.3.2. *Solution 1.2: Studying through ready-composed materials*

Through the processes of Teaching Mathematics through English ourselves and the fostering teachers of the Ministry of Education and Training to teachers, we have composed various materials to support of teaching and studying Mathematics through English, in order to provide to other colleagues.

From our recommendation, in order to teach Mathematics through English, a teacher must be familiar with general Mthematical terminologies (in both English and Vietnamese), as well as common sentence models used in an English class.

To serve this purpose, we have already composed our version of material under a form of "English Mathematics Guidebook". This series consists of two guidebooks, perspectively 310 and 240 pages long, both containing specific usage guidelines.

2.1.3.3. *Solution 1.3: Vocabulary Teaching Method (mostly mathematical English terminologies)*

In the lessons, the teacher must decide which words to teach. In order to answer this question, he/she must determine each word's frequency of appearance, as well as its role in understanding the text. Words that are repeated or carry a contentual statement are inevitably words that need to be elaborately explained to the students. Most of these are either mathematical English terminologies, or frequently used structures in Mathematics teaching.

- Teach new vocabularies through listening, comprehension reading and intentional vocabulary learning; develop the vocabulary's fluency.
- Teachers can help students consolidate and expand their lexical resource by creating classroom activities and shaping the learners' proactiveness.

In this part, the authors want to emphasize on some notes related to when teachers expand their own English vocabulary or teach students new words (mostly terminologies):

(1) Learning and teaching vocabulary in a word list can be one of the ways to learn.

(2) When learning vocabularies of a topic, teachers should learn all related words as well, as it will make the original vocabulary easier to remember and more difficult to forget. By studying these "collocations", the teacher will find it easier to paraphrase and avoid boring, repetitive use of words when teaching Mathematics through English.

(3) Just as learning new vocabulary in a list, the act of translating a word is not necessarily "negative". In many situations, learning new words by translation proves itself fast, easy to understand and helpful for learning other words.

(4) Sometimes, the use of force to make students guess the meaning of an advanced word, terminology or a word in a new context might cause a loss of interest in reading.

(5) Although each student may have their own method of learning vocabulary, a combined method can still generate interest and effectiveness.

(6) As we mentioned in (3), merely using an English – English dictionary does not guarantee great results.

(7) The learning of words in one single textbook's scale is not enough, since there is no actual textbook that can once and for all provide all vocabularies that students and teachers will use in their academic and career life.

2.1.3.4. *Solution 1.4: Guiding teachers towards composing their own materials to support teaching Mathematics through English.*

Using his/her own experience, each teacher can compose himself/herself teaching materials similar to those mentioned in part 1.1. The sharings in part 1.1 have been condensed from the experience of the author of this dissertation and surrounding colleagues, throughout the process of Teaching Mathematics through English from 20122 until now, under the light of theoretical pedagogy in general and CLIL in particular.

2.2. Measure 2: Group measures for language development, competence building and learning activities organizing, competence for building learning environment for teachers teaching mathematics in English

2.2.1. The purpose of Measure 2

This measure aims at developing some components of the competence for teaching Maths through English: language competence, design and practice competence, competence for building the learning environment for teachers.

2.2.2. The basis of Measure 2

2.2.3. The implementation of Measure 2

2.2.3.1. Measure 2.1: Introduce a system of questions, logical learning tasks to stimulate students' language thinking and mathematical thinking.

Math through English teachers are introduced a handbook "Common English Structures in the Classroom" (with attached text) that covers many different sections. In each of the sub-sections there are different types of structures, the teacher needs to know two or three ways in these sentences and needs to pronounce correctly with intonation. Once you have mastered these sentences, learn new sentence patterns to enrich your vocabulary.

2.2.3.2. Measrure 2.2: Create and organize activities to teach Maths through English in order to provide students with opportunities to explore, ask questions, formulate and validate hypotheses, and explain math content. Students will also be able to develop English Communication and specialized English in terms of four skills (listening, speaking, reading, and writing) by focusing on developing each skill and then coordinating multiple skills.)

a) Practice listening skill

b) Practice speaking skill

c) Practice reading skill

d) Practice writing skill

2.2.3.3. Measure 2.3: Designing lesson plans which are suitable to the competence of the teacher and the students in the class.

A lesson plan is a design, including teacher and student activities which take place in a context, a favorable teaching and learning environment in order to achieve the teaching purpose. The lesson plan should be consistent with the actual performance of the teacher and students in the class.

In particular, in classes teaching Maths through English, lesson planning needs to be suitable with the English communication environment and has to ensure the content of mathematics, so that the content and language is closely integrated. Some different model lesson plans can be served to tailor to the needs of teachers and students. Some samples that have been tested in practice have proven effective. Here we present one of them. (Please see the detailed dissertation)

2.2.3.4 Measure 2.4: Combining classroom teaching with some supportive activities (clubs, seminars, teaching projects ...) to provide opportunities for the development of English communication and English for specific purposes.

In order to create opportunities for the development of English communication and English for specific purposes, we can combine classroom teaching with some supportive activities such as extracurricular activities, club, seminar, teaching project….

2.2.3.5. Applying micro- teaching methods to develop pedagogical skills for teachers teaching Maths through English

- *The theory of micro- teaching methods (MTM)*

Micro denotes the meaning of smallness. The micro-teaching method means that a normal class can be divided into small, short lessons. The micro-teaching method can be clearly demonstrated in the training phase when the teacher need to split the activities.

The term "micro teaching" describes a set of teacher training techniques, especially new teachers who practice or are trained new teaching techniques.

- *The process of using the micro- teaching method to guide the teacher learners.*

+ Stage 1 (general orientation): This is the first stage which is important in MTM training. At this stage, teachers will be provided with the basic directions of MTM.

+ Stage 2 (practicing individual skills)

+ Stage 3 (practicing integrated skills)

- Assessing the teacher's competence in teaching Maths through English based on student's academic performance

+ Did the student know how to use the vocabulary, mathematical patterns through English?

+ Did the student understand the use of vocabulary, mathematics patterns through English?

+ Have students used the vocabulary, mathematics patterns through English?

2.3. Measure 3: Assessing teacher's competence in teaching Maths through English

2.3.1. The purpose of Measure 3

Through assessment, teachers can obtain students' feedback which can help them confirm the results achieved, adjust, supplement and remedy the shortcomings in students' perception. Consequently, teachers will provide timely guidance for each student so that they can be on the right track in each activity. Assessment enables learners to make their own judgments, comments, and self-judgment about their studies and to help teachers see what they must do next in the teaching process.

Moreover, through the assessment process teachers can adjust the content as well as their teaching activities. If a qualified teacher is able to self- evaluates his / her teaching lessons, he or she will achieve the initial purpose of the unit. Self-assessments will help the teaching process and lessons will be smooth and effective through more active and independent activities.

This measure aims at developing teachers' competence to assess the results of teaching and learning mathematics through English.

2.3.2. The basis of Measure 3

Self-assessment is one of the skills and competencies for each teacher and student in modern society. Moreover, due to the specificity of Maths and Maths through English, teachers can evaluate their teaching process through mathematical activities or under the guidance and orientation of educational institutions. Self-evaluation does not provide teachers with adequate feedback on the advantages and disadvantages of teaching when used alone. It is necessary to integrate teacher self-assessment with assessment from other educational organizations. As such, the re-evaluation process will make the assessment process more objective, comprehensive, accurate and effective.

It is therefore recommended that the self-assessment and evaluation for teachers teaching Math through English contribute to improving the competence of each teacher in the teaching process.

2.3.3. The implementation of Measure 3

2.3.3.1. Measure 3.1. Evaluation based on criteria for the components of teacher competence

In abovementioned 1.2.2, teachers can self-assess while self-studying, self-improving teaching Maths through English competence or be assessed periodically. It is possible to evaluate the effectiveness of teaching math through English in three ways:

- Competence to design and choose learning activities;
- Competence to organize learning activities;
- Competence to build learning environment.

2.3.3.2 Measure 3.2. Assessment based on teachers' assessments

Based on the criteria for the components of the teacher competence in abovementioned 1.2.2 and some formative assessment forms used by some schools, we designed an assessment form as shown in Table 2.9 below:

	Evaluation Criteria	Degree(Point)				
A. Preparing lesson plans, teaching aids (25đ)	1. Clearly identify the goals of the lesson / period (Maths knowledge, English, skills, attitude). 2. Prepare lesson plans carefully and thoughtfully (Math and English) 3. Prepare adequate teaching aids / equipment. 4. Activities are arranged in a logical sequence 5. The activities are designed and English should be used in accordance with the age and level of each student group.					
B. Content (20đ)	6. Ensure the accurate, logical, and scienctific side of the terminology and focus on the main points of the lesson. 7. Ensure the level of division in accordance with students' English competence. 8. Having the contents of the lessons suitable to Vietnam and international reality. 9. Integrate educational and cultural content (ethics, values, life skills, interests, beliefs ...) into the content of the lesson.					
C. Language (English) (35đ)	10. Pronounce English words correctly 11. Speak with correct grammatical rules. 12. Intonation, rhythm and stress (English word stress and sentence stress) are naturally and accurately performed by teachers. 13. Use correct terminology and English specialized sample sentences. 14. Teachers are interested in correcting students' errors resonably. 15. Commands, instructions are presented briefly, clearly 16. Use good English in situations that arise in and out of class					
D. **Teaching methodology (30đ)**	17. The teacher creates meaningful contexts to introduce the lesson through English in a natural way. 18. The teacher creates situations in which students can use English in real-life situations. 19. Choose teaching methods / techniques that are appropriate to the objectives, content, ways of teaching and students. 20. Utilize flexible teaching methods and techniques that can help students learn more effectively. 21. There are methods for collecting feedback on students'					

	cognitive competence and methods for acquiring information about the degree of students' perception. 22. Guide and stimulate students' self-learning competence					
E.Organize learning activities (35đ)	23. A variety of activities are provided to support the development of four skills for students (listening, speaking, reading and writing). 24. Students are guided, understand tasks and be proactive in learning activities. 25. Know how to use discrete questions / exercises, stimulate mathematical thinking and develop students' English. 26. Use teaching equipment reasonably and effectively. Students can use teaching equipment. 27. Flexiblly handle pedagogical situations in class. 28. Students are promptly assesed, evaluated, and corrected in terms of mathematics' content and English. 29. Ensure adequate timing of the whole lesson and time allocation for activities.					
F. Build learning environment (20đ)	29. Friendly classroom environment which enables students to use maximum English. Teachers do not talk too much. 30. Teachers successfully use non-verbal elements (gestures, postures, expressions ...) to create interesting lessons. Students show comfort, fun in class. 31. The teacher complements, comments, encourages the student to ask questions, respond to them and express viewpoints. 32. Teachers care all students in the class.					

G. **results (35đ)**	34. Students are interested in the lesson. 35. Students are confident and actively interacting during the learning process 36. Students develop four English language skills (listening, speaking, reading, writing) in the teaching process. 37. Students demonstrate competence to master knowledge, language skills and positive attitude after the lessons. 38. Students understand the meaning of specialized terminology and use sentence structures in accordance with the lesson objectives. 39. Create opportunities, encourage students to use English in the classroom 40. Students apply the knowledge, skills and language of the lesson / lesson in a particular situation.					
Total						
Total score:		**/200**				
Grade:		.....				

2.3.3.3 Measure 3.3. Assess students to evaluate teachers

- Classification of evaluation methods

Based on the assessment purpose, the assessment is usually divided into two approaches:

+ **Formative Assessment**, or Assessment for learning (to improve learning).

+ **Summative Assessment**, or Assessment for learning, summarizes the students' development at a particular time.

+ The purposes of this assessment:

Record results of students

Predict student's future academic performance

Help students obtain evidence (transcripts, diplomas, certificates) to continue their further studies.

- Some evaluation tools - test used when teaching Maths through English

+ Test

+ Portfolio

+ Worksheets

+ Observation

+ Continuous assessment

2.4. Conclusion

In Chapter 1, we have proposed three sets of measures, each with a number of specific measures, to develop the teaching competence of teachers teaching Maths through English, including:

Measure 1 group: Presenting each mathematical word- sentence needs to be consistent with a formal document through English and record the difference (if any) in a mathematical handbook for regular usage.

This group includes three specific measures:

- Expressing and presenting a lesson plan in teaching Maths through English is based on official documentation through English containing similar content.

- Learn and practice in accordance with the prepared materials

- Individually compile materials for teaching Maths through English

+ Measure 2 group: intensify specific activities to practice four skills in teaching Maths through English

This group includes five specific measures:

- Develop English communication through the use of common sentence patterns in the Math class.

- Develop specialized English in four skills (listening, speaking, reading, writing) by developing activities that focus on developing individual skill and then coordinating multiple skills.

- Creating lesson plans based on a number of samples to suit the actual competence of teachers and students in the classroom.

- Collaborate between classroom teaching with some supportive activities (extra curricula, clubs, seminars, teaching projects ...) to create opportunities for developing English for communication and specialized English.

- Apply micro teaching method to develop pedagogical skills for teachers teaching mathematics through English.

+ Measure 3 group: Assessing teachers' competence for teaching Maths through English

This group includes two specific measures:

- Based on the criteria for the components of the teacher competence

- Evaluate based on teachers' assessment forms.

These groups have a dialectical relationship with one another, complementing each other to create a whole. Each of three groups is indispensible because:

- Group 1 is a group of prerequisites, which is necessary because if teachers do not prepare the knowledge of mathematics as well as language, they will not be able to successfully complete the objectives of the lesson. In addition, because the competent requirements of teachers teaching Maths through English differs from those of teachers teaching basic subjects, planning a lesson requires not only the content but also the language.

- Measures in group 2 help with the practice of four skills, namely listening, speaking, reading and writing for teachers teaching Maths through English. In addition to the knowledge of

mathematics, teachers have to master these skills in order to successfully deliver the lessons so that the students find it easy to acquire.

- Measures in group 3 re-evaluate the tasks that Group 1 and Group 2 have set in order to develop assessment and self-assessment skills after each lesson for teachers teaching Maths through English.

In each group, we explain in detail the purpose, theoretical basis and how to implement measures to develop the teaching competence for teachers teaching Maths through English. The link among the measures is the basis for creating feasibility and effectiveness for proposing measures.

CHAPTER 3: PEDAGOGICAL EXPERIMENT

3.1. Purposes, contents and organization of pedagogical experiment

3.1.1. Purposes of pedagogical experiment

Pedagogical experiment (PE) aims at assessing the feasibility and effectiveness of the measures to develop teachers's competence in high schools in accordance with PPCLIL.

It is necessary to assess the proposed measures:

+ Will they help teachers overcome difficulties in teaching Maths through English?

+ Will the measures contribute to the development of teachers' competence?

+ Will PE lessons help students develop four skills of listening, speaking, reading and writing Maths through English?

3.1.2. PE's tasks

Task 1: Apply the measures in Chapter 2 to experiment on a group of teachers teaching maths through English and monitor their competence development based on assessment and self-assessment results following the criteria proposed in Chapter 1 (case study approach);

Task 2: Collect teachers' feedback on the feasibility and effectiveness of measures in chapter 2, then process statistical data by SPSS software;

Task 3: Compare and contrast students' results before and after PE lessons using qualitative and quantitative methods.

3.2. PE's organization and content

3.2.1. Organize and implement the first pedagogical experiment

* Organizing a group of PE teachers:

We organize a group of PE teachers at Foreign Language Specialized School – Vietnam National University, Hanoi

* Experimental time: from 20/8/2017 to 31/10/2017; twice a week on Wednesday and Saturday, 120 minutes each session.

* Group's activities:

- Activity 1: Provide teachers with training -a clil approach

- Activity 2: Study proposed measures in chapter 2 of the thesis and practice planning lessons

- Activity 3: Prepare and teach experimental pedagogy

- Activity 4: Observe and assess teacher's competencies based on four components and criteria proposed in Chapter 1 of the thesis.

- Activity 5: Apply micro teaching methods to experimental teachers to draw lessons for the whole group

3.2.2. Organize and implement the second pedagogical experiment

3.2.3. Organize and implement the third pedagogical experiment

3.3. Evaluation of pedagogical experiment results

3.3.1. Results of the first pedagogical experiment

After each week of PE implementation, we evaluated the results for each competency component of each team member by averaging the group's results (coefficient 1) and the results of the instructor's evaluation. (coefficient 2). The competence development of the teachers on each competency component was assessed after 6 weeks of training in accordance with the proposed measures in Chapter 2.

In addition, PE results also show:

+ The teachers in the group have started designing the CLIL lesson plans. This result can be seen in Appendix 6 and a comparitive clip of the lesson plans and lessons before and after learning CLIL methodology.

+ The teachers in the group have made their own Maths through English manual including specialized Math vocabulary in both Vietnamese and English and they have been able to use these structures in the classroom.

+ These teachers graduated from the university with grade good and distinction. However, when being evaluated in accordance with four components of competence in teaching Maths through English, they got acceptable level. After six weeks of rigorous training, these teachers have reached pretty good levels.

The results reveal the difficulties in developing the competence of teaching Maths through English. However, the results also illustrate the feasibility and effectiveness of the proposed measures.

3.3.1. Results of the second pedagogical experiment

We have used the feedback forms from 20 teachers on the measures to develop teachers' competence (annex 7) and the results are listed in the table (see detailed dissertation).

Results from the table above show:

- Most of the teachers appreciated the feasibility and effectiveness of the proposed measures (18/20 selected column 4 on average - the highest rating); No teacher thinks that the measures are ineffective and not feasible (0/20).

- At least 17 of 20 teachers commented on the overall assessment of the proposed measures: The proposed measures help teachers overcome difficulties in teaching Maths through English, help to develop the competence of teachers teaching Maths through English and helps students develop their listening, speaking, reading, and writing Maths skills through English.

3.3.3. Results of the third pedagogical experiment

TEST 1 (Grade 11 I - 44 students)

Skill	**Low (0-2.5points)**	**Normal (2.6-5points)**	**Quite good (5.1-8points)**	**Very good (8.1-10points)**
Listening	30%	43.2%	22.3%	4.5%
Speaking	40.9%	44.6%	11.4%	3.1%
Reading	33 %	37.6%	15.7%	13.7%
Writing	27.3%	27.3%	30%	15.4%
Mathematics	22.3%	43.2%	31.8%	2.7%

TEST 2 (Grade 11 H- 44 students)

Skill	**Low (0-2.5points)**	**Normal (2.6-5points)**	**Quite good (5.1-8points)**	**Very good (8.1-10points)**
Listening	22.3%	34.1%	34.1%	9.5%
Speaking	33.1%	36.9%	30%	0%
Reading	18.2%	23%	36.5%	22.3%
Writing	20.5%	11	20.5%	34.1%
Mathematics	4.5%	19 %	44.7%	31.8%

TEST 3 (Grade 11 B - 42 students)

Skill	**Low (0-2.5points)**	**Normal (2.6-5points)**	**Quite good (5.1-8points)**	**Very good (8.1-10points)**
Listening	11.9%	38.1%	23.8%	26.2%
Speaking	16.2%	23.8%	31%	29%
Reading	4.8%	16.2%	42.9%	36.1%
Writing	0%	14.3%	23.8%	61.9%
Mathematics	7.1%	14.2%	45.2%	33.5%

3.4. Chapter 3' conclusion

Once the purpose, subject and method of pedagogical experiment have been identified, we conduct pedagogical experiments at Foreign Language Specialized School – Vietnam National University, Hanoi. It is possible to draw some conclusions from the results obtained and the data processed from the survey-observation method, the case study method and the theoretical research method, as follows: some teaching competence can be formed and developed from the proposed measures. These pedagogical measures not only help teachers develop their teaching competence but also help students to become more active, self-conscious, and achieve teaching goals.

Conclusion

The thesis has obtained the following main results:

1) The thesis provides an overview and research results of teaching English subjects (in general), teaching Maths through English in particular. Research results show that the teaching of the subject (in general) in a foreign language appeared very early, but only the emergence of content and language integrating learning (CLIL, 1994) made teaching Maths through English more rational and effective in many countries.

2) Practical research from countries applying CLIL shows that: Teaching one/ some subjects through English in high schools has been a common sight in many countries around the world, especially in the age of flat world and 4.0 technology. Tightly integrating content and language is necessary to teach Maths through English effectively. Therefore, teaching Maths through English using CLIL method is sensible and appropriate.

3) After firmly grasping the features of teaching Maths through English, we proposed a framework for teachers' competence, based on four components and specific criteria for each component. This competence framework will support the practical inspection of teachers' competence and orientate towards proposing measures to develop teachers' competence in upper secondary schools and serve as a basis for assessing competence development.

4) We have proposed three sets of measures to develop competence in teaching Maths through English for upper secondary school teachers. Each group of measures has purposes, scientific basis and a number of specific implementation measures.

5) In order to assess the competence development for upper secondary school teachers, we propose a 200-point evaluation form based on the results of theoretical studies and empirical situation in Vietnam.

6) The pedagogical experiment results based on a number of lessons following the proposed measures and case study results from a group of newly graduated teachers from the Department of Mathematics and Informatics, Hanoi National University of Education, 2016, shows that the proposed measures are feasible and effective.

These results prove that the scientific hypothesis is accepted and research tasks have been completed.

The research results of this dissertation can be applied to Vietnamese context. Especially, two Maths through English Handbook have been published to serve teachers, students who have desire to become teachers teaching Maths through English.

List of works published by the author related to the topic

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