A Remedial Training Program Based on CLIL to Develop Some Math Content Components and English Language Competences for Mathematics Future-Teachers and their teaching Performance

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Abstract

The aim of the research is to develop Some Math Content Components, and English Language Competences for Mathematics Future-Teachers and their teaching Performance through a remedial training program based on CLIL. Participants are 21 third year mathematics future-teachers, (English section), Faculty of Women, Ain Shams University. The research adopted the experimental one group design. Instruments of the research were implemented pre and post the intervention. Tools were both mathematical and language ones. The mathematical tools consisted of mathematical content test and mathematical teaching observation sheet. While the language tools consisted of language competences tests and classroom language observation sheet. Besides, a satisfaction questionnaire was implemented at the end of the program. Statistical analysis used non-parametric SPSS Wilcoxon test. Results showed the effectiveness of the program in developing future teacher's mathematical content knowledge (Mathematical Symbols and Shape, Numbers and Algebra, Geometry and Measurement, Probability and Statistics, Story Problem Solving), teaching performance (opening skills, general presentation skills , presenting subject matter skill , teaching strategies, techniques and teaching aids, classroom management skills, classroom content language interaction, language of content instruction , and evaluative), language competences, namely Speaking (accuracy, fluency and interaction, pronunciation and accent), writing (Shape, directionality, and letter formation, Letter and word size and spacing, Sentence structure, grammar and spelling), as well as classroom language (the beginning of the class, using disciplinary expressions, praising and correction, giving instructions, checking for understanding, developing pupils' language, and finishing the lesson).

Keywords: Egypt - CLIL- Math Content Components - English Language Competences - Teaching Performance.

المستخلص

يهدف البحث الي تنمية بعض مكونات محتوى الرياضيات ، وكفاءات اللغة الإنجليزية لمعلمات الرياضيات المستقبليات وأدائهن التدريسي من خلال برنامج تدريبي علاجي قائم علي CLIL.المشاركات في البحث 21 معلمة رياضيات المستقبل بالسنة الثالثة (شعبة اللغة الإنجليزية) ، كلية البنات ، جامعة عين شمس. اعتمد البحث تصميم المجموعة التجريبية الواحدة. تم تطبيق أدوات البحث قبل وبعد التجريب. كانت الأدوات رياضية ولغوية غلي حد سواء. تتكون ادوات الرياضيات من اختبار محتوى رياضي وبطاقة ملاحظة لتدريس الرياضيات. بينما تتكون أدوات اللغة من اختبارات الكفاءات اللغوية وبطاقة ملاحظة اللغة الصفية. التحليل الإحصائي استخدم الاختبار اللابراميتري ويلكوكسون. أظهرت النتائج فاعلية البرنامج في تنمية المعرفة بالمحتوى الرياضي للمعلمة المستقبل و التي تشمل (الرموز الرياضية والشكل ، والأرقام والجبر ، والهندسة والقياس ، والاحتمالية والإحصاء ، وحل مشكلة القصة) ، والأداء التدريسي (مهارات الافتتاح ، ومهارات العرض العامة ، وعرض الموضوع ، واستراتيجيات التدريس ، والتقنيات والوسائل التعليمية ، ومهارات إدارة الفصل الدراسي ، والتفاعل اللغوي لمحتوى الفصل الدراسي ، ولغة تدريس المحتوى ، والتقويم ، والكفاءات اللغوية و التي تشمل التحدث (الدقة ، والطلاقة والتفاعل ، والنطق واللهجة) ، والكتابة (الشكل ، والاتجاهية) ، وتشكيل الحروف ، وحجم الحروف والكلمات والمسافات بينها ، وتركيب الجمل ، والقواعد والهجاء) ، وكذلك لغة الفصل (بداية الفصل ، استخدام التعبيرات الانضباطية ، والمدح والتصحيح وإعطاء التعليمات ، والتحقق من الفهم ، وتحسين لغة الطلاب ، والانتهاء من الدرس.

الكلمات المفتاحية: مصر - CLIL - مكونات محتوى الرياضيات - كفاءات اللغة الإنجليزية - الأداء التدريسي-

Introduction

Teacher education has always been a crucial issue for the development of any country and should have priority to ensure a high-quality one. It is undeniable that teaching is a professional work that needs knowledge, skills, positive attitudes and willingness to change. In a global world of open skies, of technology and explosion of knowledge, of multilingualism and multiculturalism, teachers anywhere are facing challenges to develop professionally, interact with this generation and to cope with the great leaping cognitive advance.

Future teachers need inspiring programs of preparation to acquire key competences for life-long learning which combine knowledge and skills suitable for 21st century, including "communication in the mother tongue and foreign language, learning to learn, social competences; sense of initiative and entrepreneurship; cultural awareness and expression" (An introduction to CLIL Notes based on a CLIL course at British Study Center – Oxford **, Summer 2012).**In the last two decades an approach for teaching has flourished worldwide under the acronym CLIL (Content and Language Integrated Learning). CLIL provides learners with all the previously mentioned competences. It involves the integration of both content and language which lies on the fact that the learning of any content must involve the learning of the language associated with the content.

CLIL is considered important in the educational system nowadays because it is suitable for our global society where knowledge of another language helps learners to develop skills in their mother tongue, develop skills to communicate ideas about science, arts and technologies to people around the

globe. In a CLIL classroom, the subject matter and the foreign language are integrated and taught together, thinking and learning skills are integrated too.

CLIL could be a successful trend in Egypt, according to Maffei and Favilli (https://arpi.unipi.it/retrieve/handle/11568/672063/86539/CERME8_WG9_Favilli) .According to their findings, using an L2 to teach/learn arithmetic in Egypt might be called a "artificial tool" because the classroom language is a non-native language for nearly all maths teachers and pupils. However, when compared to multilingual classrooms, the adoption of an L2 (second language) can make the classroom atmosphere more homogeneous, allowing the role of an additional language to emerge without being influenced by social context elements.

Context of the problem

In the Egyptian context, English plays a vital role in the educational system where students begin studying it from the early years of the primary stage. Because English is an international language and the language of science, experimental and language schools teach mathematics and science in English. This means that math and science teachers need to master not only knowledge and skills of the content they teach, but also acquire the foreign language's written and oral skills to be able to communicate the scientific content in a correct and comprehensible language. Thus, Egyptian mathematics teachers face an intractable problem. They must carry out two tasks: one is to teach mathematics and convey its knowledge and skills, and the second is to use the English language effectively in the classroom.

Hence, faculties of education aspired upgrading the qualifications of their future teachers in these scientific fields. Thus, faculties of education, namely,

Faculty of Women for Arts, Science and Education, Ain Shams University, established an English section, parallel to the Arabic one, to graduate teachers who can proficiently teach mathematics at language and experimental schools. Reviewing the admission regulations, it was found that applicants to the mathematics English section are not required to be graduated from language or experimental schools. Moreover, the department does not examine the candidates' English language proficiency level.

Reviewing the courses taught to the future teachers of the English Mathematics Department (Research sample) based on admission regulations p.37, Article (5) in the bylaws of the Faculty of Women (Student's Guide to Educational Departments and Sections) 2018-2019 states that "the language of instruction in all educational sections, except for foreign languages departments and the departments which have sections for studies in foreign languages, faculty members are committed to the Arabic language. The students in each academic year study one subject of the specialization in English (except for the languages departments and the departments which have sections of studies in foreign languages)". Thus, there is no course for teaching English for specific purposes or for academic purposes and there is no integration between math courses and language. Also, educational courses are taught in Arabic including the most relevant course to the mathematics specialty which is the Methods of teaching Mathematics, due to students' poor English. However, methodology instructors are keen to give practical applications in English, and the teaching practice takes place in experimental schools. Thus, when these students joined the English Mathematics Department, they faced the problem of studying mathematics in English. Due to their language deficiencies, they practice studying and teaching

mathematics in Arabic using only the Latin symbols and the mathematical terms in English, also the classroom language used for interaction was in Arabic. All these factors hinder their ability to teach mathematics in English accurately, and thus the goal of their preparation program is not achieved. To document this information, the researchers reviewed the previous studies and developed a pilot study.

First, previous studies in the field

Unfortunately, all the studies found in the field of teaching mathematics in English in Egypt dealt with in-service teachers. Such as that of Al-Said (2019), Said (2019), Abdul-Majeed (2017), Ali (2009), Obida (2012), Ismaail (2000) which insured that those teachers lack the ability of teaching mathematics in English due to the following reasons:

1) The difficulty of a foreign language lies in the fact that it is not a mere combination words and structure put together and means of communication, but it is a way of thinking . If teachers lack in the ability to think in English, they cannot covey properly and effectively any content.

2) The time duration of in-service teachers' training which almost last for 9 months is not enough to acquire the required skills of a foreign language, it should start the first year of joining the faculties of education and continue after graduation through professional development training courses.

3) Evaluation in the training programs provided to in-service teachers by Ministry of Education and Faculties of Education depend mainly on the written form ignoring the oral skills needed for communication and explanation.

After surveying the previous studies, it is found that, as much as the researchers know, there is not a single study dealing with future-teachers and their

preparation programs. Besides, none of them developed a program integrating language and content through the cooperation of both instructors utilizing CLIL.

Second, The Pilot study

The pilot study was carried on 10 Future-teachers of mathematics who study it in the Mathematics Department, English section. Each was asked to prepare a lesson from the mathematics book of preparatory stage and present the lesson in front of the class in not less or more than 10-15 minutes. The researchers videotaped the presentations and recorded their notes as follows:

Concerning the mathematics competences:

The methods of teaching mathematics researcher analyzed the performance of the same 10 students in light of an observation sheet covering some skills of mathematics teaching performance and mathematical content. The following table (1) shows the future-teachers' performance percentage of the checklist's overall mark.

Table (1) Results of future-teachers' performance percentage of the checklist's overall mark.

Percentage	Less than 50%	50% - 60%	More than 60 %
Number	4	6	**0**

40% of the sample = 4 future teachers got less than 50% of the observation sheet score, 60% =6 of the sample's score ranged between 50%-60% of the observation sheet score, while none of the sample could score more than 60% which indicates the weak level of the sample in the skills of teaching mathematics in English. As a consequence, the methods of teaching mathematics researcher concluded the following:

- the sample of the study used the Arabic language more than once when giving instructions or explaining a particular concept.

- EL Future-teachers relied on the direct method of teaching, delivering the concept and giving an example of a solution followed by exercises without trying to use any other strategies. This may be due to their lack of experience and their keenness not to make mistakes while teaching in English. They reduced the use of interaction during classroom management and presented synonyms of the concept in English but the explanation was presented in Arabic.
- Using a foreign language decreased future teachers' ability to explain, discuss and use recent strategies while teaching the mini-lessons. The English language hindered their creative abilities to teach Mathematics.
- When explaining a new concept or revising a previous concept, most of the sample used simple words and direct examples. Despite their previous knowledge of the concept or mathematical term, the language stood as a barrier to the flow of teaching and hindered their ability to give more than one example.
- None of the sample members used any teaching aids or any geometric tools (rectangle, compass…etc.) when explaining geometry lessons. They relied on the regular method of teaching neglecting the importance of the tangible aspect when teaching mathematics.
- They did not urge their audience to use the English language in answering the questions. They allowed the use of Arabic and never asked their audience to use English.
- It was recognized that all the sample chose the mini-lessons that do not deal with story/word problems and preferred to explain lessons based on the use of symbols in order to minimize the use of English.

Concerning Language competences:

The TEFL (Teaching English as a Foreign Language) researcher concentrated on the following competences:

Students' writing competence: letters directionality, word formation, grammar, sentence structure and mechanics of writing.

Students' speaking competence: word utterances, pronunciation and fluency

English Classroom language competence: communicating with students, giving instructions and using the language while lesson explanation.

The TEFL researcher depended on two sources: the first was students' mid-term writing exam to analyze their writings concerning spelling, grammar and sentence structure and mechanics of language. The second source was the mini-lesson presentation to analyze word directionality, size of the letters, the use of upper case and lower-case letters (writing on the board), word utterances, pronunciation, fluency and classroom language. It was found that the 10 students lack the previously mentioned competences needed for teachers who are expected to teach mathematics in English. Results were as presented in table (2):

Table (2)

Results of piloting the English language competences for mathematics future-teachers

Speaking	Writing	Classroom language
Word utterances: 60% were unable to utter words that consist of three syllables or more such as **characteristics, interpretation.**	**Letter directionality:** **U**nfortunately, 100% students committed mistakes while writing on the board concerning the directions of the letters. Such as **t**, and **f** letters they write the middle lines from wright to left. 60% used upper case letters in the middle of the word and	**Communication with students:** Classroom language used while communicating with students (Incidental language) concerning starting the lesson, ending the lesson, encouragement and praise …etc. all happened in Arabic with 100% of the students.

	size of letters in the word are not proper.	
Pronunciation: **100%** students mispronounce lots of words. They cannot differentiate between /p/ and /b/ sounds for example. They have heavy accent and they overstress most of the words. Besides, pronunciation of questions lacks accurate intonation.	**Sentence structure:** All the 100% students committed mistakes concerning the tense, subject-verb agreement and sentence formation.	**Giving instructions:** 100% students read the exercise from the book or from the board with hesitation but only 2 who tried to give the instructions to their students mixing Arabic with English. the other 8 students gave the instructions in Arabic
Fluency: **50%** could not speak in English except for mentioning the mathematical terms, the other 50% of the students' **s**peech is characterized as very slow, hesitant & difficult to perceive continuity in speech; inaudible.	**Spelling**: 60 % committed spelling mistakes both in the exam papers and on board.	**Lesson explanation:** 70% explained the minilesson in Arabic except the mathematical terms. The other 3 tried hard to use some English vocabulary.
	Mechanics of language: 70% committed mistakes concerning upper-case and lower-case letters, use of punctuation and paragraphing	

Out of these results, it is concluded that:

1- EL future-teachers suffer from much hesitation and a lot of stuttering when they try to speak English, and soon the tension prompted them to use the Arabic language.

2- They use only the mathematical terms in English but with inaccurate pronunciation and heavy accent because their relationship to English is largely interrupted, and they have not studied any special courses for it for 3 years. The use of Arabic is her comfort zone therefore they feel more relaxed when using the English term and translate them into Arabic.

3- Their strict adherence to the preparation notebook for fear of making mistakes limited their ability to deal freely and naturally with the class setting.

4- It was clear that they did not pay attention to some writing problems, whether on the board or on paper, all they cared about was writing the information such as the title, the mathematical symbols on the board or writing sentences that did not adhere to grammatical accuracy such as subject verb agreement, use of articles, etc. They did not realize that they would teach in language schools whose students have been studying English since the nursery stage, and this puts them as future teachers in a dilemma.

Research problem

The research problem can be identified in the third-year mathematics future teachers' - at Faculty of Women, Ain Shams University- limited mastery of the mathematical content components, language competences and their teaching performance. Thus, the present study attempts to develop a remedial and training program based on CLIL to develop mathematics future-teachers' some mathematical content components, language competences and their teaching performance.

Research questions:

This research attempts to answer the following questions:

What is the effect of a remedial and training program based on CLIL to develop EL mathematics future teachers' some mathematical content components, English language competences and their teaching performance?

The following sub-questions emerged from the main question, have to be answered:

1- What are the necessary mathematical content components and teaching performance skills as well as language competences that should be developed for the EL mathematics future-teachers?

2- What are the features and the theoretical base of the remedial and training program based on CLIL to develop EL mathematics future-teachers' mathematical content, English language competences and teaching performance?

3- What is the effectiveness of the program based on CLIL on developing third-year EL mathematics future-teachers' competences; namely:

a) some mathematical content components

b) some mathematical teaching performance

c) Some language competences namely; speaking, writing and classroom language

4- What is the effect size of the overall mathematical content components, mathematical teaching performance and the overall mathematical tests in general (both content components and the mathematical teaching performance?

5- What is the effect size of the overall speaking, writing, classroom language competencies and the overall language competencies in general?

6- To what extent are the EL mathematics future teachers satisfied with the training remedial program?

Research hypotheses:

1) There is a statistically significant difference between the mean ranks of the experimental group's performances on the overall mathematical pre-

posttest (mathematical content components and teaching performance) in favor of the post-test.

2) There is a statistically significant difference between the mean ranks of the experimental group's performances on the overall mathematical content components pre-posttest in favor of the post-test.

3) There are statistically significant differences between the mean ranks of the experimental group's performances on the pre-post administration of the overall teaching performance skills observation sheet and its sub-components (opening skills, general presentation skills , presenting subject matter skill (knowledge of the content of the lesson) , teaching strategies, techniques and teaching aids, classroom management skills, classroom content language Interaction, language of content instruction , and evaluative) in favor of the post administration.

4) There is a statistically significant differences between the mean ranks of the experimental group's overall English language competences pre-posttest in favor of the post-test.

5) There are statistically significant differences between the mean ranks of the experimental group's overall speaking competence pre-posttest and its sub-competences: accuracy, fluency and interaction, pronunciation and accent) in favor of the speaking competence post-test .

6) There are statistically significant differences between the mean ranks of the experimental group's writing competence pre-posttest and its sub-competences (sentence structure, grammar and spelling, shape, directionality and formation of letters, size and spacing) in favor of the overall writing competence posttest.

7) There are statistically significant differences between the mean ranks of the experimental group's performances on the pre-post administration of the classroom language observation sheet and its sub-components (the beginning or starting of the class, using disciplinary expressions, praising and correction, giving instructions, checking for understanding, developing pupils' language, and finishing the lesson) in favor of the post administration.

8) It is hypothesized that the experimental group is satisfied with the program at a percentage not less than 85% by the end of the experimentation.

Delimitations of the study

The present study is limited to:

1)Third year mathematics future-teachers, English section, Faculty of Women for Arts, Science and Education, Ain Shams University.

2) Second term of the academic year 2017-2018

3)Mathematical content namely; Symbols, mathematical terms, and geometric shapes, Numbers and algebra, Geometry and measurement, Statistics and probability and solve story problems.

4)mathematical classroom teaching performance.

5) Language competences namely; speaking, writing and some classroom language area

Definition of terms

CLIL

In this research CLIL refers to the integration between the mathematical content of preparatory stage math subject matter with the English language competences. Both the mathematics content instructor and the English language instructor

work together in the same sessions with the aim of remedying their deficiencies and mistakes as well as developing mathematical content, language competences and teaching performance equally for third year future-teachers of mathematics, Faculty of Women, Ain Shams University.

The remedial-training program

The proposed training remedial program aims to train future female third-year teachers in the Mathematics Department (English section) at the Faculty of Women, Ain Shams University on teaching mathematics in the English language, diagnosing and treating some of the language problems they face when using the English language, whether spoken or written in light of the CLIL approach. The content, activities, teaching aids and evaluation methods were prepared in coordination between the content instructor and the language instructor to achieve the desired integration. The training on the content was carried out through the mathematics of pre-university education and was limited to the preparatory stage courses. The future teachers are trained to teach the mathematics content that she is supposed to teach in the future which includes the following areas: symbols, mathematical terms, algebra and geometric shapes, geometry and measurement, Statistics and probability and solve story problems included preparatory stage students' book. The program also included training them on speaking and writing competences and using adequate classroom language other than those related to the content (accidental language) to communicate with students.

Mathematical content components

The content of mathematics for pre-university education, as stated in the document of the standard levels of the National Authority for Quality Assurance of Education and Accreditation in the Arab Republic of Egypt, included the

following areas: preparation and operations, algebra, relations and functions, geometry and measurement, data analysis, statistics, probability, trigonometry, calculus, and mechanics (the National Authority for Education Quality Assurance and Accreditation: 2009) and (NCTM:2020). Based on the classification of the National Authority for Quality Assurance of Education and Accreditation in the Arab Republic of Egypt the following components were identified to train EL future teachers in the light of CLIL, using the preparatory stage course books: Mathematical Symbols and shape, numbers and algebra, geometry and Measurement, Probability and Statistics, Story/ Word Problem Solving.

Mathematics teaching performance

The teaching performance of future mathematics teachers is the set of responses made by the student teacher in a teaching situation and can be directly observed through the observation card prepared to track the professional growth in the performance of the student teacher of mathematics teaching skills in English in the classroom during the training period on the proposed program based on CLIL and she is awarded Three grades for high performance and its grades for average performance and one grade for poor performance and includes the following teaching skills: opening skills, general presentation skills , presenting subject matter skill (knowledge of the content of the lesson) , teaching strategies, techniques and teaching aids, classroom management skills, classroom content language Interaction, language of content instruction , and evaluation .

Language competences

In this research language competencies refer to the required spoken and written competencies as well as classroom language competencies for third year mathematics future-teachers at third year, Mathematics Department (English

section), Faculty of Women, Ain Shams University. The required spoken competences are accuracy, fluency, pronunciation and intonation. The required writing competences are sentence structure, grammar and spelling, shape, directionality and formation of letters, size and spacing. While the required classroom competences are the beginning or starting of the class, using disciplinary expressions, praising and correction, giving instructions, checking for understanding, developing pupils' language, and finishing the lesson.

Review of literature

CLIL (Content and Language Integrated Learning) is a term that refers to the study of an academic content through a foreign language. It has a double focus; a content goal and a language goal without any preference of importance of one over the other.

There are very essential reasons for implementing CLIL in education as argued by Marsh, Maljers, and Hartiala (2001) who classified the reasons into five stages: environment, content, language, learning, and culture. As for environment, they believe that CLIL is a way to prepare for globalization. They also believe that it may help schools access international certification. Referring to content, students will be prepared for future studies and will have a different view point of sciences. CLIL will provide students with information within different knowledge fields, thus; their abilities will be improved and as a consequence their performance at work field will be developed. Speaking about language, target language competence may be developed to a high level of fluency through high exposure to CLIL and other forms of language learning. regarding learning, CLIL attempts to improve learning by giving attention to individuals' needs in terms of social and thinking skills. Finally, the concept of

Intercultural education has become well-known recently because of the demands of globalization and the interactive internationalization.

The three main principles describe the sequence that any program or project should follow as summarized by (Pérez,M. and Rodríguez, M. (2016).

(1) the language is used to learn content of the subject but it is also essentially significant in itself in order to understand and communicate, thus, it has a double aim, content-wise and language-wise.

(2) The language used is determined by the content; so, elements such as vocabulary, linguistic forms and skills will be dependent on the contents of the subject.

(3) The communicative competence is the third principle where fluency is more important than grammar and linguistic accuracy in general.

The rationale for CLIL is based on a number of hypotheses about second language learning (Dalton-Puffer 2008). CLIL can provide an authenticity of purpose unlike any other communicative classroom because of its integration of subject matter and language (Greenfell 2002, Graddol 2006). CLIL can address the lack of relevance of language education focused on grammatical progression and increase learners' motivation by realigning language and cognitive development (Lasagabaster 2009). CLIL provides a richer, more naturalistic environment for learners to promote language acquisition and learning, resulting in increased proficiency in learners of all levels (Lyster 2007, Lightbown and Spada 2006). CLIL also enriches subject teaching by encouraging the learner's cognitive development and flexibility through its constructivist approach, as well as by recognizing language as an important instrument in learning (Lyster 2007, Coyle 2010, Dalton-Puffer 2008). Finally, CLIL can help students gain a deeper

awareness of other cultures and prepare them for internationalization. CLIL, in essence, promises to be a dynamic entity larger than the sum of its two parts, giving an education that extends beyond subject and content learning (Coyle et al. 2010).

CLIL is not associated with any specific methodology. Some common aspects are used in different nations, according to Pavesi et al (2001), and "CLIL demands active approaches, cooperative classroom management, and focus on all modes of communication (linguistic, visual, aural, and kinaesthetic)".

• In CLIL, using audio-visual aids and multimedia to overcome challenges produced by the usage of a new language is critical.

• Pavesi et al. stress the need of learning in a comprehensive manner as well as from practical, hands-on experiences.

• For real communication, Pavesi et al recommend using targeted language (TL).

• Language scaffolding, such as reformulation, simplification, and exemplification, should be used when teaching a second language and subject at the same time.

• When it comes to communication, code switching (switching to the students' school lingua franca (SLF) instead of the target language) should be the absolute last resort.

• The CLIL teacher's usage of the school lingua franca (SLF) should be maintained to a minimum and avoided unless absolutely necessary. S Ioannou Georgiou and P Pavlou (2011)

• CLIL teachers require teamwork skills both in the preparation of the curriculum and in the classroom.

• Teachers should consider the AL/TL language level of their pupils while organizing lessons.

It is noteworthy to emphasis that CLIL is based on constructivism. Constructivism is an attitude adopted by various psychological and educational theories including the theories of Jean Piaget (1952), Lev Vygotsky (1978), David Ausubel (1963 & 1977), Jerome Bruner (1966 & 1977). Content and Integrated Language Learning (CLIL) came on learning from various socio-cultural, constructivist perspectives of learning.

According to Hanesová (2014) the contribution of constructivism lies in the way it emphasizes the process of language acquisition in learner's minds especially due to interaction with other people. It investigates how the learner construct a new concept relying on previous knowledge challenged through the exposure to a rich learning environment providing authentic incentives related to learner's life. Learning occurs when new information is presented and then compared with the previous knowledge. Adapting and transforming experiences, knowledge and schemes would make sense in terms of what one already knows about the world and add new information to this added knowledge.

The idea of viewing CLIL as a kind of constructivist learning is based on the assumption that CLIL approach requires an active construction of the learner's own knowledge and personal meanings. Constructivism regards learning/ teaching as a process where comprehension is activated through relevant practical experience (Gomez, et.al, 2016). Vygotsky focused, mainly, on higher mental thinking, rationality, problem-solving, planning, meaning- making. Vygotsky explained that "human beings possess two different levels of biological foundations; lower-level activities and the higher-level abilities, including consciousness'. Thus, learners need to practice activities that build their lower and higher abilities including critical

thinking, problem solving, communication skills, synthesis skills as well as language development. Consequently, the purpose of this research is to develop a program to drive future teachers to build meaning through learning content concepts and language competencies during the CLIL class to become problem solvers by giving effective solutions to math problems, classroom management and their daily communication with their students.

The function of CLIL is significantly illustrated by the language instructor and the content material teacher. A language instructor does no longer teach content material, and is not supposed to, but uses the content as a vehicle to introduce language. The language teacher works closely with the content material teacher to offer guidance and orientation to the language they need in their training. Thus, the language instructor plays the role of 'consultant' to content instructors.

CLIL is considered as a holistic teaching method where the instructor is not teaching content material only Coyle. On the contrary, students learn variety of skills and competences in addition to the content knowledge such as language skills relevant to their career, communication skills and thinking skills which contribute to their professional development Coyle (2010).

In CLIL classroom students are not required to learn language rules, syntax, phonology etc. in depth, they only are required to learn language necessary for content learning, language for communication and problem-solving. Gradually, they will enrich their vocabulary, and develop their communication and interaction competence due to satisfactory practice.

It is crucial to note that in CLIL teaching classroom there is no language course that the language instructor goes through. The language items or areas are defined based on content requirements and students' needs. There should

be a specified content course based on which the language instructor identifies his/her language objectives. Consequently, assessment in content material is definite while assessment in language areas belongs to the language instructor who determines its items. The language instructor is required to inform the students which language areas will be assessed and the manner of assessment. Moreover, language assessment should not be overwhelming for the students. Language assessment should be relevant to the content area, communication skills and should be as interesting as the exercises they encountered during the CLIL course.

4Cs Model

The4 Cs model was first presented by Coyle (1999) , then revisited more than once (2007 , 2009 and 2010) . Each "C" represents an element of CLIL and in light of these components' activities, tasks and materials for CLIL course are to be designed. *Content, Communication, Cognition* and *Culture* .

The components of this model are as follows:

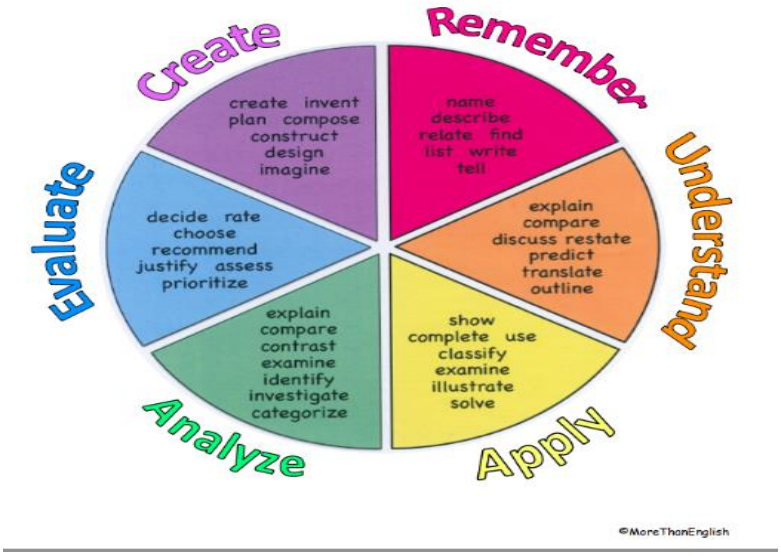
Content: the knowledge and concepts related to the subject area such as mathematics, science etc.

Communication: using the foreign language to learn the content area. Students work together in pairs and groups interacting with each other using the target language. Previously in the traditional classroom students did not have enough room to interact and communicate because the teacher is dominating the scene most of the time. In CLIL courses teacher talks minimize and students talks maximize.

Cognition: Coyle refers to the higher levels of thinking and the importance of activating them in CLIL courses. Instead of relying on the Lower Order Thinking Skills (LOTS), CLIL shifts the emphasis to the Higher Order

Thinking Skills (HOTS), according to the revised taxonomy of Bloom by Anderson and Krathwohl, where students are required to analyze, synthesis, evaluate, create etc.

Thus, students build their cognitive skills in CLIL in light of the Bloom's wheel (, as presented by Montalto, S. & Walter,L.(2021).



www.languages.dk)

Culture / Community: CLIL encourages students to relate what they learn to their life and the world around them. Moreover, it encourages them to explore the different cultures specially that of the target language and understand the similarities and accept the differences. CLIL teachers help students to relate what they learn to the world around them. Students see that what they learn is not just a school subject, but something that relates to 'the real world'.

The CLIL teacher therefore needs to think about:
What is the relevance of this lesson to the student's daily life and surroundings? How does it link to the Community or Culture surrounding the students? Does it also link to other cultures?

The 4Cs framework requires conceptualizing the language from language learning towards an integrated model which involves the learner in using and developing the language triptych: language of learning, language for learning and language though learning.

Language of learning is the language needed for the content area where learners have to know this language in order to understand the content such as the terms used in mathematics (rectangle, hypothesis, set etc...).

Language for learning is to provide real context for learning which develops learners' meta-cognitive skills. This means how to learn the content effectively and develop skills required for cooperative group work, pair work, posing questions, debating, thinking, negotiating, solving problems etc. using the target language.

Language through learning is aimed at developing students' language functions while learning content subject. Moreover, their linguistics skills, presentation skills, communication skills are developed while interacting to cope with content concepts using the target language.

Coyle (2007) re-visited his model and indicated that the 4Cs Framework is built on the following principles.

(1) Learning a subject is about a lot more than just gaining knowledge and skills. It is about the learner building his or her own knowledge and gaining relevant and acceptable skills (Lantolf, 2000; Vygotsky, 1978).

(2) Learning and thinking are required to acquire topic knowledge, skills, and comprehension (cognition). The linguistic needs of the content as a conduit for learning must be analysed and made available to enable the learner to create a comprehension of the subject matter.

(3) In order to aid development, thinking processes (cognition) must be analysed in terms of their language demands (Bloom, 1984; McGuiness, 1999).

(4) Language must be taught in context (that is, through the language), which necessitates rebuilding subject themes and related cognitive processes in a foreign or second language, such as language intake/output (Swain, 2000).

(5) Learning requires interaction in the learning situation. Students would be able to think through things and make them their own if teachers could provide more opportunities for exploratory speaking and writing. When the learning context is based on L2, this has ramifications.

(6) There is a complex link between cultures and languages (Byram, 2001). Culture is at the centre of the framework, and intercultural knowledge pushes the envelope on alternative agendas like transformative pedagogies, global citizenship, student voice, and "identity investment" (Cummins, 2004).

In general, CLIL aims to: introduce learners to new ideas and concepts in content area subjects; improve learners' performance in both subject matters and the target language; increase learners' confidence in using the target language; encourage instructors to give due care to both subject instructional materials and tasks as well as language exercises and aids; encourages both content instructor and language instructor to cooperate while preparing the

lessons to use language and tasks suitable for learners' language proficiency and cognitive abilities.

the 4C's in Maths are presented by Pérez,M. and Rodríguez, M. (2016)

(1) content: what is the maths subject matter? e.g., algebra, ratio, linear graphs

(2) communication: what maths language will students use all through the lesson? e.g., the language of evaluation for evaluating and contrasting graphs

(3) Cognition: what wondering abilities are demanded of inexperienced persons? e.g., Identifying, classifying, reasoning, generalizing.

(4) culture (every so often the 4th C is called community or Citizenship): is there a cultural recognition inside the lesson. It could be specific identification to the target language culture or the 1L culture. Such cultural item could be presented through the references included in the student's book related to well-known scientists in the field of mathematics such as Abu Bakr al-Karaji, Omar Khayyam and Abu l'Hasan al-Uqlidisi or Isaac Newton, Carl Gauss etc.

Regarding the content, it's important to make a distinction among content material compulsory (obligatory) and content material-well matched language (compatible): content-compulsory (obligatory) language offers with specific vocabulary, grammatical systems and purposeful expressions directly related to the content whereas content material-well suited language (compatible) isn't always particular to a topic and can be found out in the English class so that it will talk extra fully.

Thus, both content instructor and language instructor should recognize that there are two types of language related to content and they both should organize their work inside the classroom to fulfill both types' aims.

Content-compatible Language

Content-compatible language is the language that is not directly related to the content of the lesson but future-teachers need to know to be able to communicate with their teacher, classmates and may need outside the classroom in similar situations. This type of language is presented through the language instructor such as the communication between the future-teachers and their students at schools i.e., the classroom language (greetings, apologizing, giving instructions etc.).

Content-obligatory: language lexical Items

1- **Specific Vocabulary:** As it has been previously mentioned, content-obligatory language is related to the language related to a specific subject. Students need to be familiar with the specific terminology. These words are probably unknown to the students in English so it is necessary to provide them with this vocabulary in order to understand the concepts which will be explained and used during the lesson: by highlighting and listing these words the students will have the tools communicate in the Maths class and it will also give them an idea of the most significant points of the unit. This type of language is presented by the content instructor.

2- ***Phonetics:*** It is significant that Mathematics future-teachers are required to pay attention to phonetics, but it must not be forgotten that they are not language specialists, so they may probably not know many of the specific, correct pronunciation of many words in English.

Therefore, the language instructor plays a vital role in explaining the manner of articulation and how the future-teachers can pronounce the words correctly for both the compatible language and the obligatory language.

Mathematics and English Language Relationship

Any language is generated by a set of rules associating symbols to meaning which let the process of formation of an infinite number of utterances from a limited number of elements. The rules are what we call the grammar of the language, the system which governs our use of language. These abstract rules are used to form our sentences in oral and written language. Similarly, Mathematics is the language of numbers, symbols and grammar. In Mathematics, we use numbers and symbols, to construct "words" and "sentences" in mathematical constructions or what is called "mathematical story" as in solutions of exercises, problems. Thus, Mathematics, like languages, has also its own grammar or as (Leshem & Markovits: 2013) called it the mathematical logic as a criterion of validity or falsity of statements.

Mathematics, like language, is using many non-verbal communication, visual and graphic materials. The language used in mathematics has a specific grammatical structure of its own; words found only in this field. Whether in Arabic, English or French or any language, mathematical vocabulary is similar (Duval: 2006 and Novotna and Hofmannova:2000).

Both English and mathematics have similarities and differences as well. Both are languages of signs and symbols combined to "words", sentences …etc. They have their own grammar which is characterized as universal "languages" i.e. Each has its rules that are interasnationally used by any learner. However, they also have major differences; the language of mathematics, for instance, is distinguished by its precision, less flexibility and less ambiguity. While languages are more flexible and ambiguous, which come from the cultural and contextual richness of meanings Prochazkova

(2013) and Adanur; Yagiz and Işik (2004). Both mathematics and English, as a second or foreign language, need to be learned as they do not develop naturally as the mother language. Learning, therefore, must entail conscious practice based on rules which learners' study through drilling and activities to practice the skills required. These activities in both mathematics and English should expose learners to authentic real-life tasks (Dekeyser, 2007).

Chapman (1993) and Jaber (2004) identified types of language used in mathematics as follows

Oral language: presented in classroom discussions, explanation and interaction where metaphors and figurative language can be used for clarification.

Written language: presented in using mathematical terms, symbols such as triangle, union, factor etc. and interpreting the problem and the procedures of solving it in a written form.

Pictorial language: presented in graphs, diagrams, tables etc.

***Dramatization*:** using stories and dramatic scenes to present a mathematical problem or specific concepts where language can serve in presenting these concepts in an interesting educational environment.

But in order to present all these types of languages, teachers have to master the foreign language as well as the mathematical language. Leshem & Markovits (2013) indicated that Most mathematics teachers in general education classrooms are monolingual and don't have expertise in second language instruction. One of the best ways to deal with this dilemma is to collaborate with a bilingual or English-as-a-second-language (ESL) specialist. By collaborating, content and language instructors can combine their skills and knowledge to implement more effective curriculum, activities,

assessment, and resources. For example, the language instructor can assist content instructor in designing curriculum that is infused with language activities. The language instructor can analyze the content objectives, as well as the language abilities students need to master the content, to determine a basis for language activities in the ESL classroom. While the content instructor can help design and develop mathematics-based materials to be used in the class. They both also help each other to incorporate problem-solving activities into the class. This will support students' learning of the specialized language and ways of thinking in mathematics. It will provide a purposeful context for practicing more complex language skills as well as higher-order thinking skills.

More importantly, the National Council of Teachers of Mathematics (NCTM:2020) supports and advocates for the highest-quality mathematics teaching and learning for each and every student. These standards go in terms with the main principles of CLIL. The researchers inferred the relation between 3 standards out of 7 and CLIL as follows:

Standard 1—Knowing and Understanding Mathematics

Standard 2—Knowing and Using Mathematical Processes

Standard 3—Knowing Students and Planning for Mathematical Learning

Standard 4—Teaching Meaningful Mathematics

Standard 5—Assessing Impact on Student Learning

Standard 6—Social and Professional Context of Mathematics Teaching and Learning

Standard 7—Middle Level Field Experiences and Clinical Practice

Examining the standards, the researchers found that 3 of them stress the importance of language education for mathematics learning. The following is a presentation of the three standards and an explanation of the parts related to mathematics and language.

Standard 2: **Knowing and Using Mathematical Processes:**

Candidates demonstrate, within or across mathematical domains, their knowledge of and ability to apply the mathematical processes of problem solving; reason and communicate mathematically; and engaging in mathematical modelling. Candidates apply technology appropriately within these mathematical processes.

The NCTM explains that candidates need to think in English, express their ideas both orally and in written form precisely. Explaining concepts and managing to deliver the message adequately happens through communication where language is one of its components.

Mathematical communication happens when teachers manage to share ideas and clarify understanding. In order to communicate ideas, hold discussions and reflect on their teaching and their students' learning, they have to be clear, convincing and precise in their use of the target language.

Listening to others' explanations, participating in conversations held in English discussing mathematical issues will help in promoting teachers' language proficiency and mathematical competences (NCTM 2000).

Standard 3: Knowing Students and Planning for Mathematical Learning:

Candidates use knowledge of students and mathematics to plan rigorous and engaging mathematics instruction supporting students' access and learning. The mathematics instruction developed provides equitable, culturally responsive opportunities for all students to learn and apply mathematics concepts, skills, and practices.

The NCTM provided Guiding Principles for Teaching Mathematics to English Language Learners

1. **Challenging mathematical tasks**: teachers are required to provide students with challenging mathematical tasks. Teachers' roles are to ensure that students understand the task by clarifying, explaining the task because unclear, or new vocabulary may hinder students' understanding and as a consequence hinder their ability to solve the problem of the task.

2. **Linguistically sensitive social environment**: the environment of teaching mathematics in a foreign language is considered a sensitive social environment because the learners' mother tongue is completely different from the language of teaching/learning. They are supposed to learn content material and understand it through the medium of a foreign language. Teachers are required to support their students all through the learning process, facilitate communication using the foreign language between both teacher-student and student-student.

3. **Support for learning English while learning mathematics**: Facility with the English language is acquired when ELLs learn mathematics through effective instructional practices, including support structures that scaffold students' language development, engage students in Mathematics Discourse Communities (MDC)s make mathematics content linguistically

comprehensible to them, and assess their progress in reaching predetermined linguistic and mathematical goals.

4. **Mathematical tools and modeling as resources**: Mathematical tools and mathematical modeling provide a resource for ELLs to engage in mathematics, communicate their mathematical understanding and are essential in developing a community that enhances discourse.

5. **Cultural and linguistic differences as intellectual resources:** Students' cultural and linguistic differences in the mathematics community should be viewed as intellectual resources rather than as deficits and should be used in the classroom to connect to prior knowledge and to create a community whose members value one another's ways of engaging in mathematics.

The NCTM refers to the mathematical communication criterion which include teaching mathematics as a language and recommended integrating mathematical topics in children literature in a context that makes mathematics meaningful to develop students' mathematical knowledge in an interesting, purposeful and meaningful way.

Analyzing the most recent trends in the teaching of mathematics, it is found that there is a relation between the approach used and its philosophy, as the approach depends on acquiring the content knowledge, mastering the foreign language competence through which the content is presented, cultural and intercultural competences and cognitive skills. These elements of CLIL correspond well with the NCTM guide lines and its principles.

Based on the previous review, the researchers developed the following figure that represents their practical view of CLIL implementation for FEL mathematics future-teachers.

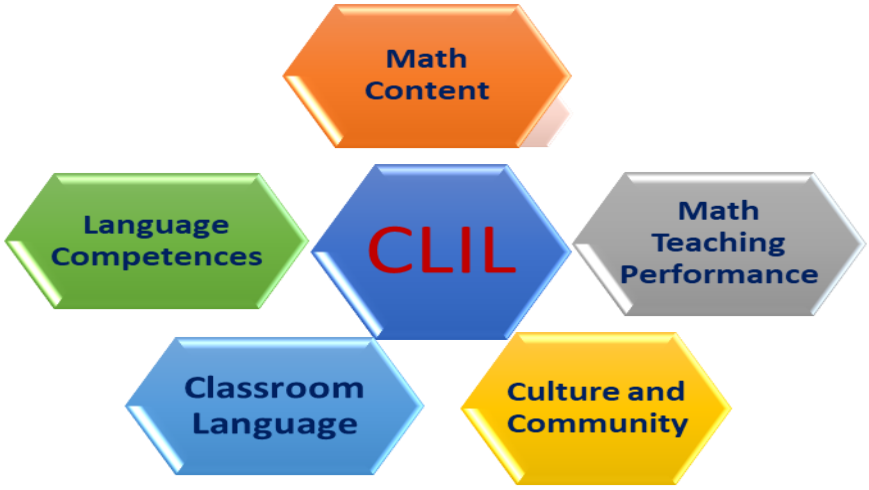


Figure (2)

Aboelela & Khater (2022)

As shown in the figure, CLIL is the heart around which the integration between content and language teachers gathers in an interaction that aims to combine the acquisition of mathematical content and teaching performance skills along with the acquisition of the language competences that students need as well as the language of classroom interaction. in light of that learning cultural knowledge related to the foreign language as well as community knowledge related to the mother tongue and related to learning mathematics are acquired too.

Moreover, the standards for full registration mandatory requirements for registration with the general teaching council for Scotland formal enactment (2021) serves the following purposes for developing professional teachers:

- a clear and concise description of the professional qualities and capabilities probationary teachers are expected to attain;
- a professional standard against which reliable and consistent recommendations and decisions on the fitness of new teachers can be made;
- a clear and concise description of the professional qualities and capabilities teachers are expected to possess.

Consequently, they have described the professional knowledge and understanding teachers should master as follows:

1 Have a depth of knowledge and understanding of Pedagogical Theories and Professional Practice

This standard is in terms with the first standard provided by The Council of Accreditation and of Educator Preparation CAEP (2013) which is entitled "Content and pedagogical knowledge" explaining that after graduating, educators should have a deep understanding of key concepts and principles in their area of expertise and flexibly adopting area-specific practices.

2 Have a depth of knowledge and understanding of Research and Engagement in Practitioner Enquiry.

3 Have a depth of knowledge and understanding of Curriculum Design

4 Have a depth of knowledge and understanding of Planning for Assessment, Teaching and Learning.

Under the fourth standard the following requirements were provided:

teachers must show complete knowledge and understanding of:

1 - How to plan effective evaluation, education, and learning individually and collectively in different situations to support the needs of each learner.

2 How to adapt a planning approach to effectively address the needs of each learner.

3 Adapt individual collaborative approach to broad assessment, recording and reporting as an integral part of learning and education.

4 National evaluation requirements and other relevant awarding and accreditation body requirements.

5 How to provide meaningful feedback to support and agree on the positive effects of having learners participate in dialogue about their progress.

It could be concluded that all recent trends in teacher preparation require them to be professionally well developed in the content area knowledge as well as have expertise in the skills, strategies, evaluation techniques related to their teaching performance. Thus, the CLIL is considered a successful recent approach that integrates all the skills, competences and skills related to both the teaching of mathematics and the English language required for EL mathematics teachers who asre supposed to teach in language and experimental schools in Egypt.

Research Design and Approach

A quantitative methodology was useful for describing the difference between the variables. Through the analysis of numerical data representing the various constructs and variables in this study, it was possible to address the research question. The quantitative design chosen for this study involved obtaining pretest as well as posttest measures.

The experimental design was used to examine the change between the pretest and posttest scores of the treatment group to determine whether the difference between the pretest and the posttest was statistically significant.

Participants of the study

The participants for this study included 21 mathematics EL future-teachers, Faculty of Women for Arts, Science and Education, Ain Shams University. The treatment group had similar student demographics where their age ranged between 20-21, all of them were females due to the faculty specialty. The overall number was 31 future-teachers, but the participants were only 21 who were punctual in attending the program and who had pre-posttest.

Instrumentation

Before tackling each tool separately, it is crucial to mention that all the four pre-posttests, namely; the mathematical teaching performance test, speaking, classroom language, and part of the writing test depended on students' live presentation of mini-lessons from the mathematics students' book for preparatory stage; the English version prepared by the Ministry of Education for language and experimental schools**.** Future mathematics teachers were completely free to choose an algebra lesson or geometry lesson. Their presentations were video-taped in order to be evaluated in light of the rubrics and the observation sheets later. Part of the writing pre-posttest depended on the mini-lesson presentation because this part dealt with letter directionality, word formation and size, while the mathematical content test and the other writing competences test (sentence structure, grammar and spelling) were examined through a written pen-and-paper exams. The tools were prepared in light of the CLIL approach.

Before developing the tools, the two researchers prepared 4 checklists to identify the mathematical content and teaching performance components as well as the speaking, writing and classroom language competencies that EL

mathematics future-teachers lacked and were in need to be developed. The sources of the identified competences were the students' opinions and needs as determined by them in a class discussion where they were asked the following questions:

a)What are your needs to be a good EFL math teacher ?

b) What are the most important difficulties that you face during your practical training in schools while teaching in the classroom?

c) What do you expect from the training will help you in your future work?

In addition to these questions, the pilot study developed by the researchers at the beginning of the research and the holistic analysis of the preparatory stage pupils' book were also used. The importance of these checklists lies in the fact that the measuring rubrics and the tests development depend on the identified mathematical content, the teaching performance components and the language competences, as well.

The mathematical checklists

Mathematical content and teaching performance checklists:

the source of these checklists was derived from the holistic analysis of the preparatory stage mathematics students' books, (the English version which was prepared by the Ministry of Education for language and experimental schools), to identify the main mathematical terms and the mathematical problems that should be mastered by the mathematics future-teachers. The future mathematics teachers were asked about the problems they face when they present a mathematical lesson in English. They ensured that mastery of the mathematical terms that should be explained in correct English is the first

problem. Besides, there problems of applying their knowledge in a classroom situation and their inability to solve mathematical story problems in English, and how to present the knowledge they acquired innovatively. The content area researcher summarized these problems in two checklists: the mathematical content and that of teaching performance. She introduced them to the mathematics future-teachers who approved both of them according to their needs.

The mathematics tools

The future-teacher's knowledge and understanding of school mathematics affects the way s/he is able to teach mathematics' skills in English. Accordingly, the research tools consisted of a test in mathematical content and Mathematics teaching performance skills which are measured by using the observation-sheet to judge the teaching performance of the female EL future-teachers of mathematics during the training on the proposed program.

Describing the mathematical content test prepared in light of CLIL approach

The test was based on the content of preparatory stage mathematics that included: Symbols, mathematical terms, and geometric shapes, Numbers and algebra, Geometry and measurement, Statistics and probability and solve story problems. The test items are varied to enable the trainees to develop ideas for the content of the curriculum, and to express mathematical concepts and terms in different ways. The test items varied between writing the mathematical and geometric terms, solving story problems, expressing the problem by drawing and solving it through drawing geometric or graphic shapes, mentioning the theory based on solving the geometric problem (not

proof of the solution), the ability to read the problems presented and expressing them in other ways using the English language only. The full score is not accounted for unless the trainees use the correct and proper written English language, and the score is not calculated if it is done in Arabic, even if the answer is mathematically correct.

. The test consists of 15 various questions: complete, reformulate the problems and write theories, distributed over the test components. The overall score for the Mathematical Content test is *140

The following is a table of specifications.

Table (3)

Table of mathematical content sub-components specifications

Math Content	Questions	Percentage %
Mathematical Symbols and Shape	**1,2**	**13.3**
Numbers and Algebra	**3,9, 14(6-8-9-10-13)**	**15.2**
Geometry and Measurement	**4,5,11(5-6-7-8-9-10),13,14(1-2-3-4-5-7-11-12-14-15-16-17)**	**28.5**
Probability and Statistics	**10,11(1-2-3-4),12,14(18),15**	**23**
Story/ Word Problem Solving	**6,7,8**	**20**
Sum	**15**	**100**

The validity of the mathematical content test

The internal consistency:

To ensure the internal consistency of the test items, the correlation coefficients were calculated between the score of each item and the total score of the test. The following table shows the correlation coefficients:

Table (4)

The values of the correlation coefficients between the score of each item and the overall score for the test

Item number	Correlation
1	0.85**
2	0.74**
3	0.59**
4	0.788**
5	0.57**
6	0.56**
7	0.63**
8	0.61**
9	0.56**
10	0.61**
11	0.58**
12	0.64**
13	0.60**
14	0.78**
15	0.56**

**** sig. at 0.01, when the correlation coefficient is greater than 0.55 where n = 20**

It is concluded from the previous table that all the items of the test are statistically significant to the total score, which indicates the internal consistency of the test.

The reliability of the overall test: The reliability of the test was confirmed by:

• **Alpha-Cronbach coefficient:** The alpha-Cronbach coefficient was calculated for the test and its value was (0.82), which is a high value that generally indicates the accuracy and reliability of the test as a means of measurement and therefore it can be relied upon.

The mathematics teaching performance observation sheet prepared in light of CLIL approach

The goal of the observation sheet is to measure the performance of the research group for the following sub-components of the teaching performance: opening skills, general presentation skills, presenting subject matter skill (knowledge of the content of the lesson), teaching strategies, techniques and teaching aids, classroom management skills, classroom content language Interaction, language of content instruction, and evaluative skill. The researcher developed the initial version of the observation sheet in the light of the review of related literature in the field of preparing the mathematics teachers to teach in foreign languages. Consequently, the items of the observation sheet were designed with the aim of integrating the content and the language of learning. The overall items were 41 skills distributed among the observation sheet's main components (8Components) which are: Opening skills, General presentation skills, Mathematics knowledge skills strategies, techniques and teaching aids, classroom management skills, content language Interaction, Instructions and Evaluation.

The validity of the mathematical teaching performance observation sheet

Jury members validity

The test had been presented to a group of jury members. The items have been modified in the light of their opinions where certain skills have been rephrased and others were deleted, so it can be said that the observation sheet is valid.

The internal consistency

To ensure the internal consistency of the sub-skills of the Teaching Performance observation sheet, the correlation coefficients were calculated between the degree of each skill and the total degree, after deleting the item's degree from the total degree. The following table shows the correlation coefficients:

Table (5)
The values of the correlation coefficients between the score for each skill and the total score for the test

Teaching performance subskills	Correlation coefficient
Opening skills	0.70**
General presentation skills	0.72**
Mathematics knowledge skills	0.56**
strategies, techniques and teaching aids	0.74**
classroom management skills	0.71**
content language Interaction	0.56**
Instructions	0.56**
Evaluation	0.67**

**** sig. at 0.01, when the correlation coefficient is greater than 0.55 where n = 20**

It is noted from the previous table that all dimensions of the teaching performance note card are statistically significant to the total score, which indicates the internal consistency of the teaching performance observation sheet.

observation sheet reliability

Alpha-Cronbach coefficient: The alpha-Cronbach coefficient was calculated for the test and its value was (0.78), which is a high value that generally indicates the accuracy and stability of the teaching performance observation card as a means of measurement and therefore it can be relied upon.

Quantitative assessment of the future-teachers' performance: The researcher adopted the triple rating (high - medium - poor) represented in 3-2-1 order. The quantitative performance of the skill is assessed by calculating the overall grades obtained by the future-teachers in all skills.

Describing the English language checklists and tools prepared in light of CLIL approach

1. **The speaking check list**: The discussions with the mathematics future-teachers indicated that they cannot speak spontaneously, cannot pronounce words and terms appropriately and they had stress and accent problems and grammatical mistakes. The language researcher summarized these problems in a checklist and introduced them to the students and the content researcher to approve it according to their needs. The final version of the checklist included: accuracy, fluency and interaction, pronunciation and accent .

2. **The writing checklist:** the source of this checklist stems from the discussions with mathematics future-teachers about the problems they face while writing in English, the analysis of their writings, analysis of the mini-lessons they taught in the pilot study and the observations of their content instructor. The problems were: grammatical mistakes, sentence structure problems, spelling and capitalization problems, letter directionality and word formation problems while writing on the board. The final version of the

checklist included: sentence structure, grammar and spelling, organization, mechanics of language, shape, directionality and formation of letters, size and spacing.

3. **Classroom language checklist**: the source of this checklist was derived from the observation of mathematics future teachers' performance in the pilot study, the content area instructor's comments and their own diagnosis of their problems while teaching. The problems were their inability to communicate with their students while giving instructions in English, explaining the lesson, giving appropriate feedback and constructive comments in English. The language instructor summarized these problems in seven areas, giving the checklist to the future-teachers and the content instructor to approve it according to their needs. The final version of the checklist included: the beginning or starting of the class, using disciplinary expressions, praising and correction, giving instructions, checking for understanding, developing pupils' language, and finishing the lesson.

Accordingly, and in light of these checklists, the language tools were developed as follows

1)A speaking competence pre-posttest to measure the development of the third-year mathematics future-teachers.

2)A writing competence pre-posttest to measure the development of third-year mathematics future -teachers.

3)A classroom language observation sheet

4)Speaking competence rubric

5)A writing competence rubric

1)The pre-post administration of the tests and observation sheets:

The pre-posttest was divided into two parts, the first part concerning speaking, hand writing and classroom language observation, depended mainly on mini-lessons presentations introduced by each student within 15-20 minutes. The mini-lessons were chosen from preparatory stage students' book (the English version which was prepared by the Ministry of Education for language and experimental schools). The second part of the test was that of a paper-pen writing test to measure sentence structure, grammar and spelling. The test was divided into two sections: section one was obligatory where they were asked to choose a mathematical term or concept and were asked to explain it. The second section consisted of three topics and they were asked to choose one to write about. These topics were:

Describe a strategy you learned to teach a mathematical concept.

Write a short story to your students representing mathematical concepts.

Write a lesson plan on how you would present a mathematical concept in class.

Write a conversation between a student and his/her mathematics teacher about any topic you choose.

Speaking test Validity

The internal consistency:

To ensure the internal consistency of the components of the English-Speaking test, the correlation coefficients were calculated between the score of each component and the total score of the test after deleting the dimension

degree from the total score. The following table shows the correlation coefficients.

Table (6)
The values of the correlation coefficients between the score of each Sub-competence and the total score of the English-Speaking test

Speaking test sub-competences	Correlation coefficient
Accuracy	0.82**
fluency and interaction	0.92**
pronunciation & accent	0.95**

** sig. at 0.01, when the correlation coefficient is greater than 0.55 where n = 20

It is recognized from the previous table that all the sub-competences of the test are statistically significant to the total score, which indicates the internal consistency of the test.

The overall speaking test reliability: The reliability of the test was confirmed by:

Alpha-Cronbach coefficient: The alpha-Cronbach coefficient was calculated for the test and its value was (0.88), which is a high value that generally indicates the accuracy and reliability of the test as a means of measurement and therefore reliable.

The writing test validity

The internal consistency

To ensure the internal consistency of the writing test sub-competences, the correlation coefficients were calculated between the score of each sub-skill and the total score of the test after deleting the specific sub-competence's score from the total score. The following table shows the correlation coefficients:

Table (7)

The values of the correlation coefficients between the score of each component and the total score for the English writing test

Writing test sub-competences	Correlation coefficient
Shape, directionality, and letter formation	0.85**
Letter and word size and spacing	0.79**
Sentence structure	0.58**
Grammar & spelling	0.87**

** sig. at 0.01, when the correlation coefficient is greater than 0.56 where n = 20

It is clear from the previous table that all competences of the English writing test are statistically significantly related to the total score, which indicates the internal consistency of the test.

The overall writing test reliability: The reliability of the test was confirmed by Alpha-Cronbach coefficient: The Alpha-Cronbach coefficient was calculated for the test and its value was (0.80), which is a high value that generally indicates the accuracy and reliability of the English writing test as a means of measurement and therefore it can be relied upon.

Validity of the classroom language observation sheet

internal consistency

To ensure the internal consistency of the sub-competences of the classroom language observation sheet, the correlation coefficients were calculated between the degree of each sub-competence and the total score, after deleting

the specific sub-competence's degree from the total score. The following table shows the correlation coefficients:

Table (8)

The values of the correlation coefficients between the score for each sub-competence and the total score for the observation sheet

Classroom language observation sheet	Correlation coefficient
starting lesson	0.58**
disciplinary expressions	0.56**
praising &correction	0.70**
checking for understanding	0.63**
Developing pupils' language	0.67**
finishing the lesson	0.56**
finishing the lesson	0.57**

** sig, at 0.01, when the correlation coefficient is greater than 0.56 where n = 20

It is clear from the previous table that all of the classroom language sub-competencies are statistically significant to the total score which indicates the internal consistency of the classroom language observation sheet.

The class language observation sheet reliability: The reliability of the observation sheet was confirmed by:

Alpha-Cronbach coefficient: The alpha-Cronbach coefficient was calculated for the observation sheet and its value is (0.79) which is a high value that generally indicates the accuracy and reliability of the class language observation sheet as a means of measurement and therefore it can be relied upon.

In order to evaluate future-teachers' performance on the speaking and writing tests, the researcher developed the following rubrics where they were used by the researcher and another colleague to evaluate their performance:

Speaking rubric:

The rubric was designed in light of the checklist. The rubric was divided into three sub-competences: accuracy, fluency and interaction, pronunciation and accent. The grading system of the rubric was divided into a scale of (5 points) where (5) represented the best performance and (1) represented the worst performance. (4) represented very good performance, (3) represented good performance while (2) represented fair performance.

The writing rubric:

The writing rubric was designed in light of the writing checklist. It included 4 sub-competences: sentence structure, grammar and spelling, shape, directionality and formation of letters, size and spacing (see appendix ……). The grading system of the rubric was divided into a scale of (4 points) where (4) represented the best performance and (1) represented the worst performance, (3) represented good performance while (2) represented fair performance.

The classroom language observation sheet:

The observation sheet was designed in light of the classroom language checklist. It included seven main language areas: the beginning or starting of the class, using disciplinary expressions, praising and correction, giving instructions, checking for understanding, developing pupils' language, and finishing the lesson. The grading system ranged between always, sometimes, rarely and never.

Third: A satisfaction questionnaire: it was administered at the end of the program to measure Future-teachers' satisfaction and benefaction from the remedial training program.

The aim of this questionnaire is to identify the viewpoints about the program developed for the future students of mathematics, English section, where each student is required to express her opinion after reading each statement carefully then checking (√) in front of the response that represents her own opinion as follows:

a) Agree with the statement, check (√) in the agree column.
b) Disagree with the statement, check (√) in the disagree column.
c) Do not know or not sure, check (√) in the not sure column.

The questionnaire is classified under five categories as presented in table (9).

Table (9)

The classification of the questionnaire items

Items Classification	Items Numbers
Program's Objectives	1- 6- 7-9-12- 13-16-17- 21- 22- 23- 24- 26- 27- 28- 29- 30 .
Program's content	2- 11
Methods of teaching	3- 8- 14- 15- 18- 25-31
Tasks, activities, and teaching aids	4- 19- 20
Evaluation techniques	5- 10
Sum	**31**

Instructions to the students included the importance of answering all the items stressing that there is no correct answer and that the answers express their own points of view. Also, some items required students' comments by adding examples such as items number 1-2-3-4-5 and 23. At the very end of the questionnaire, students were given the chance to add more comments if they wish.

Administration of the mathematical and language tests

The tests were administered on the second term of the academic year 2017/2018 through 3 sessions on 5th, 12th and 19th February. The researchers used to meet them regularly once a week for two hours to apply the program. The program was administered on 19th February after the end of the third session and lasted till 26th March. The posttests were administered on 30th March. Program implementation covered 6 sessions, 2 hours each. Besides, following future-teachers' progress through social media communication such as WhatsApp group.

The program

Rationale

The rationale of the program stems from the CLIL's philosophical notion of 'integration'. The dual purpose of having simultaneous language learning and content outcomes marks a shift from conventional practice in language and subjects teaching. It relies on the following outstanding principles:

- Language is used **for learning** as well as **communication.**
- It is the subject that determines the language to be learned.
- a CLIL **course** is not a language **course or** a subject **course** in a foreign language.
- In CLIL, content aims are supported by language aims.
- CLIL combines four components essential for meaningful learning: "content (subject matter), communication (learning and use of language), cognition (learning and thinking processes), and culture (development of intercultural understanding and civic world)" (Coyle et al., 2010, pp. 41). This

combination, known as the 4Cs, determines the effectiveness of learning because students have the opportunity to develop the skills needed to gain a clear understanding of the topic and foster greater engagement with the target language as they become more competent and achieve progress.

Based on these main principles, the objectives of the remedial training program have been developed for EFL future-teachers to acquire skills related to mathematical content and teaching performance using correct and acceptable English language.

To identify the aims of the program and plan its sessions, the researchers depended on analysing the training needs of future-teachers through the prior application of observation sheets and analysis of video clips while teaching a mini-lesson, as well as asking the research group about their needs (as mentioned earlier). Through these observations, the training needs were identified as follows:

A) The need to increase the use and improvement of class interaction among future teachers, as it was noticed that they depend on the Arabic language during class interaction and during the explanation.

B)Their need to be trained on avoiding the mistakes they usually commit related to handwriting, spelling and some other writing skills.

C) They relied on solving symbolic mathematical problems, avoiding verbal mathematical problems (story problem) lessons, as well as expressing, by drawing, geometric problems to avoid the use of the English language, whether spoken or written.

D) Their need to use educational aids and instructional materials that help to explain abstract concepts in a concrete manner.

E) They need to be trained on correct intonation and pronunciation of words, be trained on using strategies that help overcoming hesitation and Provided with the needed lexis for communication and be involved in listening and practicing process.

F) They need continuous practice of the mathematical teaching performance skill and intensive training on classroom language practices.

Aims of the program

1)Developing FL future-teachers of mathematics' mastery of some mathematical content components.

2) Developing FL future-teachers of mathematics' some teaching performance skills.

3) Developing FL future-teachers of mathematics' some English language competences.

Training aids and materials used in the program

- Videos presented by native speakers dealing with the topic of the training sessions were used according to the following criteria:

-The videos are in English without Arabic subtitles

-Provide the students with copies of the videos

-When presenting the videos, there were pauses for discussion on the topic of the video between the trainees and the future-teachers.

-Each video is followed by activity sheets which were presented with instructions including the aim of the activity and its duration. These activities were done in groups and individually.

- Students prepare materials and teaching aids as a practical application, using some preparatory stage mathematics lessons

- Preparatory stage students' books (pdf versions)
- Mathematical and English worksheets
- Mathematical real objects
- Handouts for letter writing directionalities, classroom language samples
- Phonemic charts
- Online-offline dictionary
- Aural-oral pronunciation mobile applications

Teaching Strategies and techniques

*Group, pair and individual work. * Role playing and dramatization.

* On-line learning * Discussions

*Learning by doing and inquiry learning

Procedures

- ✓ The two researchers did not design a new content for the program because the program is basically a remedial one. The FL mathematics future-teachers already have background knowledge of mathematical content, language competences and teaching performance, but it was recognized that they commit some mistakes that hinder their communication in English related to the teaching of the preparatory stage courses in terms of mathematical content and teaching in English, as well as some teaching performance skills. It was noted that the basis of the problem is the inability to communicate mathematically in English, hence both researchers found

that these students need an intervention to correct some of these mistakes which affect their performance and comprehension and communication.

- ✓ CLIL is a student-centred learning where instructors are guiding, advising and working from behind. They are watching, diagnosing then intervention is done to correct, modify concepts and correct performance, and thus the direct instruction is used.
- ✓ The researchers adopt the method of learning by doing where EL mathematics future-teachers are required to prepare lessons from preparatory stage mathematics books to be presented in the class. They were required to prepare the instructional materials, write the procedures of the mini-lessons …etc.
- ✓ After each student's presentation the content area instructor (Methodology researcher) asks for the rest of the class discuss the presentation, giving their feedback according to the criteria agreed upon with the professor. Then, the content researcher provides her own commentary, explaining the content area problems as well as evaluating the teaching performance.
- ✓ The English language instructor interferes to comment on the language mistakes explaining the correct rules both for the spoken and the written language. Then, discusses with them the appropriate classroom language and the different alternatives that could be used in nearly every situation.
- ✓ At the end of each session, they were provided with group work, pair and individual activities to be practised both for mathematics as well as English.
- ✓ For homework, students were always asked to carry out tasks such as:

- Searching for teaching lessons on YouTube for native speakers and upload them on the WhatsApp group to discuss the mathematical content, how it is presented, the teacher's performance, strategies used, the classroom

language used, the vocabulary they acquired and how to be written and the pros and cons of the presentation.

- Record for themselves the pronunciation of some words after listening to them on the BBC learning English application…etc.

Statistical analysis and discussion results

The following statistical methods and treatments were used using the SPSS 21 program:

1- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre and post applications of mathematics tests (content components and teaching performance) tools as a total score.

2- Wilcoxon test to find out the differences between the mean ranks of the research group in the two applications, pre and post, to test the mathematical content as a total score.

2- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre and post applications of the mathematical teaching performance observation sheet as a total score and its sub-components.

3- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre and post applications of the English language competences tools as an overall degree.

4- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre and post applications of speaking test as an overall score and its sub-competences.

5- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre-post writing competence overall score and its sub-competences.

6- Wilcoxon test to find out the differences between the mean ranks of the research group in the pre and post applications of the overall classroom language observation sheet score and its sub-components.

7- Calculating the effect size of the proposed program in developing the research group's overall mathematical main components (content and teaching performance) and its sub-skills.

8- Calculating the impact size of the proposed program in developing the research group's overall English language competencies and their sub-competences.

9- Calculating the correlation coefficient between the score of each sub-competences and the total score of the speaking test to find out the internal consistency.

10- Calculating the correlation coefficient between the score of each sub-competences and the total score of the writing test to find out the internal consistency.

11- Calculating the correlation coefficient between the score of each sub-competences and the total score of the classroom language observation sheet to find out the overall internal consistency .

12- Calculating the correlation coefficient between the score of each item and the total score of the mathematical content test to find out the internal consistency.

13- Calculating the validity of the mathematical content test, the English writing test and the English-speaking test using Cronbach's alpha coefficient.

The results and their interpretation in light of the CLIL approach:

Testing the first hypothesis

The first hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the pre-post mathematics tests (mathematical content and teaching performance) as a total score in favor of the post application***". The following table shows the results obtained:

Table (10)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the overall mathematics tests components as a total degree where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	Mean		Std. Deviation		Z	Sig.
					PREE	POST	PREE	POST		
Overall math tests (content & Teaching Performance)	Negative Ranks	0	0.00	0.00	131.57	187.14	23.53	21.79	4.015	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

It is noticed from the previous table that the results of the research group in the overall mathematics tests (mathematical content and teaching performance) that the positive ranks are 21, the neutral ranks are 0, and the negative ranks are 0, and this indicates that the scores of 21 students (all students of the research group) have increased in the post application than the pre application, and none of the students had decreased nor remained equal. The arithmetic mean in the post

application is greater than the pre application and this indicates that the level of the research group students increased in overall mathematics tests after using the proposed remedial training program based on CLIL, and the standard deviation in the application of the overall mathematics tests is less than the pre application which indicates that the level of the research group became closer after using the proposed remedial training program. The level of significance is Sig. in the overall mathematics tests (mathematical content and teaching performance) where the total degree equal to (0.000) i.e., less than (0.01) and this indicates that there is a difference between the pre-post applications at the level (0.01) of significance in favor of the post application, and thus we accept the first hypothesis.

Testing the second hypothesis

The second hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the overall pre-post mathematical content components in favor of the post application***". The following table shows the results obtained

Table (11)

The significance of the differences between the average ranks of the scores of a group before and after using the proposed remedial training program, on the test of the mathematical content as a total degree as a total degree where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	mean		Std. Deviation		Z	Sig.
					PRE E	POST	PRE E	POST		
The overall mathematical content	Negative Ranks	1	1.00	1.00	57.38	89.33	21.19	16.2	3.981	0.000
	Positive Ranks	20	11.50	230.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

It is noted from the previous table of the results of the research group in the overall mathematical content test that the positive ranks = 20, the equivalent ranks= 0, and the negative ranks =1, and this indicates that the scores of 20 students increased in the post application than the pre application, and there is only one student whose scores decreased in the post application than the pre application. The arithmetic mean in the post application is greater than the pre application and this indicates that the level of the research group increased in the overall mathematical content post application due to using the proposed remedial training program based CLIL. Also, the standard deviation in the post application of the mathematical content test is less than the pre application, and this indicates that the level of the research group became close after using the proposed remedial training program. The level of significance in the mathematical content test score is less than (0.01) and this indicates that there is a difference between the pre and post applications in the overall mathematical content test at the level of 0.01 of significance in favor of the post application, and thus we accept the second hypothesis.

Testing the third hypothesis

The third hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the overall pre-post application of the mathematical teaching performance observation sheet and its sub-skills in favor of the post application***". To verify this hypothesis, the mean ranks of the research group were compared before using the remedial training program with the average ranks of the same group scores after using the proposed remedial training program on the overall mathematical performance observation sheet and its sub-skills. The following table shows the results obtained:

Table (12)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the sports performance note card as a total score and sub-components where (21 = n) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	mean		Std. Deviation		Z	Sig.
					PRE E	POST	PRE E	POST		
Opening skills	Negative	2	2.00	4.00	9.1	12.33	2.26	2.24	3.674	0.000
	Positive	17	10.94	186.0						
	Ties	2	0.00	0.00						
	TOTAL	21								
General **presentation** skills	Negative	1	3.00	3.00	16.05	20.67	1.77	3.71	3.710	0.000
	Positive	18	10.39	187.0						
	Ties	2	0.00	0.00						
	TOTAL	21								
Mathematics knowledge skills	Negative	2	4.00	8.00	8.9	10.86	1.26	1.85	3.538	0.000
	Positive	17	10.71	182.0						
	Ties	2	0.00	0.00						
	TOTAL	21								
strategies, techniques and teaching aids	Negative	1	3.50	3.50	8	10.76	1.18	1.58	3.912	0.000
	Positive	20	11.38	227.5						
	Ties	0	0.00	0.00						
	TOTAL	21								
classroom management skills	Negative	2	3.00	6.00	9.1	10.67	1.55	1.83	2.937	0.003
	Positive	12	8.25	99.00						
	Ties	7	0.00	0.00						
	TOTAL	21								
	Negative	1	2.50	2.50					3.538	0.000
	Positive	16	9.41	150.50						

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	mean		Std. Deviation		Z	Sig.
					PRE E	POST	PRE E	POST		
content language Interaction	Ties	4	0.00	0.00	10.19	13.33	1.83	2.24		
	TOTAL	21								
instructions	Negative	0	0.00	0.00	6.95	10.38	1.32	2.13	3.499	0.000
	Positive	20	10.50	210.00						
	Ties	1	0.00	0.00						
	TOTAL	21								
evaluation	Negative	0	0.00	0.00	5.9	8.81	1.09	1.4	3.951	0.000
	Positive	20	10.50	210.00						
	Ties	1	0.00	0.00						
	TOTAL	21								
overall teaching performance	Negative	0	0.00	0.00	74.19	97.81	7.99	12.07	4.016	0000
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

It is recognized from the previous table of the results of the research group in the overall teaching performance observation sheet and its sub-skills that the ranks came as follows: For the skills (Opening skills, Mathematics knowledge skills) there are 17 positive ranks, 2 negative ranks , and 2 neutral ranks , and this indicates that the scores of 17 students increased in the post application from the pre application, and two students decreased in the post application, while two students remained the same. For the skill (general presentation skills), the positive ranks are 18, and the negative ranks are 1, while 2 had the same scores of the pre-application. With regard to the skills (teaching strategies and techniques), it is found that the positive ranks are 20, the negative rank is 1, and the neutral ranks are zero. This indicates that the scores of 20 students increased in the post-application than the pre-application, and only one student decreased. As for the

skill (classroom management skills), it is recognized that the positive ranks are 12, the negative ranks are 2, and 7 ranked the same as the pre application. This indicates that the scores of 12 students have increased in the post application compared to the pre application, and two students had decreased scores in the post application, and 7 students had equal scores in the post application as the pre application. Moving to the skill (content language interaction), it is noted that the positive ranks are 16, the negative ranks are 1, and the equal ranks are 4. This indicates However, the scores of 16 students increased in the post-application than the pre-application, and only one student had a decrease in their scores in the post-application than the pre-application, and 4 students had equal scores in the post-application as the pre-application. Coming to the skills (instructions, evaluation), it is found that the positive ranks were 20, and the negative rank is zero, and only 1 ranked the same as the pre-test, and this indicates that the scores of 20 students increased in the post-application from the pre-application, and there are no students whose scores decreased in the post-application from the pre-application while only one student had equal scores in the post-application as the pre-application. Finally, concerning the overall mathematical teaching performance, it is recognized that the positive ranks are 21, and this indicates that the scores of 21 students (all of the research group) increased in the post-application. The arithmetic average in the overall application of the mathematical teaching performance and its sub-skills is greater than the pre application and this indicates that the level of the research group increased after using the proposed remedial training program based on CLIL, and the significance level in the overall teaching performance observation sheet and its sub-skills is less than (0.01) and this indicates that there is a difference between the pre-post applications at the level

0.01 of significance in favor of the post application, and thus we accept the third hypothesis.

Testing the fourth hypothesis

The fourth hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the overall pre-post English language competences test in favor of the post application.***" To verify this hypothesis, the mean ranks of the research group were compared before using the remedial training program with the average ranks of the same group scores after using the proposed remedial training program on the overall English language competences where Wilcoxon Test was used to reveal the significance of the differences between the two applications. The following table shows the results obtained :

Table (13)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the English language competency tools as a total degree where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	Mean		Std. Deviation		Z	Sig.
					PRE E	POST	PRE E	POST		
Overall language competences	Negative	0	0.00	0.00	13.22	39.90	3.93	3.08	4.021	0.000
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTA	21								

It is noticed from the previous table the results of the research group in the overall English language competences that the positive ranks= 21, the equivalent ranks = 0 and the negative ranks= 0, and this indicates that the scores of 21 students (all of the research group) increased in the post application over the pre application,

and there are no students whose scores in the overall English language competences test have decreased or equalized. The arithmetic mean in the post application is greater than the pre application and this indicates that the level of the research group increased in the overall English language competences after using the proposed remedial training program based on CLIL. Also, the standard deviation in the post application of English language competences test is lower than the pre application, and this indicates that the level of the research group became closer after using the proposed remedial training program. Also, the level of significance in the overall English language competences is equal to (0.000) i.e., less than (0.01) and this indicates that there is a difference between the pre-post applications at the level 0.01 of significance in favor of the post application, and thus we accept the fourth hypothesis.

Testing the fifth hypothesis

The fifth hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group performance on the overall pre-post speaking test and its sub-competences in favor of the post application***". To verify this hypothesis, the mean ranks of the research group were compared before using the remedial training program with the average ranks of the same group scores after using the proposed remedial training program on the overall speaking competence and its sub-competences. The following table shows the results obtained.

Table (14)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the speaking efficiency test as a total score and sub-components where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	mean		Std. Deviation		Z	Sig.
					PRE E	POS T	PRE E	POS T		
Accuracy	Negativ	0	0.00	0.00	1.23	2.62	0.43	0.67	3.787	0.000
	Positive	17	9.00	153.0						
	Ties	4	0.00	0.00						
	TOTAL	21								
fluency and interaction	Negativ	0	0.00	0.00	1.24	3.05	0.54	0.80	4.058	0.000
	Positive	20	10.50	210.0						
	Ties	1	0.00	0.00						
	TOTAL	21								
pronunciation & accent	Negativ	0	0.00	0.00	1.23	2.95	0.50	0.62	3.977	0.000
	Positive	19	10.00	190.0						
	Ties	2	0.00	0.00						
	TOTAL	21								
Overall speaking competence	Negativ	0	0.00	0.00	3.714	8.63	1.45	1.40	4.068	0000
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

It is noted from the previous table that the results of the research group's in the overall speaking test and its sub-competences came as follows: for the skill (accuracy), it has 17 positive ranks, zero negative ranks , and 4 neutral ranks , and

this indicates that the scores of 17 students increased in The post application over the pre application. There are no students whose scores have decreased in the post application, and only 4 students whose scores are equal. As for the skill (fluency and interaction) the positive ranks are 20, the negative ranks are zero, and the equal ranks are 1. This indicates that the scores of 20 students increased in the post-application than in the pre-application, and no students had a decrease in their scores in the post-application, and only one student had equal scores in the post-application as in the pre-application. With regard to the skill (pronunciation & accent) the positive ranks are 19, and the negative ranks are zero, and the neutral ranks are 2. This indicates that the scores of 19 students increased in the post-application, no students decreased in the post-application, and only one student scored equal in the post-application as the pre-application. Thus, the overall speaking efficiency of the 21 students scored positive ranks, the neutral ranks are 0, and the negative ranks are 0, and this indicates that the scores of 21 students (all the students of the research group) increased in the post-application over the pre application, and there is no Students whose scores decreased or were equal in the speaking proficiency test as a total score. The arithmetic mean in the post application in the overall speaking test and its sub-competences was greater than the pre-application and this indicates that the level of the research group students due to the implementation of the proposed remedial training program based on CLIL. The level of significance in the overall speaking test and its sub-competences scored less than (0.01), and this indicates that there is a difference between the two applications in favor of the post application. Thus, the fifth hypothesis is verified.

Testing the sixth hypothesis

The sixth hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the pre-post overall writing test and its sub-competences in favor of the post application***." To verify this hypothesis, the mean ranks of the research group were compared before using the remedial training program with the average ranks of the same group scores after using the proposed remedial training program on the overall writing competence and its sub-competences. The following table shows the results obtained

Table (15)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the overall writing and its sub-competences where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Numb	Mean Rank	Sum of Ranks	Mean		Std.		Z	Sig.
					PREE	POST	PREE	POST		
Shape, direction ality,	Negative	0	0.00	0.00	1.52	3.14	0.68	0.79	3.994	0.000
	Positive	20	10.50	210.00						
	Ties	1	0.00	0.00						
	TOTAL	21								
Letter and word	Negative	0	0.00	0.00	2.00	3.71	0.45	0.46	4.148	0.000
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
Sentence structure	Negative	0	0.00	0.00	1.43	2.76	0.51	0.54	3.938	0.000
	Positive	19	10.00	190.00						
	Ties	2	0.00	0.00						

SKIL	Ranks	Numbr	Mean Rank	Sum of Ranks	Mean		Std.		Z	Sig.
					PREE	POST	PREE	POST		
	TOTAL	21								
Grammar & spelling	Negative	0	0.00	0.00	1.14	2.95	0.36	0.74	4.081	0.000
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
Overall writing competence	Negative	0	0.00	0.00	6.10	12.57	1.55	1.63	4.041	0002
	Positive	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

The previous table reveals the results of the research group's ranks in the overall writing competence test and its sub-competences which came as follows: For the skill (shape, directionality, and letter formation): it has 20 positive ranks, zero negative ranks , and 1 neutral rank. This indicates that the scores of 20 future-teachers increased in the post application, and there were no students whose scores decreased in the dimensional application, while only one had the same score in the post application as the pre application. Coming to the skill (sentence structure): it has 19 positive ranks, zero negative ranks and only 2 had the same scores as the pre application. This indicates that the scores of 19 students increased in the post-application than the pre-application, and there were no students whose scores decreased in the post-application, and only two future-teachers whose scores were equalized in the post-application as the pre-application. With regard to (Letter, word size and spacing competence together with the grammar & spelling skill and the overall writing competence): they included 21 positive ranks, zero neutral ranks, and zero negative ranks. This

indicates that the scores of the 21 future-teachers (all students of the research group) increased in the post-application, no student decreased or were equal with the pre-scores. The arithmetic average in the post application in the overall writing test and its sub-competences is greater than the pre application which indicates that the level of the research group's level in the overall writing competence and its sub-competences increased due to the implementation of the proposed remedial training program based on CLIL. The level of significance in the overall writing competence test and its sub-competences is less than (0.01) and this indicates that there is a difference between the two applications before and after the intervention. Hence, the sixth hypothesis is verified.

Testing the seventh hypothesis

The seventh hypothesis states that "***there is a statistically significant difference between the mean ranks of the research group in the pre- post administration of the overall classroom language observation sheet and its sub-components in favor of the post application***." To verify this hypothesis, the averages of the research group scores were compared before using the proposed remedial training program based on CLIL with average scores of the same group after using the proposed remedial training program. The following table shows the results obtained:

Table (16)

The significance of the differences between the average ranks of the group scores before and after using the proposed remedial training program, on the overall classroom language observation sheet and its sub-components where (n = 21) and (degrees of freedom = 20).

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	Mean		Std.		Z	Sig.
					PREE	POST	PREE	POST		
starting lesson	Negative Ranks	0	0.00	0.00	1.00	2.86	0.00	0.36	4.347	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
disciplinary expressions	Negative Ranks	0	0.00	0.00	0.38	2.75	0.50	0.51	4.102	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
praising &correction	Negative Ranks	0	0.00	0.00	0.62	2.76	0.50	0.44	4.117	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
checking for understanding	Negative Ranks	0	0.00	0.00	0.57	2.52	0.52	0.51	4.083	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
Developing pupils' language	Negative Ranks	0	0.00	0.00	0.24	2.33	0.54	0.48	4.200	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
finishing the lesson	Negative Ranks	0	0.00	0.00	1.14	2.81	0.36	0.40	4.179	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						

SKIL	Ranks	Number (N)	Mean Rank	Sum of Ranks	Mean		Std.		Z	Sig.
					PREE	POST	PREE	POST		
	TOTAL	21								
finishing the lesson	Negative Ranks	0	0.00	0.00	0.48	2.86	0.68	0.36	4.104	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								
The overall classroom language competence	Negative Ranks	0	0.00	0.00	3.43	18.72	1.96	1.55	4.034	0.000
	Positive Ranks	21	11.00	231.0						
	Ties	0	0.00	0.00						
	TOTAL	21								

The previous table represents the results of the research group in the overall classroom language observation sheet and its sub-components in which the positive ranks = 21, the neutral ranks= 0 and the negative ranks = 0. This indicates that the scores of 21 future-teachers (all of the research group) increased in the post-application, there are no future-teacher whose scores in the overall classroom language competence and the sub-components have decreased or have been equal. The arithmetic average in the post-application of the overall classroom language and its sub-components is greater than the pre administration which indicates that the level of the research group's performance on the classroom language competence and its sub-components increased after using the proposed remedial training program based CLIL. The level of significance of the overall classroom language and its sub-components is less than (0.01) and this indicates that there is a difference between the pre and post administration of the overall classroom language observation sheet and its sub-components at the level 0.01of significance in favor of the post-administration. Thus, we accept the seventh hypothesis.

Measuring the effect of using a remedial training program CLIL

To find out the effect size of using a remedial training program based CLIL in developing some mathematics and English language competencies for future-teachers, the size of the impact of the proposed program on the research group was calculated based on relied on what was indicated by Ezzat Abdel Hamid (2016: 279-280) that "when using the Wilcoxon Test to calculate the difference between the mean ranks of the pairs of related degrees, and when the results show a statistically significant difference between the ranks of the related pairs of degrees or between the ranks of the pre and post measurements, it is possible to know the strength of the relationship between the independent and dependent variables by using the correlation coefficient Matched-Pairs Rank Biserial Correlation ", which is calculated from the following equation:

$$r = (4(T1)/ n(n+1)) -1 \ldots\ldots (1)$$

where r = strength of the relationship (the binomial correlation coefficient for the ranks of the related pairs).

T1 = the sum of all the ranks with a positive sign.

n = number of pairs of scores.

And (r) is interpreted as follows:

• If: $(r) < 0.4$ indicates a weak effect size.

• If: $0.4 \leq (r) < 0.7$, it indicates an average effect size.

• If: $0.7 \leq (r) < 0.9$, it indicates a large effect size.

• If: $(r) \geq 0.9$ indicates a very large effect size.

The following tables show the results of the effect size for the overall mathematics tests and overall English language competencies for future-teachers as follows:

a. the following table shows the effect size of the overall mathematical content components:

Table (17)

Effect size (η2) and the sum of positive ranks of the overall mathematical content,
teaching performance and overall mathematics tests
where the number of the paired ranks = 21

performance	Sum of positive	Effect size (n^2)	Significance
Overall Mathematical	230.0	0.99	Large effect size
Teaching	231.1	1.00	Very Large effect size
Overall mathematics	231.1	1.00	Very large effect size

From the previous table, it is recognized that the effect size in each of: the overall mathematical content, the overall teaching performance, and the mathematical tests in general (both content and teaching performance) is greater than 0.9. This indicates that the effect size is very large. Thus, the question (5) of the research questions was answered, which states what is the effect size of the proposed remedial training program based on CLIL to develop the overall mathematical content and teaching performance for mathematics future-teachers?

B. The effect size of English language competencies:

The following table shows the results of the effect size in developing some English language competencies:

Effect size (η2) and the sum of positive ranks of the overall speaking, overall writing, overall classroom language and the overall language competencies in general

where the number of the paired ranks = 21

Table (18)

Overall speaking	**231.0**	**1.00**	**Very large effect size**
Overall Writing	**231.0**	**1.00**	**Very large effect size**
Overall Classroom	**231.0**	**1.00**	**Very large effect size**
Overall Language	**231.0**	**1.00**	**Very large effect size**

From the previous table, it is recognized that the effect size in each of: the overall speaking, writing, classroom language and the overall language competencies is greater than 0.9. This indicates that the effect size is very large. Thus, the question (5) of the research questions was answered, which states what is the effect size of the proposed remedial training program based on CLIL to develop the overall speaking, writing and classroom language competencies for mathematics future-teachers?

Finally, testing the eighth hypothesis which states that "It is hypothesized that the experimental group is satisfied with the program at a percentage not less than 85% by the end of the experimentation." To verify this hypothesis, the averages of the research group scores were calculated through the average mean scores' percentage. The following table (19) presents the percentage gained for each statement.

Table (19)

End of the program's satisfaction questionnaire for third year mathematics future-teachers, English section

N	Statements	Agree	Disagree	Not sure
1	**The program developed my performance in teaching mathematics in English concerning the following:** • Pronunciation • Reading the mathematical terminology correctly specially the geometric ones. • Speaking English without hesitation during lesson explanation. • Writing English correctly taking into consideration letter directionality, word formation …etc. • Preparing and presenting lessons accurately and effectively (discussion, teaching aids…etc.) • Developing self-confidence during lesson explanation using English • Using videos enhanced English language in general.	**100%**		
2	**The training program dealt with topics that are important for me as a future English mathematics teacher (mention the most important topics)** • The language of mathematics and mathematical terms. • Mathematics teaching strategies and their applications. • Classroom language • Classroom management • The use of mathematics teaching models • Mathematics organization	**100%**		
3	**The training program included several teaching strategies (mention those which you like most) such as:** • Brainstorming • Discussions • Problem solving • Micro-teaching and role-playing • Learning by discovery • Team teaching • Writing descriptions for teaching procedures.	**96%**		**4%**
4	**The training program included several tasks and activities (mention those which you like most) such as:** • Individual researches • Group researches • Assignments • Activities during and after sessions	**100%**		

	• Educational videos • Electronic applications (1300Math Formulas- Math symbols- phonemic chart …etc.)			
5	**The training program included several evaluation techniques, mention those you find valuable, suitable and achieved their aims and comment on them.** • Summative and formative evaluation through essays, quizzes and objective tests. • Individual and group researches and assignments • Observation sheets for students' performance while teaching mini-lessons in English all through the program. • Peer and group evaluation.	**96%**		**4%**
6	**The training program will enhance language skills for my future career as an English mathematics teacher**	**96%**		**4%**
7	**The training program is connected to my future career as a mathematics teacher**.	**100%**		
8	**The training program enhanced my skills in individualized learning .**	**82%**		**17%**
9	**The training program shed light on the importance of acquiring both languages (English language) and (the language of mathematics) and the importance of their integration for my future career.**	**92%**		**8%**
10	**The evaluation techniques concentrated on the practical and application part which had reflected effectively on my teaching performance.**	**96%**		**4%**
11	**The training program provided me with teaching techniques that should be acquired for my future career using the English language.**	**100%**		
12	**The training program helped me in developing my techniques in teaching mathematics in English.**	**86%**		**14%**
13	**The topics covered in the training program enriched my knowledge and my recognition of the important role I should play in educational process in my future career.**	**96%**		**4%**
14	**The training program shed light on the importance of the continuous learning, follow the recent trends in teaching and apply them.**	**100%**		
15	**The training program's teaching techniques encouraged discussions, negotiations, exchanging opinions which improved my competences.**	**92%**		**8%**
16	**The training program developed my confidence in teaching mathematics in English in an spontaneous way.**	**82%**		**18%**
17	**Providing me with the aim of the training program helped in identifying the tasks that should be accomplished and recognizing their importance.**	**64%**		**36%**

18	The teaching procedures and techniques followed would encourage me to keep studying teaching mathematics in English this way.	82%		18%
19	The training program's teaching methods and techniques are suitable.	82.5 %	3.5%	14%
20	The training program's techniques varied adequately.	96%	4%	
21	The training program shed light on the importance of being competent in both mathematics as well as the functional language.	100%		
22	The training program encouraged me to cooperate and participate in the tasks and activities effectively.	82%		18%
23	The training program helped me to acquire the characteristics of the competent English mathematics teacher (add more characteristics if you wish): • Classroom manager • Self-confident • Being regular and active	96%		4%
24	The training program developed my classroom language as well as the mathematics language which helped in managing the class.	100%		
25	The training program is a good example of effective teaching that I would follow.	100%		
26	The training program improved my pronunciation.	86%		14%
27	The training program improved my awareness towards the English language mistakes and I managed to correct myself most of the time.	59%		41%
28	The training program improved my classroom interaction in English after relying on Arabic previously.	89%		11%
29	The training program improved my English writing competence and I managed to avoid many mistakes.	78%		22%
30	The training program developed my English spoken language in general (accent, fluency and interaction, accuracy …etc).	90%		10%
31	The presence of both the mathematics and the language instructors in the same session and their interaction in teaching the same topic contributed to the success of the program.	100%		

The research group's mean scores of the satisfaction questionnaire for the proposed program reached 90.1 degrees with a percentage of 96.8 %, which is a high percentage, that indicates the satisfaction of the research group with the content of the program, the teaching method used, the activities used, and evaluation methods. This is evident in the analysis of the research group's responses to satisfaction questionnaire where they mentioned that:

1- Too much tasks, assignments and activities were provided.
2- The need for such programs from the first year to have enough training on the language competences.
3- Mathematics activities were interesting and creative.
4- The program helped the students to revise the English language rules and gave them the chance to practice speaking and acquire language extra information.
5- Enjoying the functional language which encouraged them to practice mathematics using English.
6- Enjoying the training related to mathematics teaching methods which were creative and enjoyable, as well as enjoying the variety of topics covering mathematics and English language.
7- The teaching procedures, techniques encouraged them to participate in discussions, negotiations, expressing their view points and being effective in the learning process than they do in the other educational subjects they study.
8- The need for more training on teaching mathematics in English.
9- The need for data shows instead of using mobiles or laptops.
10- Students ensured that they became more self-confident that they practiced what they acquired from the program in the periods they teach during the teaching practice at schools. Some of them ensured that they ask for extra periods to practice what they have learnt during the training program.

Thus, the research question (6) which states that "*To what extent are the EL mathematics future teachers satisfied with the training remedial program?"* was answered. Consequently, the eighth hypothesis is accepted as the satisfaction percentage was 96.8 % which exceeds the suggested percentage in the seventh hypothesis.

Factors affecting the success of the program

- **The factor of information retention**: The students searched for videos on the topics of the sessions and sent them to each other, as well as some pictures of geometric shapes and models. In addition, they were motivated to search for English language teaching sites and asked about suitable mobile applications for beginners to improve their language. This finding is in terms with that of Arthur, Badertscher, Goldenberg, Moeller, McLeod, Nikula, J & Reed, (2017) who concluded that doing right by teachers requires enabling them to learn in and from practise, as well as providing them with the skills to question the prevailing system. There is no panacea, but we can assist them in critically analysing their conditions and making informed decisions that benefit all of their pupils. Teaching, as the educators know, is all about addressing and solving issues via research, trial, refinement, and re-study. That implies that diversity training, like all other types of professional development, must assist teachers in remaining learners throughout their careers. Because we have no clue what teachers will confront in their classrooms and schools, we must equip all teachers to be the greatest problem posers and problem solvers they can be. We can only help them question, comprehend, value, and continue to learn. That is how retention happens; through learning by doing instead of memorizing or modelling.

- **The factor of direct instruction**: Since the program is a remedial program which is based on the treatment of problems and training future-teachers on the adequate performance mathematically and linguistically, it was necessary to resort to the method of direct explanation of some mathematical rules related to the content, as well as phonemic and linguistic conventions. It was recognized that the future-

teachers did not lack the information, but they lacked the competencies of how to use and apply this information in English. For example, the students used to translate story problems word for word translation which might disturb the meaning and lead to misunderstanding. They used to avoid solving story problems in full sentences or writing the geometric theory, instead they preferred using symbols. The direct explanation of the problems that were diagnosed, whether through the pilot study or the pre-application of the tests, as well as during the sessions, contributed to addressing specific errors that were directly related to the courses the future-teachers study and also, directly related to what they are supposed to teach in the near future. Glazer (2020) explains that when students are acquiring new material or challenging concepts and abilities, teachers employ explicit instruction. They carefully select examples and non-examples, as well as language, to aid student comprehension, anticipate frequent misconceptions, highlight vital knowledge, and eliminate distracting information. They model and scaffold the procedures or processes required to comprehend information and concepts, apply skills, and successfully perform activities on their own.

- **The factor dramatization and role playing**: One of the interesting strategies that encouraged the students to enjoy teaching mathematics and to use the English language freely and spontaneously without hesitation or fear of criticism is the use of role-playing and drama techniques, where the group of them played the roles of teachers in an imaginary classroom environment while their colleagues played the roles of the students. Discussion on how to solve classroom problems were always held, through which they were trained on teaching performance skills for mathematical lessons on the one hand, and on how to use appropriate classroom language on the other hand in an interesting and enjoyable atmosphere. This finding is in terms with that of Nissa, I. & Sukarma, I & Sutarto, S. (2020)

who indicated that role-playing generates a proficient strategy to assist prospective math teachers to learn mathematics critically and collaboratively. Role-playing leads prospective math teachers to strengthen understanding and problem-solving skills.

- **The factor of the collaboration between the content instructor with the language instructor:**

One of the factors for the success of the program, which was accepted and appreciated by the students, is the participation of the content instructor with the language instructor in the educational process, their participation in the same sessions, and the turn taking between them in their explanations breaks the monotony and boredom of teaching a specific course throughout the two hours. For example, when explaining a specific part of the content, the language teacher commented on the way words are written, the direction of letters and the way some words are pronounced. As well as distributing activity sheets in which the content is mixed with the language was an amazing experience for the trainees and encouraged them to work with unexpected enthusiasm. This conclusion is in terms with the study of Durand-Guerrier, Kazima, Libbrecht, Ngansop, Salekhova, Tuktamyshov, and Carl Winsløw (2021) who indicated that the emphasis is mostly on learning mathematical concepts and developing one's identity as a mathematics instructor. This is vital for the development of mathematics student teachers as mathematics instructors. However, it is proposed that mathematics student teacher training should go beyond these focus themes to incorporate the challenges of teaching mathematics in linguistically diverse classrooms, with the key issue being to consider the students' languages as pedagogical tools. Therefore, interaction and collaboration between math instructors and language instructors is considered a must. It was concluded that

the lack of well-structured programs and courses for introducing mathematics student teachers to the complexities of teaching in linguistically diverse classrooms has contributed to the absence of appropriate language practices in mathematics classrooms. Well-structured programs and courses might serve as a link between language awareness and the practices of mathematics teacher educators.

- **The factor of linking mathematic content to future-teachers' life situations** :One of the important roles that a mathematics teacher must acquire is to learn teaching strategies and innovative methods to link mathematics, which many students consider a dry subject, with life situations to bring abstract concepts closer to students. Training the students on this process helped them enjoy teaching mathematics in innovative ways, which improved their performance in the post application. This factor is very much related to the 4c model of CLIL which is the element of community. Mthethwa (2017) ensures that the importance of context in mathematics cannot be overstated. In order to attain Learning Outcomes, learners need be exposed to both mathematical material and real-life settings. advise that instructors should ensure that suitable settings are used to assist learning and understanding, and that contexts provided in text books or other resources should be modified to better meet the needs of their students. The researchers of the present research strongly recommend, in light of the trainees' satisfaction with the program and their interaction with this teaching/learning approach, that courses in which language and content are functionally integrated as a reflection of the actual link between language and mathematics content need to be designed and presented. Such interaction and integration would help the future teachers'

professional development and mastery of mathematics teaching skills in English.

- **The factor of linking mathematics content with foreign culture:** The English language mathematics teacher needs to realize some facts and concepts related to the culture to which the language belongs and realize some of the differences between the uses of the English language and the Arabic language. These differences include what is related to the use of some linguistic expressions related to the classroom language, and some of them are related to the writing style and sentence formation. For example, formal language should be used to draw some boundaries between the teacher and the student without arrogance; it is not acceptable to say " Hi class" but they can learn several expressions to greet the class …etc. providing them with such expressions that suite different situations affected their performance in the classroom language post-test administration. This factor too is related to the 4c model of CLIL which is the culture element.

- **The factor of convincing EL future-teachers with the need to master the English language**

It was necessary for the two teachers to join hands to convince the future-teachers of the necessity of learning the language along with mathematics. Approaching this issue was through discussing with them the nature of the schools in which they will work, as well as the linguistic capabilities of the students they will teach. They were informed that they will be teachers at either language, experimental or distinguished schools where students at these schools' study English from the nursery stage. Therefore, teacher should not make mistakes in forming sentences such as subject verb

agreement, spelling, letter directionality and word formation etc. The justification was convincing and motivating for them, and thus they started interacting and participating in the activities. Gradually, they emerged with great enthusiasm and enjoyment, which contributed to the success of the program. Findings of a study conducted by Rachel. (2015) highlighted the significance of the development that focuses on language in the teaching of mathematics. They mentioned that in order to gain specific knowledge in the content and skills in the language, teachers must commit substantial time and training opportunities. More significantly, these chances must be meticulously planned. Training development facilitators/ instructors must evaluate not just which language-related concepts should be taught, but also how those ideas should be sequenced in respect to a teacher's knowledge and experience.

Recommendations

1. It is recommended to take language tests for EL applicants to join the Mathematics Department, English section.
2. It is recommended to prepare an English language course for specific purposes for mathematics EL future-teachers to be studied from the first year till the fourth year.
3. Preparing the teaching methods courses in English for these students in cooperation between the content and language instructors and cooperate in teaching the subject according to the recent trends in teaching such as CLIL approach.
4. Developing a pre-requisite course for teaching mathematics based on CLIL to be taught for EL future-teachers in the second year before studying the methodology course.

5. Incorporating the CLIL approach in the pre-university stage in teaching other subjects.
6. Designing a training program for in-service EL mathematics future-teachers in light of CLIL.
7. Faculties of Education are recommended to adopt the CLIL approach as a recent trend in teaching.
8. It is recommended to develop the idea of the research to take advantage of the fruitful cooperation between the two disciplines (Math and English) in favour of preparing English language teachers who may have to teach content with some basic concepts and skills to solve mathematics problems, which actually happens in the developed courses that believe in the idea of integration between disciplines or what is known as interdisciplinary courses in light of CLIL.

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