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Research Article

CLIL and Drama on Conceptual knowledge and Logical thinking in Mathematics

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Article History:

Abstract: The current study aimed at exploring the impact of a suggested programme based on Content and Language Integrated Learning (CLIL) and drama to improve 6th graders' conceptual knowledge and logical thinking in mathematics. The study used the quasi-experimental one-group design. The community of the study were all sixth graders in the American International school and the British International school who were enrolled in the scholastic year 2020-2021, they were (16 female and male students in both schools). The sample was all sixth graders in the British International School in Gaza city, who were (7) students. To achieve the study aims, the researchers used two main tools: (1) a pre-post conceptual knowledge skills test, and (2) a pre-post logical thinking skills test that examines. The findings revealed that the suggested program based on CLIL and drama improved 6th graders' conceptual knowledge and logical thinking in mathematics. In addition, the students were able to identify several mathematical concepts and can respond to logical questions. This confirms that the connection between CLIL and drama in teaching mathematics can effectively help the learners grasp the conceptual mathematical items and facilitate the logical thinking skills. In the same regard, students showed high motivation to study mathematics in English language which is considered as a foreign language for them. In light of the presented results, the researchers recommend teachers of mathematics should use drama-based-learning based on CLIL approach as this can promote their understanding of the mathematical concepts and enhance their thinking skills.

Keywords *CLIL, Conceptual knowledge, Drama, Logical Skills, Mathematics.*

Introduction

Language learning is mentioned in several myths. Several ones stated very false impression of how learners achieve success. Obviously, there is several scientific studies on how students learn languages, which gives better understanding of 'acquiring a language' in connection to 'learning a language'. Language learning is a conscious process in which the second language acquisition (SLA) is unintentional. Language learning happens at school, SLA appears in a native speaking background.

Language works as a means of communication. Regarding cognitive processes, it is above all the instruments of information processing and storing. Mother tongue has a powerful effect on the way the reality, perceived by the learner, is processed. It is an agent with a semantic and grammatical structure, a highly developed means of communication utilized in the social environment. The reality is structured by language categories, individual notions are connected together and added to the meanings of mental schemata describing the reality and empowering the learner's orientation into the globe **(Aladini and Jalambo, 2021; International language service 2020; Diessel, 2019; Asoulin, 2016; Lieberman, 2016 and Rabiah, 2012).**

Cain, 2019; Schoenfeld and Li 2019; NCTM, 2009 state that mathematics generally and geometry has become essential and urging recently. Throughout the history, it is necessary in people's lives with its origin in the need for human beings to measure quantities and to value and assess figures and lands. Apparently, geometry still gets its importance in mathematics curriculum. This is to represent and solve problems in other topics of mathematics and in everyday life contexts, sound geometry knowledge is essential. Geometry is a good place for the improvement of learners' thinking and justification skills. The significance of geometry, for anybody who does not plan to become a mathematician, is to improve visualization, thinking abilities, and appreciation of the nature. All of the people need geometry intuition to understand and interpret the world. Geometry as an essential skill in mathematics that is significant for every student since; it is an important help for communication as geometric terms are used in speaking, it is faced in real life, it helps to develop spatial perception, learning geometry gets the learners for mathematics courses and for a variety of occupation requiring mathematical skills, general thinking skills and problem solving abilities are simplified by geometry, and studying geometry can improve cultural and aesthetic values. However, many learners need to learn geometry in an interesting way that enables them understand the topics easily and effectively.

Coman, 2020; Spathis, 2020; Fakeye, 2014 and Mezrigui, 2012 outline that difficulties fully grasping the contents and concepts of the course given in Foreign Language (FL), which is English, is one of the most serious challenges that learners face in their specific course of study. This might be attributed to their weaknesses in English skills in general, which may have a drastic effect on their academic success. Students' language competencies affect their mathematical performances in a number of various contexts. Thus, researchers tend to agree that language proficiency (or competency) is one of the most essential factors affecting English language learning and students' mathematical performance.

Several researchers have used different tools and techniques to make the math concepts understandable. **Jawwad (2016) and Ford (2019),** in their studies, investigates the effect of using mathematical modeling in developing the conceptual and procedural knowledge and solving geometrical problems among student teachers. The results showed an increase on the student's assessment and conceptual knowledge. In other several studies like, **Vlasenko et. al. (2020), Alzahrani (2014), Toivanena (2013), Ali (2009) and Khashan (2014),** they investigated Learners' Mathematical knowledge and conceptual knowledge, they revealed that students got low grades in the conducted tests. On the contrary, **Vlasenko et. al. (2020)** looked into the issue of improving students' motivation during the study of Mathematics. it focused on the implementation of a certain model within Content and Language Integrated Learning (CLIL) approach while teaching Elementary Mathematics to students in higher technical educational institutions. The results of this study revealed that there was ground to conclude that the conducted course in Elementary Mathematics on the basis of the CLIL method had a positive effect on improving students' interest in mathematics as well as their motivation.

Therefore, **Aladini and Jalambo, 2021; Muszynska and Galazka, 2017 and Pozo, 2016** in their studies concerning the effect of CLIL and drama affirmed that 'drama-and-CLIL' connection is strong due to their mutual cornerstones as they mix engagement in active learning, sustainment of learner motivation, authenticity in communication, responsibility in making choices and reflecting on the process and the results. CLIL opens new methods for drama implementation in its different ways: role-play, simulations, drama activities, educational drama.

Mathematical conceptual knowledge

Scheibling-Sève, Pasquinelli, & Sander 2020 and Nahdi and Jatisunda 2019 and Alsaeed & Abdullatif (2019) clarify that Conceptual knowledge is in general an abstract knowledge addressing the essence of mathematical principles and relations among them it contains symbols, conditions, and processes that can be applied to complete a given mathematical task. **Faulkenberry (2003)** suggests that conceptual knowledge is rich with relations, and refers to the basic mathematics constructs and relations between the ideas that illustrate mathematical procedures, and gives it a meaning. On the other hand, procedural knowledge addresses the mastery of mathematical skills, acquaintance of the procedures to determine the mathematical components, algorithms, and definitions. **Elanzi (2020) and Mahir (2009)** indicates that conceptual knowledge is connected to other knowledge contexts, this knowledge permits the individual to differentiate between these correlations, which are as essential as the contexts themselves.

Based on the researchers' experiences in teaching, they confirm that the students face many challenges in learning the mathematical conceptual knowledge. This may attribute to several reasons as the non-interesting environment that the teachers of Math use with their students.

Logical thinking and mathematics

Cole (2020), Amsel & Moshman (2015) and Plessis (2012) state that Logical thinking is the process in which one uses reasoning consistently to come to a conclusion. Problems or situations that involve logical thinking call for structure, for relationships between facts, and for chains of reasoning that make sense. Logical thinking is also an important foundational skill of math. In an empirical study for **Jawwad (2016)** which investigated the impact of using mathematical modelling in developing the conceptual and solving geometrical problems among student teachers. The results showed that the mathematical modelling was effective for the experimental group. also, the findings also revealed high average with a significant value in conceptual and procedural knowledge , solving geometrical problems for the second groups. **Alzahrani, Salem and Hussein (2019) and AbuIyana et al. (2018)** investigated the effectiveness of meaning construction strategy in developing logic thinking skills and geometric proof writing for second year prep pupils. The results showed that there were statistically significant differences in the test of the logical thinking skills and test the skills of geometric proof writing for the experimental group that studied with the meaning construction strategy.

Teaching mathematics curricula in Palestine

The Palestinian curricula came within an integrated plan that aims to produce a generation who are capable of coping the age of knowledge. This is to be done within an integrated plan that addresses the pillars of the educational process in all its aspects in a way that contributes to overcome the challenges. Also, the curricula seek to create a generation who are capable to actively participate, possess the values and the culture so as to go

along with the scientific authenticity and belonging to his/her homeland **(Palestinian Curricula committee 2015).**

The basic educational level is the stage of empowerment and intellectual preparation. During this level, students tend to be independent in thinking, research, and investigation. Therefore, what should be taken into account is their participation in the discussion. In addition, their suggested solutions to the presented problems. This builds up the students' personality and keep them up with the tremendous scientific and technological developments in a world full of the changes that makes him be initiative. This is only done by conducting activities that stimulate thinking. In this stage, the mathematical content is presented in an attractive and interesting way through various life contexts, activities and exercises.

In the current study, the sixth graders are to study geometry in one unit as it represents the sample of the developed units. Students are to interact and respond to the conducted tasks and activities. Students are to be able to employ geometric shapes in practical life through the following:

1. learn about the parallelogram, the trapezoid, and the properties of each.
2. Identify the relationship of the parallelogram to the rectangle, the rhombus, and the square.
3. Learn the concept of height for geometric shapes (parallelograms and trapeziums).
4. inferring of the rule of calculating the area of the parallelogram and trapezoid.
5. find the area of a parallelogram and a trapezoid.
6. employing the properties of the parallelogram, the trapezoid, and the area of each in solving life problems.

CLIL and mathematics

CLIL stands for Content and Language Integrated Learning and refers to teaching subjects such as mathematics, history or geography to students through a foreign language. The foreign language (FL) is used a medium of instruction. CLIL got students reach the plurligualism. **Macmillan (2021) and Wiseman (2018).**

Therefore, CLIL implementation in classroom is not an easy task and it is demanding and challenging for educators. This challenge can be due to the interference of the two languages. The difficulty of the (FL) to be taught itself. Therefore, teaching math via English language can represent a difficulty for students. **Miqdadi and Aljamal (2013),** in their empirical study, confirmed that there were pedagogical difficulties influenced deeply and with varying degrees students' learning of mathematical CLIL. The analysis of results, in contrast, showed those students' perceptions on epistemological, personal, and discourse sources of difficulty types as infrequent.

On the contrary, **Aladini and Jalambo (2021), AlSaeed (2019) Vlasenko et. al. (2020) Alvarez (2016)** stated that CLIL in math classroom creates a suitable motivating environment for the learners and gets them be exposed to the language and the content at the same time. This can help them learn the content of mathematics and the FL.

Moller (2017), Perez and Basse (2015) and Ter Kuile, Veldhuis, Van Veen & Wicherts (2011) outlines that CLIL and traditional foreign language classes are different since there is a possible increased development of metalinguistic awareness in the CLIL classroom. Metalinguistic awareness can be described as the ability to reflect on and manipulate the structural features of languages. It permits reasoning and application of logic with language.

CLIL gets the learners study the areas of cognitive functions, and language skills. This is attributed to learning a FL and the content of mathematics. In addition, CLIL when integrated with drama considering a certain culture or content and this empowers and enhances the conceptional knowledge of math especially the problems and the solutions. **CLIL Media (2021)** states that Mathematics is a subject that makes a lot of use of problems that look a lot like others, students can use these as an example and don't have to think about the problems themselves so much. It is more about creativity than being able to do it.

Coyle (2010) outlines the 4Cs that should be contained in a CLIL classroom:

- Content – ongoing knowledge and skills of a specific component in the curricula.
- Communication – using the language to communication and interact with others.
- Cognition – thinking skills to connect between concepts and understanding
- Culture – awareness of others' characteristics and traditions.

It can be said that CLIL and mathematics can work together well and when drama is added to such teaching, this can be effective. In the same regard, several researchers indicate the effectiveness of using CLIL in a math class to enhance students conceptual knowledge, procedural knowledge and logical thinking such as: **AlSaeed**

(2019) Vlasenko et. al. (2020) Alvarez (2016), Daud and AbdulGhani (2017) and Surmont et al. (2016).

The Statement of the Problem

Based on the researchers' experience, students in the British school are in bad need to study math in a CLIL environment integrated with drama to make the geometry concepts and logical thinking much easy to deal with and to be more understandable. Thus, in this study, the researchers suggest CLIL and drama as an integrated strategy to help learners to use the English language in learning math concepts and logical thinking skills.

The Research Question

1. What categories of conceptual knowledge and logical thinking skills are needed for basic sixth graders in Palestine?
2. Does the average score of the 6th graders vary in the conceptual knowledge test in mathematics attributed to the pre-post application of the test?
3. Does the average score of the 6th graders vary in the logical thinking skills test attributed to the pre-post application of the test.?
4. Does the average score of the 6th graders in the conceptual knowledge test in mathematics differ from the general average of (80%)?
5. Does the average score of the 6th graders in the logic-thinking test in mathematics differ from the general average (80%)?
6. What is the efficiency of using drama and CLIL in average scores of the conceptual knowledge skills and the logical thinking skills in mathematics?

The Significance of the Research

To the best of the researchers' knowledge, no previous studies were conducted on CLIL and drama in teaching math in Palestine. Yet, **Aladini and Jalambo (2021)** conducted their study in Palestine in teaching Social topics in English to improve English speaking skills. Therefore, this study will add a new method of teaching Math in Palestine to be more understandable and interesting to learn.

Definition of the Study Terms

- **CLIL**: it stands for Content and Language Integrated Learning. It is teaching a content of a subject like math or science using a FL as a medium of instruction.
- **Drama**: an authentic or artificial tale or story that can help the learners understand the taught concept in a motivating way.
- **CLIL and Drama**: to use drama in a CLIL lesson.
- **6th Graders:** students who are almost 11 years old and who are in grade 6.
- **Conceptual knowledge:** refers to the knowledge of, or understanding of concepts, principles, theories, models, classifications and learn conceptual knowledge through reading, viewing, listening, experiencing, or thoughtful, reflective mental activity.
- **Logical thinking**: it is observing and analyzing phenomena, reactions, and feedback and then drawing conclusions based on that input. They can justify their strategies, actions, and decisions based on the facts they gather.

Methods and Procedures

The study used experimental and quasi-experimental design. The community of the study were all sixth graders in the American International school (AIS) and the British International school (BIS) who were enrolled in the scholastic year 2020-2021. The sixth graders were 9 in the AIS and 7 were in the BIS, the total was (16 female and male students). The sample was all sixth graders in the British International School in Gaza, who were (7) students.

The experiment was implemented through the following design:

G: O1 O2 X O11 O22

G is the experimental group, O1 is the pre-logical thinking test, O2 is the pre-conceptual knowledge test, O11 is the post logical thinking test, O22 is the post-conceptual knowledge test and X is the experimental variable.

The procedures for implementing the experiment were as follows:

- hold several meetings with the selected teacher who applied the intervention.

- implementation of the logical test and the conceptual knowledge test on a pilot group
- A preliminary meeting was held with the students of the pilot group and informed them of the objectives of the experiment and the tasks assigned to them during the implementation.
- Divide the students of the pilot group into heterogeneous cooperative groups.
- After completing the implementation of the intervention, the logical thinking test and the conceptual knowledge test in Geometry and Cartesian Axes were post-tested on the Experimental Group and the scores were then assessed and statistically analyzed.

The sample of the study:

The sample of the study was all sixth graders in the British International School in Gaza, who were enrolled in the first semester of the scholastic year 2020-2021, they were (7) students. The community was (16) students in both International schools who are taught mathematics in English language.

Equivalence among students of the pilot group:

To ensure that students are equal during the first semester of the 2020/2021 academic year, the researchers checked the student data from the British International School Administration. The "signal test" is then calculated as follows:

Table 1 The results of the signal test of the differences among the means of sixth graders in the general achievement and the achievement in mathematics and the default mean of (80%)

Percentage	number	Max	Mini	Mean	SD	sig (0.05)
General total	7	98.00	80.00	89.2857	6.21059	(0.302)
Math achievment	7	99.00	82.00	89.1429	6.66905	(0.698)

Table 1 shows that there are no statistically significant differences between students in the pilot group in the previous year (in grade five) in each of the following: Overall achievement rate and achievement in mathematics, which means the equivalence of students of the experimental group in these variables.

The study tools:

The conceptual knowledge test:

The aim of the test is to measure the development of conceptual knowledge skills of the 6th grade students after learning the geometry unit and the Cartesian hubs according to CLIL and drama. To identify the vocabulary of the test; the researchers identified the categories and skills of conceptual knowledge as follows:

- Applies theories, models and mathematical structures.
- Employs mathematical principles, laws and generalizations.
- Gives an explanation and explanation of mathematical issues and classifications.

The test therefore included (20) questions: (6) questions on mathematical theories, models and structures, (7) questions on mathematical principles, rules and theories, and (7) questions on interpretation and reasoning of mathematical issues and classifications, where the test aims to measure the acquisition of maximum conceptual knowledge. The perception and characteristics of geometry forms, and the linkage of knowledgee activities to learning processes. The test lasted for 45 minutes, where each question had one grade. The total test score was 20 grades. The examination considered the comprehsiveness of the questions of CLIL and drama, with clear language and suitability to the students' age.

Psychometric properties to test mathematical knowledge:

Face validity

The apparent validity of the mathematical knowledge test has been verified by reviewing its questions and making sure that each question is related to the aspects to be measured. Also, it was tested by making sure that each question belongs to its own skill. The test was verified by (6) professors in curricula and methods of teaching mathematics at Palestinian universities in Gaza, and (9) supervisors and math teachers. The test was modified as a result to their precious comments.

Construct validity:

The internal consistency of the conceptual knowledge test has been calculated by applying it to a survey sample from another group similar to the study sample. (8) seventh graders in the British International School who studied math in the same school completed the geometry unit and Cartesian Hubs. The correlation coefficients

between each skill and the total test degree were calculated, on the one hand, and the correlation coefficients between each question and the skill to which it belongs, where the values of the correlation coefficients in both cases ranged from (0.63-0.83) statistical function correlation coefficients at (= 0.05). This result indicates a high degree of internal consistency to test conceptual knowledge and questions.

c) Test reliability factor

The reliability of the conceptual knowledge test using the Cronbach Alpha was calculated by applying the test to the survey sample above. The reliability values of the three key skills of the conceptual knowledge test are as follows: 0.84, 0.85, 0.76, which are high reliable coefficients suitable for the use of the test for study purposes. The final test therefore consisted of 23 questions.

Test time limit

The appropriate time to test conceptual knowledge was calculated by finding the mean of the time that the pilot study sample used. Accordingly, the suitable time was (45) minutes.

Logical thinking test:

The aim of this test is to measure the development of logical thinking skills for sixth graders after learning the geometry unit and Cartesian axes according to CLIL and drama, and to design the test vocabulary; the researchers identified the logical thinking skills:

- Inference of result from data
- Extrapolating a general rule

The test therefore included 23 questions of multiple choice, 13 questions of first skill and 10 questions of second skill. The test time was 45 minutes, and the scores were distributed so that each question was given one score and with a total test score of 23 degrees. The examination took into account the comprehsiveness of the questions in CLIL and drama, with suitability of the test language.

The Logical Thinking Test was built on the "Geometry and Cartesian Axes" unit to measure the logical thinking skills for the sixth graders. The researchers used logical thinking tests in mathematics in several previous studies, such as a study of Author (2020) in addition to related educational literature.

Psychometric characteristics of the logical thinking test:

(a) **Face Validity**

The face validity of the logical thinking test was verified by reviewing its questions and ensuring the extent to which each question relates to the aspects to be measured, as well as ensuring that each question belongs to the skill to which it belongs. On the other hand, the test was presented to a group of referees consisting of (6) professors in curricula and methods of teaching mathematics in Palestinian universities in Gaza, and (9) supervisors and teachers of mathematics. Their comments were taken into consideration. Accordingly, the number of logical thinking skills test questions has become (23) questions.

B. **The validity of the internal consistency** of the logical thinking test was calculated by applying it on a pilot sample of (8) students from the seventh grade in the British International School who had studied the sixth grade in the same school and finished the study of the geometry unit and Cartesian axes. The correlation between each skill and the total score of the test on the one hand, and the correlation coefficients between each question and the skill to which it belongs, where the values of the correlation coefficients ranged between (0.76-0.89), which are statistically significant correlation coefficients at (= 0.05). This confirms a high degree of internal consistency of the logical thinking skills test and its sub-questions.

(C) Test reliability coefficient

The reliability of the logical thinking skills test was calculated using the Cronbach Alpha reliability coefficient by applying the test on the pilot sample, where the value of the reliability coefficient of the logical thinking test was (0.84), which is a high reliability factor suitable for using the test for the purposes of the study. The test has become in its final form consisting of (23) questions.

Results and Discussion:

The answer to the first question, which is stated as: What categories of conceptual knowledge and logical thinking skills are needed for basic sixth graders in Palestine?

To answer this question, the researchers divided the answer into two parts as follows:

A) Classifications of conceptual knowledge:

By reviewing the educational literature and previous studies related to conceptual knowledge in mathematics. The researchers analyzed the sixth unit (Geometry and Cartesian axes) of the grade six mathematics book from the British International School, and identified the mathematical concepts required for development for students. The researchers identified the mathematical concepts and forms. These were presented to a group of university professors specialized in curricula and teaching methods of mathematics. Also, they were presented to a number of supervisors and teachers of mathematics, in order to ensure its accuracy and comprehesiveness of all the vocabulary of the developed unit. The researchers came up with classifications of

conceptual knowledge in mathematics. The researcher defined them procedurally as shown in the following table:

Table 2 Classifications of conceptual knowledge

Classification	Procedural definitions
Theories, models, and constructs	An abstract and detailed formulation of the mathematical interrelationships of the problem so that it relates meaningfully to describe, understand, and explain mathematical content.
Principles, rules and generalizations	A mental process in which thinking moves from the specific to the general or from the part to the whole, and that is to reach the general rule through parts and examples**.**
Interpretation and classifications	Develop mathematical classifications and categories to clarify and interpret solution mechanisms and form links between specific and given elements.

B) Logical thinking skills:

By reviewing the educational literature and previous studies related to logical thinking skills in mathematics. The researchers analyzed the sixth unit (Geometry and Cartesian axes) of the grade six mathematics book from the British International School. They investigated the logical thinking skills appropriate to the proposed unit; The researchers extracted the skills: deducing the result from the data, and extrapolating a general rule, due to their relevance to the nature of the content of the proposed unit. Apparently, problems and geometric shapes measure the skills of induction, and then they were presented to a group of experts and specialists in curriculum and methods of teaching mathematics. Also, they were presented to a group of teachers and mathematics supervisors to confirm their suitability for the proposed unit. Accordingly, the two researchers have procedurally defined the skills as shown in table (3):

Table (3): Logical thinking skills to be developed among sixth grade students

Skill	**Procedural definitions**
Inferences	A mental process in which thinking moves from the general to the specific or from the whole to the part, reaching results for solving mathematical problems and problems**.**
Deduction	A mental process in which thinking moves from the specific to the general or from the part to the whole, and that is to reach the general rule through parts and examples**.**

By analyzing the Geometry syllabi, the researchers found that this topic needs vivid tool to be used for teaching.

Students find it difficult to improve their techniques for solving problems discuss them with their classmates. Finding solutions to real-life problems is not the final aim in mathematics teaching. Teachers also help the children to transfer their informal strategies into more formal methods applicable in other life situations. **Paksu and Ubuz (2016) and Vidermanovaa and Valloa, (2015).**

The answer to the second question, which is stated as follows: Does the average score of the 6th graders vary in the conceptual knowledge test in mathematics attributed to the pre-post application of the test?

The researchers used the Wilcoxon-matched pairs test to calculate the significance of the differences between two related and independent samples in the conceptual knowledge test of mathematics in light of (pre-post application) as shown in the following table:

Table (4): Results of the "Wilcoxen" test to find the significance of the differences between the mean scores of the students in response to the conceptual knowledge test in mathematics in light of the pre-post application of the test.

app	No. of members	mean	Total	U	W	Z	Sig.	Sig.
Pre.	7	4.00	28.00	0.000	28.000	3.209	0.001	Sig 0.05
Post.	7	11.00	77.00					

It is evident from the previous table that the calculated value of (Z) (3.209) is less than the tabular value of (Z) (2.015) and that is at a degree of freedom of 7-2 = 5 and a

level of significance of 0.05. These results show that the post application of the program based on CLIL and drama was more effective than the pre-application of the program.

As a result, it is clear that the employment of CLIL & Drama contributed to enhancing the conceptual knowledge in the post application of mathematics among the sixth-grade students in Palestine. The researchers attribute this result to the enjoyment that the sixth graders found during the application of CLIL & Drama. Also, the students were active in participation. They were happy to jump from one point and the other on the Cartesian axes, according to a system given to them, and the rules of organized and purposeful educational games in which the students merged into the nature of the games. They presented a clear and meaningful explanations and descriptions of knowledge, especially these descriptions and clarifications came through their application of principles, rules and generalizations functionally by measuring distances and finding reflections of geometric shapes on Cartesian axes, and linking quadrilaterals to each other. This was conducted based on clear rules and rules with the aim of coming up with mathematical generalizations. **Surmont et al. (2016)** has shown that content and language integrated learning (CLIL), an educational approach that offers content courses through more than one educational language, increases metalinguistic awareness. The results showed that CLIL appears to have a positive impact on the mathematical performance of pupils even after a short period of time.

Yaser and Aral (2012) aims to identify six-year-old pre-school children's creative thinking skill levels and to establish whether there is a difference between the creative thinking skills of children who received drama education and those who did not. The results revealed a meaningful difference between the creative thinking scores of experimental and control group children.

The answer to the third question, which is stated: Does the average score of the 6th graders vary in the logical thinking skills test attributed to the pre-post application of the test.?

The researchers used Wilcoxon-matched pairs test to calculate the significance of the differences between two related samples in the logical thinking skills test of mathematics in light of the pre-post application as shown in table (5)

Table (5): Results of the "Wilcoxen" test to find the significance of the differences between the mean scores of the students in response to the logical thinking skills test in light of the pre-post application.

app	No. of members	mean	Total	U	W	Z	Sig.	Sig.
Pre.	7	4.00	28.00	0.000	28.000	3.148	0.001	0.05
Post.	7	11.00	77.00					

It is evident from the previous table that the calculated value of (Z) (3.148) is less than the tabular value of (Z) (2.015) and that at a degree of freedom of 7-2 = 5 and a level of significance of 0.05. The results of table (5) show that the post application of the program was more effective than the pre-application of it.

Consequently, it is apparent that the employment of CLIL & Drama contributed to raising logical thinking in the dimensional application of mathematics among sixth grade students in Palestine. The researchers attributed this result to Bilateral integration through teaching mathematics using the English language, going along with the rules, instructions, and comprehensive relationships of the subjects of Cartesian axes. Also, the integration into teaching the geometric shapes in a holistic manner using the English language was effective. It contributed significantly to increasing students' motivation about mathematics and improving their dimensional logical thinking.

It is worth mentioning that students performed and participated well in managing dialogue and group discussions during students' learning of geometry, Cartesian axes, and expression of ideas. The program created an active and stimulating environment for logical thinking.

Alvarez (2016) Content and language integrated learning (CLIL) is a worldwide recognized approach that has been implemented in different schools as a way to help learners become skillful in terms of content while improving language proficiency in a natural way, since the language becomes a vehicle to understand the content. From the analysis of the data, the researcher concluded that the teachers at GLC attempt to implement CLIL in their lessons. They are very familiar with the stages of a CLIL lesson and are aware of aspects such as scaffolding, feedback, and language through learning. However, they mostly focus their lessons on the teaching of content and need more awareness of the importance of designing language objectives in order to fulfil language needs according to the level and age of the students.

The answer to the fourth question, which is stated: 4. Does the average score of the 6th graders in the conceptual knowledge test in mathematics differ from the general average of (80%)?

To answer this question, the researchers calculated the mean, standard deviation, and percentage of the study sample responses. Then, the "Sign Test" was used for one sample which is presented in table (6):

Table (6): The results of the "Sign Test" between the average grades of sixth graders on the test of conceptual knowledge in mathematics and the default average (80%

Classifications of conceptual knowledge	max	Mean	SD	Precentage	Sig.	Sig.value (0.05)
Theories and models	6	4.8571	0.69007	%80.95	0.016	(0.000)
Rules and principles	7	6.0000	1.15470	%85.71	0.016	(0.000)
Classifications	7	6.1429	0.69007	%87.76	0.016	(0.000)
Conceptual knowledge	20	17.0000	2.00000	%85.00	0.016	(0.000)

It is apparent from Table (1) that the level of significance in all classifications of conceptual and total knowledge is equal to (0.016) and it is less than (0.05). This result clearly indicates a high level of conceptual knowledge among sixth grade students.

Looking at the mean averages for each of the classifications of conceptual knowledge. Thus, it is clear that "interpretation and classifications" came in first place with a percentage (87.76%), while in second place was the "principles, rules and generalizations" with a percentage of (85.71%). The third place was "theories, models and structures." With a percentage (80.95%), the researchers attribute this result to the student's explanation of the occurrence of a point in the Cartesian coordinates, or the withdrawal of a geometric shape from one place to another according to a specific rule, or the classification of points according to their location in the Cartesian axes. This represents the simple cognitive aspect of conceptual knowledge in mathematics, which contributed to students' understanding of mathematical concepts, processes and relationships, and that the students 'interpretation and classification of pairs arranged on Cartesian axes increased students' knowledge of what should be done and why to do it. Also, the interpretation of a point transfer according to its given rule increases the interdependence of the cognitive relationships of mathematical ideas, followed by the classification of mathematical principles, rules and generalizations that are intertwined and merging with each other. This contributed in the students' ability to draw a reflection of a point on one of the Cartesian axes, and to verify some mathematical rules and generalizations, and by moving and withdrawing a group of points with double movements given to him/her. The last grade was the classification of theories, models and structures considering students prove theories and construct mathematical models and structures of matters. Yet, applying Cartesian axes on concrete models, transforming mathematical problems into life applications, by drawing mathematical models and structures on the classroom floor and in the school yard. Furthermore, employing numbered cards and tapes and all this contributed to representing theories and mastering models and structures and using them in solving mathematical problems.

The answer to the fifth question, which is stated: 5. Does the average score of the 6th graders in the logic-thinking test in mathematics differ from the general average (80%)?

In order to answer this question, the researchers calculated the mean, the standard deviation, and the percentage of the study sample responses, and then the "sign " test which was used for one sample, presented in the table: (7)

Table (7): **The results of the "Sign Test" between the average grades of sixth graders on the logical thinking skills test in mathematics and the default average (80%)**

Logical thinking skills	max	Mean	SD	precentage	Sig.	Sig.value (0.05)
Inferences	13	11.1429	1.46385	%85.72	0.016	(0.000)
Deduction	10	8.0000	1.41421	%80.00	0.016	(0.000)
Total	23	19.1429	2.79455	%83.23	0.016	(0.000)

From Table (7), it's clear that the level of significance in both skills of logical thinking and the total sum of the test is equal to (0.016) and it is less than (0.05), and this indicates the high level of logical thinking among sixth graders in mathematics.

Looking at the mean averages for each of the two logical thinking skills, it is clear that the skill of "deducing the result from the data" got a percentage of (85.72%), while the skill of "extrapolating a general rule" was the second and it got a percentage of (80.00%), and the total was (83.23%). The researchers attribute this result to the student's ability to conclude the result and move from the general to the specific or reach an unknown result from a set of data or introductions and the logical sequence of Cartesian axes. This is to determine the previous knowledge and its employment in solving exercises and mathematical problems, which contributed in the development of students' awareness and understanding of the steps in solving mathematical problems and the realization of the true meaning of Cartesian axes, in addition to the relationship between

geometric shapes. This contributed in the development of deductive logical thinking. In addition, CLILL and drama increased students' participation in linking previous knowledge with new knowledge, according to the gradient from specific to general, and linking facts and relationships with knowledge that students possess in order to reach the general base, which was observed through discussion.

Daud and AbdulGhani (2017), Erdogan and Baran (2009), Fleming et al. (2004) and Favilli et al. (2013) identified using CLIL (content and language integrated learning) methodology in schools. They revealed the positive effect on students' performance in learning math or other subjects.

The answer to the sixth question, which is stated: What is the efficiency of using drama and CLIL in average scores of the conceptual knowledge skills and the logical thinking skills in mathematics?

To answer this question, the researchers tested the Effect size and the effect of drama and CLIL on all students' scores in the post-test of the conceptual knowledge skills test and logical thinking skills test were calculated by finding the value of the ETA square: table (8)

$\eta^2 = \frac{t^2}{t^2+df}$) Effect size $d = \frac{2t}{\sqrt{df}}$

Table (8): **t-value, eta-squared-value, d-value, effect size CLIL& Drama .**

Independent Variable	Dependent var.	η2	D	T	Effect Size
CLIL& Drama	Conceptual knowledge	0.99887	59.407	72.758	High
	Logical thinking	0.9974	39.313	48.149	High

It is apparent from table (8) that the value of ETA square in conceptual knowledge is equal to (0.99887), and in logical thinking skills is equal to (0.9974) and it is greater than (0.14), which was determined by Cohen (1988). It is clear that the size of effect of CLIL & Drama program in the score of the two tests was large and the value of d in the conceptual knowledge reached (59.407) and in logical thinking got (39.313) which indicates that that values were greater than the reference value (0.8) and this indicates the size of a large effect of the program. This confirms that a large proportion of the differences are attributed to the use of CLIL & Drama. It had a great impact in raising academic achievement.

Conclusion:

It seems to be characteristic of many of the CLIL initiatives all over the world and much of the published research that CLIL necessarily produces encouraging outcomes, very often in terms of quantitative scores.

CLIL has presented a challenge to the status quo whereby subjects like math are learned as separate disciplines. The dual focus on accomplishing simultaneous content and language learning outcomes has been impacted by multi-disciplinary pedagogical research and dialogue. This has resulted in the triple focus concept, whereby content and language goals are pursued with understanding of student cognition, usually referred to as thinking skills **(CLIL media (2021), Coyle et al. (2010), Campillo, (2020), Duatepe (2004), Mehisto (2012), Sengun and Iskenderoglu (2010).**

In a study for **Smet et al. (2018),** it investigates pupils' anxiety and enjoyment in the classroom when learning a second or foreign language. The particularity of this study lies in the comparison of two target languages (English and Dutch) in two educational contexts (CLIL and non-CLIL) at different instruction levels (primary and secondary education). While most research on content and language integrated learning (CLIL) focuses on English as a target language. Data were collected from 896 pupils in French-speaking Results indicate that while CLIL pupils experience significantly less anxiety than their non-CLIL counterparts, English learners report significantly less anxiety and more enjoyment than Dutch learners. This suggests an important role of the target language for emotional engagement in the classroom and calls for further investigation into the role of target language perceptions.

In the current study CLIL is considered as a new method to be used with Palestinian learners whose first language is Arabic. English for them is an FL but they believe that learning this FL can open a good chance for them in the world of plurilingualism. The results showed a good turning point for the Palestinian learners and an opportunity to re-think of the CLIL classroom.

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