

Difficulties in Content and Language Integrated Learning: The Case of Math

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Abstract: The purpose of this research is to identify difficulty types encountered by Content and Language Integrated Learning (CLIL) learners in foreign language setting as relevant to university students' ability to understand math lectures that are taught in English. Using a self-reported questionnaire as well as interviews, the current study presented evidence to support the identification and comparison of difficulty types perceptions held by students as drawn upon epistemological, personal, pedagogical and discourse sources. The analysis concluded that 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. The findings of this study might be of pedagogical help and significance to textbook designers, researchers, tutors and those interested in communicative competence in general and ESP in particular. **Keywords:** (CLIL, difficulties, EFL setting, mathematics, pedagogy).

English is a global and an international language that usually preserves technological, scientific, artistic heritage. Yet, when it comes to studying English as a foreign language many difficulties will continuously come up. Teaching the English language in Arab countries in general and Jordan in particular catches the attention of many academics especially when the issue is particularly related to mathematical education in undergraduate settings. Teaching both the subject and the language is becoming increasingly popular in various educational institutions across Jordan. Studying content through another language (foreign) is an approach that is called Content and language integrated learning (CLIL) where content and language are merged together to succeed globally in a certain subject matter.

صعوبات تعلم المحتوى المدمج باللغة: حالة الرياضيات

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ملخص: هدفت هذه الدراسة الى تحديد انواع الصعوبات التي يواجهها طلبة الجامعات في المساقات ذات المحتوى المدمج باللغة الانجليزية لغة أجنبية (CLIL) وعلى معرفة قدرتهم على فهم محاضرات الرياضيات التي تقدم باللغة الإنجليزية. استخدمت هذه الدراسة الاستبانة والمقابلات لتحديد ومقارنة انواع الصعوبات المتعلقة بمصادر معرفية، وشخصية، وتدرسية، وخطابية. وقد خلص التحليل إلى أن الصعوبات التدريسية تؤثر بشدة وبدرجات متفاوتة على تعلم الطلبة الرياضي للمحتوى المدمج في اللغة الانجليزية. وبالمقابل، أظهر التحليل أن تصورات الطلبة لانواع الصعوبات المعرفية، والشخصية، والخطابية كانت غير منتظمة. قد تكون نتائج هذه الدراسة ذات فائدة و أهمية تربوية لمصممي الكتب المدرسية، وللباحثين، وللمعلمين، وللمهتمين بالكفاءة الخطابية بشكل عام وللمدرسي اللغة الإنجليزية لأغراض خاصة بشكل خاص. الكلمات المفتاحية (بيئة تكون اللغة الانجليزية فيها هي لغة أجنبية، تعلم المحتوى المدمج باللغة، صعوبات، طرق تدريس).

Mathematics difficulties are widespread among school students. This is problematic since the present era places heavy emphasis on learning mathematics (National Council of Teachers of Mathematics, 2000). Reports from business, industry, and government persons indicate that students not only need to have mathematical understanding and skills, but also need to acquire abilities to analyze problem situation and be able to solve them (Schoen & Hirsch, 2003). Hence, the main goal of mathematics learning is the mathematization of the learner's thinking. Precision of thought and adopting assumptions to logical conclusions is fundamental to the mathematical initiative. There are many ways of thinking, and the kind of thinking one learns in mathematics is an ability to handle abstractions, and an approach to problem solving.

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Literature review

Understanding the relationship between language and mathematics learning is critical to effective mathematics instruction for students who learn English as a foreign language. The American Association for the Advancement of Science (1998), for example, maintained that the ability to speak a second language is joined with strong skills in mathematics.

There are many problems that impact content language in CLIL undergraduate settings. Some of these include epistemological, personal, pedagogical and discourse difficulties (Cummins, (1986); Dewey, (1933); Gardner, (1985); Halliday, (1978); Romberg & Kaput, (1999); Vygotsky's, (1978). Accordingly, the current study explored such difficulties at the Jordanian University for Science and Technology (JUST). The study builds on why language is problematic in mathematics education, understanding language leads to a deeper mathematical conceptual understanding. The convergence of mathematics and English explains why a language focus in mathematics is extremely significant.

Researchers (namely; Fletcher and Santoli; (2003); Schoenberger & Liming, 2001) showed that vocabulary can be an obstacle to success in mathematical problem solving. This absence of understanding of mathematical vocabulary items and expressions leads to a failure in the capability to solve problems. Schoenberger and Liming (2001) highlighted the principal reasons behind students' inability to solve word problems involving arithmetical operations. Schoenberger and Liming studied a sixth grade general education mathematics class and a ninth grade special education mathematics class in their research. These comprise an emphasis on repetition and rules, poor language skills and the lack of knowledge of mathematical concepts. Schoenberger and Liming stressed that mathematical problems have their own exclusive language. Accordingly, partial understanding of the concepts behind such mathematical language can make CLIL difficult. They recommended the employment of glossaries built by students.

Roti, Trahey and Zerafa (2000) described a program for refining students' comprehension of the language of mathematical problems. The population of the study entailed 5th and 6th grade multi-age students and multi-age learners with special needs at a middle school. Analysis of probable cause data showed that students cannot solve mathematical problems due to a number of factors. Students often have difficulty finding out the relationship between the words and the symbols in mathematical problems. Students often depended on superficial cues that can lead to incorrect solutions, or solutions that make little sense in terms of the language of the problem. Additionally, the language itself that is used in mathematical problems is different from a students' everyday language and can cause some

comprehension difficulties in terms of solving the problem.

Fletcher and Santoli (2003) endeavored to enhance math education. They undertook an action research project in Mobile, Alabama, investigating how reading and vocabulary influence gifted Algebra 1 and Pre-Calculus students. The participating students were able to comprehend mathematical texts and succeed in vocabulary quizzes. Students struggled at first with the new way, but later their scores were enhanced, while showing an in-depth competence of math concepts. Yet, the study reported that students encounter overlapping vocabulary in several situations.

Rubenstein (2007) investigated knowledge and attitudes of pre-service students and Master's degree candidates at the University of Michigan. Rubenstein concern was making math accessible to all students and to improve math communication. According to her, students perceived math as a foreign language because of the vocabulary that is used exclusively in that content area.

It has been perceived that most CLIL learners frequently make linguistic mistakes of syntax and pronunciation as an impact of the interference of their L1. In such case, math word lists together with a suitable pedagogy is mostly recommended. This is generally identified as L1 transfer. Dulay, Burt, and Krashen (1982) therefore referred to the second language acquisition process as "creative construction: the subconscious process by which language learners gradually organize the language they hear, according to the rules they construct to understand and generate sentences" (p. 276).

In educational settings, students are often independently responsible for creating senses and must rely on their own understanding of both the language and concepts in question (Lee & Fradd, 1996). Lee and Fradd investigated how to develop the knowledge of academic content for three groups of elementary students and teachers: (a) monolingual English; (b) bilingual Spanish; and (c) bilingual Haitian Creole. They encompassed student dyads and teachers of the same language, culture, and gender. The findings emphasized the precise difficulties that students encountered in understandings activities. The findings stressed the need to consider the multiple roles that language plays in CLIL learning in order to instruct according to the needs of students learning of English as a new language.

A Mathematical discourse was elaborated on successfully by Halliday (1978) who as considered on mathematical language as special. He wrote (p. 65):

We can refer to a 'mathematics register', in the sense of the meanings that belong to the language of mathematics (the mathematical use of natural language,

that is, not mathematics itself), and that a language must express if it is used for mathematical purposes.

So, a register is a language variety (as according to Halliday) which is linked to a specific situation of use where there are many meanings for the same term. That is, learning mathematics involves learning to use such different meanings properly in different situations. An example of numerous meanings is stated in Walkerdine's (1998) account of the differences between the meanings of "more" in the mathematics classroom and at home. While in a classroom situation "more" is typically assumed to be the opposite of "less", at home the opposite of "more" is generally connected to "no more". The term 'mathematical register' was explained by Dale and Cuevas (1992) in terms of exclusive vocabulary and syntax (sentence structure).

Meaney (2007) employed data from research in which a six-year old student's interactions with others, together with her teacher, her peers and her family, were documented. From one day's recording, first findings are offered of how authority is established in these interactions and the influence that this has opportunities for the student to acquire the mathematics register. It would seem that how interactions occur in the home are more likely to result in the acquisition of the mathematics register.

According to Gersten et al (2005) and Van De Walle (2004), it takes time and a lot of experiences for students to develop a full understanding of number that will grow and enhance through all school grades. Many students do not get those opportunities, and therefore find it difficult to learn concepts of mathematics because of this difficulty. Examples of epistemological difficulties are as follows: (a) students might be unable to make the connection of the number and the quantity it represents. (b) Students may encounter trouble in connecting symbolic notation of mathematics to real world situations. (c) There are students who might exhibit problems in visual, spatial or sequential aspects of mathematics and hence might either be confused when learning multi-step procedures, or might find it problematic to order the steps required to solve a problem.

The current study investigated epistemological problems faced by undergraduate CLIL students as they study math courses. Epistemology, however, is relevant to students' beliefs regarding the nature of knowledge by which they understand complex topic. All of Perry (1968) and Schommer (1990) indicated that epistemological beliefs are related to students' persistence, active inquiry, integration of information, and coping with complex and ill-structured domains.

Perry (1968) proposed that students experience consecutive and linear stages of epistemological development, where they in their early stages perceive knowledge in absolute terms. In later stages, students

realize that there are multiple potential ways for perceiving knowledge. Perry interviewed Harvard undergraduates over their four-year college experience. Perry concluded that many first year students believe that simple and unchangeable facts are given by professors. Yet, by the time they reach their senior year, students believe that complex knowledge is resulting from reason and empirical inquiry. Perry assumed nine developmental settings that reflect undergraduates as they start as 'dualistic' thinkers and proceed to be 'relativistic' thinkers at the end of four year experience.

Schommer (1990:501) theorized five epistemological dimensions, primarily regarded as continua. These are: Simple Knowledge, Certain Knowledge, Omniscient Authority, Quick Learning and Innate or Fixed Ability. Simple Knowledge means "Knowledge is simple rather than complex". Omniscient Authority implies "Knowledge is handed down by authority rather than from reason". Certain Knowledge indicates "Knowledge is certain rather than tentative". Innate Ability means "The ability to learn is innate rather than acquired". Quick Learning is "Learning is quick or not at all".

Students need to develop their cognitive potentials. Such development can be maintained by social interactions within specific cultural contexts (Vygotsky's, 1978). Learners need to be dynamic participants in the process of their own learning. Dewey (1933) hypothesized that just students who were actively involved in their learning could develop to be informed participants. He believed that rote learning leads to the passive approval of one's place in society, whereas learning through problem-solving and application would lead students to take a more active role within society.

Schoen and Hirsch (2003) reported achievement marks from three-year Core-Plus Mathematics field test (1994-97) for each subtest of the standardized Ability to Do Quantitative Thinking (ATDQT) test and for students who scored in the top, middle, and bottom third on the ATDQT pretest. Results on measures of students' understanding of algebraic and geometric concepts and methods and of statistics, probability and discrete mathematics were, additionally, offered. Students' perceptions and attitudes about mathematics and about their mathematics course were highlighted. In conclusion, SAT and ACT scores of students in CPMP are associated to those in more traditional curricula. On all measures except paper-and-pencil algebra skills, students in CPMP did as well as or better than those in traditional curricula.

Gresham (2007) led study above the course of six semesters concerning a total of 246 participants. Gresham (2007) employed informal interviews, discussions, and journal entries to gather information about which issues relevant to anxiety reduction in

mathematics. Extra factors encompassed the enthusiasm of the professor and the use of journal writing

The socio-educational model of learning integrates the students' attitudes towards the learning setting (Gardner, 1985). If students perceive an aim and if that aim is adequately attractive and striking, they will be intensely motivated to do whatsoever is needed to grasp that aim. Thus students asking to learn mathematics in English will possibly be extrinsically motivated, i.e. more worried with issues lying outside the classroom as they will have long term aims. Such students are easier to teach. Thus, attitudes are what invite students to learn mathematics in English when it cannot be done in Arabic. Accordingly, teachers are urged to "enable the students develop their individually different process of knowledge building and meaning construction as well as positive attitudes" (De Corte, 2000).

In *Teaching Problems and the Problem of Teaching*, Lampert (2001) sorted out the difficulties of teaching – of showing the complex content knowledge, preparation, and decision-making in which she practiced for a year. Lampert taught a class in fifth grade mathematics. Lampert perceived her teaching through numerous lenses. She initiated close up, with a view of a specific lesson. Lampert portrayed each student in the class, and how they started working on a problem she allocated. She identified in on one particular interaction, which happened once a student wrote something on the board that she did not understand. She asked the class if others could clarify where that answer might have come from. The student she named requested instead if she could interpret her own solution.

The viewpoints outlined above, "learning vocabulary" and "creating various meanings, "enhancing epistemological knowledge", "being aware of cultural dilemmas", "attending attitudes" and "considering the right pedagogy" have delivered useful analytical tools towards identifying problems encountered in Content and language integrated learning (CLIL) setting. However, these viewpoints are used to identify the *problems and difficulties* that bilingual students face as they learn mathematics in English in a FL context.

The problem

This research was verified as a reaction to the researchers' experience with struggling students across all content area of English and math courses at JUST University. Successful EFL students speak, read, write, and listen to each other so they can comprehend, recall, and implement mathematical concepts. To grasp that issue fully, difficulties should be identified. This research explains JUST University undergraduates' types of difficulties (epistemological, personal, pedagogical and discourse sources) and supports the important role of overall language proficiency when understanding CLIL courses such as 'Calculus 1'.

The current research, thus, aims to provide a variety of perspectives on matters related to Content and Language Integrated Learning in the Jordanian context in order to contribute to a fuller understanding of the difficulties held by CLIL undergraduates as they learn mathematics in English. By accessing the varied constructions of reality represented by the multiple perspectives of varied difficulties, the findings of this study aims at providing a rich, detailed understanding of students' language awareness while at the same time explaining its critical role in understanding mathematics.

Consequently, identifying difficulties that range from fundamental language issues to rather epistemological, personal as well as pedagogical concepts, may in turn, provide university lecturers with knowledge to create a positive impact on undergraduates' CLIL. The present research, however, stressed a fundamental question that fall basically in the following question:

- What are the difficulties (e.g. epistemological, personal, pedagogical, discourse) that face Jordanian CLIL undergraduates as they undertake math courses?

Significance of the study

The current study tends to be significant for it sheds light on several problematic perspectives relevant to CLIL, such an increased emphasis on mathematical language of communication could result in several scenarios. On the one hand, this emphasis could eliminate obstacles for CLIL learners by providing additional opportunities. On the other hand, it might pave the way to conceptualize language mathematical register. And lastly, the long-term research into the benefits of teaching mathematics in English to Jordanian CLIL students refers to the development of students' cognitive skills for both mathematics and English

For university instructors, this emphasis will invite them to reconsider their conceptual frameworks that allow students to understand mathematics more fully. For their views will have great impact on what they teach together with increased awareness of language role in shaping students' CLIL difficulties. Accordingly, the vision of the current research entails identifying difficulties in mathematics education in order to: (1) promote undergraduates learn to enjoy important mathematics in English language that is a part of their life experience; (2) And to support undergraduates learn how to solve word problem while using the English language.

Limitations

There are some limitations to this study. The researchers may point out these limitations in the following points:

1. The results will be generalized to the participants of the study and limited to Jordanian Engineering, Information Technology, and Science undergraduates undertaking mathematics courses. The results, also, can be generalized to similar context, sample, instruments and procedures.
2. The results are bounded by two demographic details (i.e. gender; secondary certificate grade in English and in mathematics). Other demographic details may have different results, accordingly.

Methods and procedures

The present study aimed at examining the difficulties encountered by CLIL learners as studying a content subject (i.e. mathematics) in English language by using data elicited from engineering, information technology, and science undergraduates. Accordingly, a university (The Jordanian University for Science and Technology (JUST) was examined for a ‘‘Calculus 1’’ course. This course is an obligatory course for all engineering, information technology, and science students.

Participants

The present study focused particularly on the CLIL difficulties of content material, with special references to the mathematics, held by students at JUST University. The participants were all male and female students signing up for this course in the first academic semester of 2012/2013. The number of the students who willingly took part in the current study mounted up to 248 participants. 32 students out of the study’s sample were interviewed. The interviews consisted of two questions designed to elicit specific answers on the part of respondents. Table 1 displays that the participants’ details regarding gender. It is worth mentioning that 21 students did not indicate their gender.

Table 1: Sample distribution according to gender

Participant’s details	Number	Percent
Males	126	51%
Females	101	41%
Did not indicate	21	8%
Total	248	100%

Most of the participants were males (51%), less than half of the participants were females (41%). However, Table 2 gives an account of the participants’ high school certificate grade in the subjects of English and mathematics respectively.

Table 2: Sample distribution according to high school grades

Subject	Mean	St Dev.
High-school English	87.91	21.53
High-school Math	87.623	9.796

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High-school Math	87.623	9.796

Neither English nor mathematics seemed a problem at high school for the undergraduates participating in the current study. Table 2, clearly, demonstrates relatively high mean scores of 87.91 in English and that of 87.623 in mathematics respectively. It’s worth pointing out that students admitted by JUST University, typically, have high grades that are not less than 85%.

Instruments

Quantitative (i.e. a questionnaire) as well as qualitative (interview) data were elicited for the purposes of the current study. The questionnaire was divided into two sections. The first section included demographic data regarding students’: high school grade in English and in mathematics, and gender. The second section included a 30 item questionnaire categorized difficulties into four- domains, namely; epistemological, personal, pedagogical, discourse. The participants rated the 30 item on the extent to which they agree with each statement using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The criterion for assessing the degree to which students expressed their CLIL difficulty was based on the following: (1.00 – 2.60 as Weak; 2.61 – 3.40 as Moderate; 3.41- 5.00 as Strong). The percentage was calculated according to the following equation: *The highest value – The lowest value*. In the present research, the highest value was 5; the lowest value was 1. Thus, the percentage was calculated as follows: $5/5 - 1/5 = 0.80$.

Since the focal core of this research is academic language building, it was worthwhile considering the following theoretical orientations in order to identify difficulties in CLIL setting:

- Ideas that entail considering language proficiency informally is essential to cognitive academic language proficiency (e.g. Cummins, 1986).
- Language register research (e.g. Halliday, 1978).
- Research on the nature of math learning and the abstractness of mathematical concepts (e.g. Romberg & Kaput, 1999)
- Attitudes and setting factors research (e.g. Dewey, 1933; Gardner, 1985; Vygotsky’s, 1978).

In order to examine face *validity* of the instrument, four faculty members of the curricula and Instruction department as well as mathematics department at Yarmouk and JUST reviewed the instruments. The team was asked to validate the content of the instrument concerning its instructions and suitability to the objectives of the present study. The team’s comments and suggestions were studied carefully, and the

necessary modifications were made accordingly. For example, the items of the questionnaire integrated 40 statements which were restated and reduced to 30 statements.

Before using the instrument, a pilot study was undertaken. The *reliability* of the instrument, however, was field tested and refined through the split-half method on a pilot group of 30 students (10 Engineering students, 10 Information Technology students, and 10 Science students undertaking mathematics courses) chosen randomly and excluded later from the sample of the study. The participants were asked to fill the questionnaire twice within a two-week interval. The instrument was further polished and refined as based on pilot study results. Internal consistency was checked in which Cronbach alpha was found as follows which were found as suitable to conduct the current study:

Table 3: Cronbach's alpha coefficients

Subscale	No. of items	Cronbach's alpha
Epistemological	9	0.8586
Personal Difficulties	7	0.6919
Pedagogical	10	0.7283
Discourse	4	0.8745

Thirty- two students out of 248 students accepted willingly to be interviewed. The interview, however, included two questions (*I-* By which language do you like to learn math? *II-* Are you happy and satisfied with the way math is taught in math courses?).

Procedures

The questionnaire was distributed during the first classes of different courses of "Calculus 1" course in the academic year 2012/2013. It's worth mentioning that this Course is likely undertaken by all students of Engineering, Information Technology, and Science at JUST. Two sections out of six were chosen at random in which the sample composed of 248 participants. The students completed answering the questionnaire in classes and returned the forms to the lecturers. Only 80% of the students filled the questionnaire. In order to ensure that the respondents expressed their own views, they were encouraged to give answers for all questions individually without consulting their classmates.

In this current study, descriptive and inferential statistics were employed to analyze the data. The frequencies of the occurrence for each of the questionnaire statements were tabulated first. Then, analysis of the data was performed using the SPSS software. Percentages for each statement were reported. In the data analysis, responses 'strongly disagree' and 'disagree' were grouped as disagreement with a statement, while 'strongly agree' and 'agree' answers were interpreted as agreement.

Findings and discussion of Quantitative data

This study focused on classified levels of difficulties such as: epistemological, pedagogical,

personal and discourse, and asked how Jordanian undergraduate students made sense of English language component in mathematical discourse, taking into account the fact that they have been successful in English and mathematics subjects in high school. Table 4 shows the mean scores and standard deviations of students' responses to the 30 item survey questionnaire (see Appendix).

The findings revealed that all the mean scores are above 2.6 except for item # 11 with mean 2.5587 and standard deviation 1.2213 which states that "I believe over time that I am "just not good at math." The researchers explained that such students used to have high self-confidence in their ability as they already have passed high-school with a high grade in mathematics and are studying technical fields that require a lot of mathematical proficiency. Yet, it seemed that they are unsure of their command in math at the university when they study it in English. Item # 12 revealed a low score with mean 2.4656 and standard deviation 1.1747 which states " I believe over time that I am "just not good at English." Again this could be explained by the type of students who scored high in English in high school where they were self-confident their English language abilities; yet it is not the case when at university where English is a tool for content subject learning . Item # 13 also revealed a mean of 2.2944 and a standard deviation of 1.1861 which states " I feel a sense of fear and failure regarding mathematics because of my English language"; this could express their perception of their current short potential abilities regarding studying math in English.

The highest mean score was that of item 19 with a high mean score as 3.7642 and a standard deviation of 1.0697 which states that "Math tutors' teaching methods in English are unclear". This clearly indicated that students attribute their difficulty in learning mathematics in English to the instructors' methods of teaching. That is also consistent with the results of Table 5 which shows the highest mean score to the domain of "pedagogical". This means that students found mathematics so difficult and challenging to learn because it is related to what and how mathematics is taught to them.

Students come to the university with a great body of knowledge of many concepts in Arabic. At the university, it is expected they build on their epistemological knowledge regarding concepts of numbers, magnitude (the lesser number, the bigger number), some addition facts in English. Result gained by item # 3 entails that " Math is often reduced to solving problems, so there is no point of knowing English" which scored a low mean score as 2.5911 and standard deviation of 1.1854 . Research shows that effective learning happens when this informal knowledge is used as the foundation for learning and that new knowledge is built on the previously acquired

concepts. Yet, in the present study JUST students perceived developing epistemological knowledge only in math with considering English language which is a tool through by which math is delivered. According to Piaget (1972), students construct new mathematical concepts by reflecting on their existing mental structure. However, if students were discouraged from using their informal knowledge, then they would encounter learning difficulties (Romberg & Kaput, 1999). Furthermore, Bruner (1986) stressed on the importance of the social aspect of learning. That is students learn mathematics not only through manipulating materials, looking for pattern, conjecturing, and generating various solutions, but also through communicating with the teacher and their peers. Therefore, students would find mathematics difficult if they are not provided with opportunities in which they are able to express their solutions verbally or in a written manner, engage in dialogue, discuss and critique strategies.

The present study considered issues relevant to understanding language which may lead, in turn, to a deeper conceptual understanding. So, one likely interpretation is that students were offered procedures and rules to be memorized and applied in math which take a lot of time at the expense of developing the necessary language skills. They would spend, accordingly, ample time on drill and practice and demonstrating procedures without emphasizing concepts and problem solving (NCTM, 2000). In the current study, item # 17 that entailed “Math tutors lack preparation and support in the teaching of mathematics in English” as having the lowest mean score (i.e. 2.5887 with a standard deviation of 1.1733) in pedagogical difficulties domain. One prediction as based on this finding tends to be steered towards introducing math ineffectively where students perceived mathematics as a boring subject that consists of meaningless symbols that need to be memorized and imitated. Thus, students would fail to learn math and English all together. Mathematics instead should focus on constructing concepts with meaning in which the learner is active in thinking about the patterns, building connections and making sense of the new concepts (Hiebert and Carpenter, 1992). This will encourage students to develop an appreciation of mathematics since they would understand it. Recall the Chinese proverb: “I hear and I forget; I see and I remember, I do and I understand”.

One possible interpretation that may part of the difficulties that occurred with JUST students is that of polysemous words whose multiple meanings can cause confusion. Polysemous words can have multiple meanings within mathematics or have one meaning in mathematics and another in standard English. In Calculus courses at JUST, two kinds of language conventions take place: a foreign language (English) and an academic content (mathematics). Foreign language conventions are highly contextual, enabling

undergraduates to deduce meaning and infer visual cues. On the other hand, academic content is more abstract and common words can take on specialized meanings.

The results of the present study build on how language is problematic in mathematics education. The study reported the most problematic issues related to language and mathematics in undergraduate setting by highlighting epistemological, pedagogical, personal and discourse difficulties. Table 5 showed the mean and standards deviation of the four types of difficulties with pedagogical difficulties as having the highest mean score of 3.5589 with standard deviation of 0.7923. Obviously, this result is consistent with results gained in Table 4 when cross referencing was made. In the current research, pedagogical problems are those relevant to the teaching process in terms of methods of presentation, teacher’s preparation, assessment, material presentation media and mostly content knowledge proficiency. Pedagogical content knowledge was defined by Shulman (1987) as the specialized content-related knowledge for teaching.

Table 5: Difficulties classifications results

Type of Difficulty	N. of students	Mean	SD
Epistemological	248	2.983	0.6938
Personal	248	2.6536	0.9234
Discourse	248	3.1165	0.5993
Pedagogical	248	3.5589	0.7923

To many students mathematics and English are difficult topics. “Success or lack of it plays a vital part in the motivational drive. Both complete failure and complete success may be de-motivating” (Harmer, 1989). Cognitive development is affected by feelings. Negative attitudes can lead to creating emotional resistance such as refusal to participate in tasks; they can minimize the students’ skill to solve problems. Psychological causes include students’ attitudes, motivation to learn, and anxiety. Many educators believe that a student’s success in mathematics and hence in a student’s future success in technical fields can be dramatically affected by a student’s feelings toward the subject matter (Ma, 2004). The lowest mean score was estimated as 2.6536 together with a standard deviation of 0.9234 seemed relevant to personal types of difficulties. This showed that nearly most students did not attribute their difficulties in learning mathematics in English to reasons linked to their psychological feelings; simply because they previously scored at high school extra high grades in English as well as in math. Also, admit students who are high achievers. Provided that Table 2, previously, illustrated that students participating in the study had extra high scores in English and in math subject matter.

The study reported that it may not be easy to understand the mathematical ideas in English. So, one interpretation entails that it is difficult to sort out which aspects of a lecturer’s utterance enhance students’ conceptual understanding or the students’ English

language proficiency. Yet in the current study, it was found that the concern of teaching is to support students as they learn mathematics regardless of defining the cause of an error (whether conceptual or language based).

The viewpoints outlined in Table 5 have delivered useful analytical tools towards identifying problems encountered by undergraduates. Nevertheless, these viewpoints are used to emphasize the *difficulties* in content and language integrated learning (CLIL) bilingual students faced as they learn mathematics in English. Understanding Cummins' (1986) ideas regarding the influence of high levels of development in L1 on understanding in another language may solve the problem of Jordanian undergraduates achievement gap in mathematics, for they speak more than one language .

This research, moreover, designated specific English language discourse difficulties for students in undergraduate mathematics courses. Table 5 presented that discourse features stand as another source of difficulties where the mean score was estimated as that of 3.1165 with standard deviation of 0.5993. Jordanian students' language background is not English, yet it is the language of instruction at the University when they study mathematics. One argument entails that there is an on-going restlessness in language requirements. Students with moderate English language, therefore, may take mathematics under the impression that they will not be so disadvantaged. Many perceive it to be relatively language-free.

Obviously, Table 5 illustrated how instruction tends not to best support students learning of both language and mathematics. Foreign language acquisition specialists describe vocabulary acquisition in a first or second language as taking place more successfully in instructional settings that are language rich, and dynamically involve students in employing language, entail both receptive and expressive understanding, and necessitate students to use words in various ways over extended periods of time (Pressley, 2000). Overall, unraveling pedagogical difficulties should deliver chances for students to energetically employ mathematical language to negotiate and discuss meaning in mathematical settings.

Epistemological problems in the current study were identified as the problems that may be attributed to the difficulty of the nature of math and the abstractness of mathematical concepts (Romberg & Kaput, 1999). The study reported that JUST undergraduates as having 'some' difficulties (i.e. a mean score of 2.983 with a standard deviation of 0.6938) that tend to be epistemological. So, it seems that the students in question do not have major weaknesses in number, place value, number operations, and number sense.

Findings and discussion of Quantitative data

The central theme of the present research addressed a variety of perspectives on matters related to Content and Language Integrated Learning (CLIL) in the Jordanian context. Command in English form the cement holding conceptual and procedural knowledge of science as taught JUST together. In fact, CLIL is becoming increasingly popular in most Universities across Jordan. Table 6 clearly demonstrated that 66% of students participating in the study were 'holding onto' the idea of learning math in Arabic, while only 6% preferred leaning it in English.

Table 6: Students' language preference

By which language do you like to learn math?	English	Arabic	English & Arabic	Total
Frequency	2	21	9	32
Percent	6%	66%	28%	100%

The researchers felt that students' responses might follow a style by the interviews that is often fuller and richer than traditional responses gained by the questionnaire, and can be more wordy and include more information

The researchers were driven to think that students are temporarily learning terms and then forgetting them as they move on to something new. Research findings (Fletcher and Santoli, 2003) indicate that, it takes a student many times of exercise to learn a new vocabulary word. The current study reported that JUST students having quite a few opportunities to learn each new math term. 21 candidates had the same remark that kept repeating to their instructors during lecture time: "Can we slow down?" Many students reported in the interviews the key to studying math in English is to start slow, one student said: "taking small steps, one at a time, toward math and English involvement."

Another likely argument is that the students were offered words in isolation and as an effect they felt they should have math in Arabic rather than in English. However, the current research sparked from students' data that showed they establish low proficiency with math words in English. Another assertion that can be made here is that if instructors use English properly in class, there may be more connection to what is being learned. Murmurs statements were voiced like, "Math is hard. I hate it. Am I required to do it on a daily basis"?

The researchers got the impression that most of the interviewed students "do not understand math lectures in English". One student reported that: "lectures basically lack precise meanings. I can learn new terminology best when I come across it during purposeful activities". Another student described herself as "a literal student and may search for a rewording or a reiteration that just isn't present in the problem statement". However, another student felt that "he relies

on key words or rules to understand math problems in English”.

Multiple meanings of words invited student to have math lectures in Arabic. Understanding polysemous terms necessitates that CLIL students “discern the specialized meaning of common terms in a mathematical context” (Garrison & Mora, 1999). Ron (1999) similarly recommends that the numerous linguistic challenges and the absence of automatic transfer between the first and second language require that teachers provide CLILs with high quality, fair chances for using mathematical language.

Mathematics and language are inevitably connected (Dale & Cuevas, 1992). developing these

Table 7: Students’ perception of the current math pedagogy

Are you happy and satisfied with the way math is taught in math courses?	very much	satisfied	not satisfied at all	Total
Frequency	6	4	22	32
Percent	12%	19%	69%	100%

One interviewee remarked that: “my cultural values and styles of interacting may differ from what’s expected in math activities. I may be more comfortable when classroom interactions resemble that of Arabic culture”. One student reported that “the meanings of words are dependent on their context within math lecture”. Another student stated that “I struggle to understand verbal directions from my lecturer”. One interviewed student suggested that “lecturers can present a new concept or problem with a demonstration, allowing us to listen and observe”.

Research maintained that math is a language that needs to be taught so that students can learn to “talk in math” (Rollnick, 2000). Talking math means being aware of certain technical and non-technical terms that have unique meanings in a mathematical context (e.g. problem solving). According to Dale and Cuevas (1992) mathematics and language are connected in that language facilitates mathematical thinking. As to the National Council of Teachers of Mathematics (2000), the role of language is extremely important where teachers need to attend in order to enhance students’ understanding of mathematics. ‘Talk’ is the very core of any educational practice. Henderson and Wellington (1998) stressed that “talk in the classroom involves the talk of the teacher and the talk of the learners, and, as in any relationship, the one can have a deep impact on the other, for better or for worse” (p.36).

Recommendations

The current study recommends that CLIL at foreign language settings should achieve more than concentrating only on the subject matter in question (i.e. mathematics). It’s rather need to reinforce the foundation of English and later to lays the basis for Specific English which will be used in the years of the

events entail that students precisely understand academic mathematically situated language. 28% of students participating in the interview often have no difficulty in learning math in Arabic or in English. A possible interpretation maintained that CLIL students have attained mathematical words in Arabic language and lack a similar degree of proficiency in English. The intricate and decontextualized nature of mathematical language added further challenges to CLIL students as they learn English as a foreign language.

Table 7 however, supported and backed up earlier findings in Table 4. The Table showed a large percent of 69% as not satisfied with the methods math courses are taught.

students’ specialties such as business, health, computers etc.

Understanding the relationship between language and mathematics (i.e. CLIL) is critical to designing mathematics instruction for students who are studying English as a foreign language. The current study recommends understanding mathematical language and developing principled instruction, particularly for Jordanian universities students where they stand as an example of presenting a content subject in an EFL setting. Further, this study suggests conducting research-based language approach for diverse course levels across different specializations. Then, the study praises developing ready to use techniques that provide insightful practical and comprehensive materials.

The current study might be of pedagogical help and significance to textbook designers, researchers, tutors and those interested in communicative competence in general and ESP in particular.

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