

Mathematics and English, Two Languages: Teachers' Views

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Abstract

English is an international language used all over the world. Mathematics is the language of sciences but it is also a language used in everyday life. Although both are perceived as languages, mathematics and English are considered as two completely distinct disciplines. In this paper we first discuss English and mathematics as languages. Then we present interviews conducted with five mathematics and English teachers in order to explore their views regarding issues of language features, ways of teaching and issues of anxiety and collaboration between English and mathematics teachers. The interviews suggest some communalities in the way English and mathematics teachers relate to the two languages. The connection between the two disciplines seems to challenge teachers' thinking about their teaching.

Keywords: teacher education, mathematics and English, universal languages, teachers' beliefs

1. Introduction

English is an international language used all over the world allowing people from different countries to communicate for different needs. Mathematics is the language of sciences but it is also a language which is used for communication and for describing different situations in everyday life. Although both English and mathematics are perceived as languages, they are considered by schools and colleges as two completely distinct disciplines.

We are both teacher educators in an academic college of education. Author 1 is an expert in teaching English as a foreign language (TEFL) and Author 2 is an expert in mathematics education. We both have experience as teachers in schools and at present we are head of departments in the faculty of education in our college. Our collaboration commenced when we were invited to make a contribution to a book on teacher education in our country. We then realized that, in fact, our two "distinct disciplines" have communal features. This realization made us aware of various interesting incidents that emerged in our classes and sparked some thoughts concerning the connection between our two areas of expertise.

In the course of one of Author's 1 academic writing courses at the college, we discussed the different processes that writing entails, in order to achieve an elegant coherent piece of text. Students were invited to share how they perceive the art of writing. "*This is just like problem solving*", said one of the students. "*There are so many linguistic elements that we have to think of and knit together into a colorful tapestry of words so that everybody can read and understand. This is not easy when you have to write in a language different from your mother tongue. You have to draw the right words from your command of vocabulary, be familiar with the right lexicon, know the grammar and convey meaning in an unambiguous manner. This is high order problem solving.*" This description brought home some thoughts about the possible similarity to mathematical problem solving.

The following took place in one of Author's 2 mathematics classes when discussing a research study which investigated the understanding of 7th grade students of the relationships between fractions and decimals. We realized that although most of the students know that 0.5 and 1/2 are equal, this might be difficult to grasp for some of them, since the two numbers do not look alike. One of the students commented that this is just like in languages. "*The word 'cat',*" he said, "*is pronounced differently in Hebrew and in English. When written down, this word does not look alike in the two languages. Still the words have the same meaning. Thus, we can use the examples from language in order to explain and make sense of the problem in mathematics.*"

Colleagues from both disciplines showed kin interest in the topic and encouraged us to further investigate it. This made us ponder on the nature of mathematics and English as languages. As a result, the following questions

emerged: Are there commonalities in the teaching strategies of English and mathematics? Do teachers perceive these two disciplines as two languages? What could be the implications of such awareness or lack of awareness? Could there possibly be any instructional collaboration between teachers of English and teachers of mathematics? How could the awareness of these issues help students who are good at mathematics but find English difficult, and vice versa?

Thus, the purpose of this study is firstly to discuss the disciplines of English and mathematics as languages, and secondly, to examine the views of mathematics and English teachers regarding language features, ways of teaching, issues of anxiety and collaboration between English and mathematics teachers. We believe that the way English teachers perceive the language of English would generally influence how it is taught. Similarly, the way mathematics is taught in class is influenced by the way teachers perceive the nature of mathematics. Moreover, if mathematics is perceived as a language by English and mathematics teachers, they could have common grounds for collaboration, enriching the teaching of both disciplines.

1.1 What is Language?

A language is based on a set of rules relating symbols to meaning which allow the forming of an infinite number of utterances from a finite number of elements. The rules are what we call the grammar of the language, the system underlying our use of language. These rules are abstract rules of a language which we use to construct our sentences in speech and writing (Freeborn, 1987).

The fact that human language is a learned symbolic system allows flexibility: language changes, words are transformed and new words are created. Language evolves in response to changing historical and social conditions and people in different places in the world speak divergent languages. However, the need for social or commercial communication brought about “lingua francas”, one language used by common agreement. Having this in mind, let's see how English has become the lingua franca of the whole world (Fromkin & Rodman, 1974).

1.2 The English Language

English is the language for international communication and is nowadays used by more nonnative than native speakers. English has developed from “the native language of a small island nation to the most widely taught read and spoken language that the world has ever known” (Kachru & Nelson 2001, p. 9). Since the second half of the twentieth century, the English language has spread around the world to an extent unknown in any other historical period or for any other language (Jenkins, 2006). It has turned to be the nativized language for what Kachru terms as the Outer Circle (Kachru, 1985). English also serves as a lingua franca among non-native speakers of English. Beneke (1991) estimates that about 80 percent of verbal exchanges in which English is used as a second or foreign language do not involve any native speakers of English.

For the first time in history, a language has reached truly global dimensions, and as a consequence, is being shaped, in its international uses, at least as much by its nonnative speakers as its native speakers (Seidlhofer, 2004). The globalism of the English language is well described by Brumfit: “The members of the expanding circle who do use English are an increasingly significant group who operate in an increasingly global economy which has an impact on the economy in all countries...and the internet, mobile phones and other technology increasingly establish the potential for use of English which is quite independent of the controls offered by traditional educational systems, publishing outlets and radio/television” (Brumfit, 2002, p. 5). The language is also used more and more for practical purposes by people with varied norms and scopes of proficiency. Thus, English as a language, according to many linguists, is undergoing a process of internationalization and destandarization (Melchers & Shaw, 2003).

The native speaker norms, in light of the internationalization of English, have been a debated issue for quite some time. Actually, the 1990s were a revolutionary decade, according to Crystal (2003) due to proliferation of new linguistic varieties arising out of the world wide implementation of the Internet. The consequences were a public recognition of the global position of English. English is now the language most widely taught as a foreign language-in over 100 countries and in most of these countries it is emerging as the chief foreign language to be encountered in schools, often displacing another language in the process. Since the 1960s, English has become the normal medium of instruction in higher education for many countries. About 80 percent of the world's electronically stored information is currently in English.

Crystal (2003) argues that a global language is particularly appreciated by the international academic and business communities. English is the medium of a great deal of the world's knowledge, especially in areas as science and technology. The reason why so many nations have in recent years made English an official language, or chosen it as their chief foreign language in schools, is educational. The rapid change, the growth in international contacts, the mobility of people, the “global village” have provided the circumstances needed for a global language: “There

has never been a time when so many nations were needing to talk to each other so much. There has never been a time when so many people wished to travel to so many places. Never has the need for more widespread bilingualism been greater, to ease the burden placed on the professional few: And never has there been a more urgent need for a global language (p. 14).”

This has also aroused thoughts among TESOL (Teaching English for speakers of other languages) teachers about the consequences it might have on the conceptualization, development and teaching of English: how far should students, classroom teachers and teacher educators conform to native-speaker norms (Timmis, 2002)? What is the best way to prepare learners for international communication if second language pedagogy should not aspire for intelligibility for native speakers receivers (Jenkins, 2002)?

1.3 The Language of Mathematics

Galileo Galilei said that: “Mathematics is the language with which God has written the universe.”(Note 1) It is the language of numbers, symbols notations and grammar. Using numbers and mathematical symbols, one can write “words” and “sentences”. When appropriate, several “sentences” together might form a “mathematical story” (solutions of exercises, problems, etc.). Mathematics has also grammar – the mathematical logic which determines whether statements are valid or not. Jamison (2000) is using linguistic terms to describe mathematics and argues that not many see mathematics as a language. He suggests that treating mathematics as a language would help to increase its understanding: “I want to show how making the syntactical and rhetorical structure of mathematical language clear and explicit to students can increase their understanding of fundamental mathematical concepts. ... Regrettably, many people see mathematics as a collection of arcane rules for manipulating bizarre symbols – something far removed from speech and writing (p. 45).” Gough (2007) suggests that mathematics is not a natural language but a formal language, artificially constructed, using our natural everyday language in teaching the mathematical language. In the document “Making Mathematics Count” released by the Department of Education and Skills of Great Britain, mathematics is described as a ‘powerful universal language’ (Making Mathematics Count, 2004).

And indeed mathematics is a universal language, since the same numbers and symbols (in most of the cases) are used around the world by billions of people. If a person in China would write a letter (written in Chinese) to a person in the United States it is almost sure that the person in the United States will not be able to read it. But if, instead, he will send a simple mathematical equation with its solution, it is almost certain that the person in the States will be able to “read” the solution and most probably understand it.

Mathematics as a universal language is important to the modern society. It is being used in technology, sciences, business and financial services and at many workplaces around the world (Making Mathematics Count, 2004). It is a language taught in school and learned all around the world from first to twelfth grade and it is also part of the activities children are engaged in during pre-school.

Woodin (1995) refers to mathematics as a language and suggests teaching it as a language to children with learning disabilities. He even compares math to English and says that: “Math may be viewed as a language – a simpler, more consistent and more regular language than English. This is especially the case with math facts. Numbers represent nouns, while operational signs (+, -, x, /, =) serve as verbs. Both components are governed by rules of syntax. Math facts, such as $2 \times 3 = 6$, may be thought of as math sentences. Students should be encouraged to speak in complete sentences, to convey an entire thought, and to develop a consistent rehearsal pattern for the math fact.... Math at the simple sentence fact level is a much easier language than English. Although math has an infinite number of nouns, it has only five verbs (+, -, x, /, =) associated with four basic operations. Some students, however, may need to have the syntax, as well as the coding (place value) and number theory, explicitly taught to them.”

Mathematics is also a language of communication in our everyday life. Newspapers and television broadcasts, for example, include graphs, percentages and other mathematical concepts to convey important information. Mathematics as a language of communication is also emphasized in mathematics curricula around the world. For example, The NCTM (National Council of Teachers of Mathematics) in the United States refers to mathematics as a language of communication in The Standards for School Mathematics (NCTM, 2000) and states that “Instructional programs from pre-kindergarten through grade 12 should enable all students to: communicate their mathematical thinking coherently and clearly to peers, and others and use the language of mathematics to express mathematical ideas.”

The language of mathematics and mathematical skills are an integral part of our everyday life. Small children have in their lexicon phrases such as, “3 candies”, or “one half”. We use mathematical language in recipes when we

describe ingredients (200 grams of flower or 3/4 cup of sugar). During sales prices go down by 20 percent. Thus we all actually speak “mathematics” without even being aware of it.

Mathematics as well as English as a second language do not develop naturally as a child develops a natural language, they need to be learned. Learning entails conscious practice which adheres to “skill learning theory” (Dekeyser, 2007): providing concise rules which the learner can rehearse; offering abundant repetition and drilling; providing open-ended activities to practice the skill in a wider applicability range. Classroom activities in mathematics and English should engage learners in authentic, real-life functional use of the language.

Thus English and mathematics as languages are similar and yet different. They both are languages of signs and symbols which combine to “words” “sentences” and “stories”. These “stories” have a grammar, which is universal and hence makes them languages of international communication. Albeit these similarities, there are some principal differences. The language of mathematics for example, is precise and less flexible - it cannot afford ambiguity, while natural languages contain constructive ambiguity derived from their cultural and contextual wealth of meanings. Having this in mind, we wondered whether these commonalities and differences are part of teachers’ beliefs and how they could affect the teaching strategies.

1.4 Teachers’ Beliefs and Ways of Teaching

Numerous studies on the relationships between teachers’ beliefs and classroom practices have been conducted in the last decade (Clark & Peterson, 1986; Tillema, 2000; Borg, 2006; Fulton, 2012). Horwitz (1985), Roberts (1998), Kern (1995) and others suggest, for example, that pre-service teachers’ beliefs about language learning originate from their second language learning experiences, particularly in secondary school. Connely and Clandinin (1994) also note that teachers’ personal values and beliefs are very much shaped by their personal experiences. For example, teachers who believe that language learning means memorizing grammar might spend most of their time on these activities (Peacock, 2001). Johnson (1994) found that pre-service teachers’ acceptance or rejection of the content of their teacher preparation courses appeared to rest on their prior formal and informal language learning experiences. Wood and Bennet (2000) argue that beliefs assumptions and knowledge of teachers affect the way a teacher interprets teaching events and hence the teaching decisions that are made. This is supported by later studies by Tsui (2003) pointing out how teachers’ personal assumptions, values and beliefs filter through to their classroom practices and the way they define problems and manage dilemmas in the classroom. Keys (2005) demonstrated that teachers often had two sets of beliefs, those they exhibited in the classroom and those they stated but never followed through within the classroom. Many teachers needed ongoing support as they attempted to implement a new practice that was not aligned with their beliefs.

Studies by Ng and Farrell (2003) found evidence to suggest that what teachers say and do in the classroom is governed by their beliefs. In a previous study, Farrell (1999) examined the beliefs system of pre-service teachers of English grammar in terms of its influence on teaching practice and found evidence to suggest that these beliefs may be resistant to change. Similarly, Richards, Gallo, and Renandya (2001) discovered that although many teachers stated they followed a communicative approach to teaching, they held strongly to the belief that grammar is central to language learning. Thus, in understanding teachers’ classroom practices and the knowledge embodied in these practices, it is important to understand their conceptions of teaching and learning and the sources of influence that shape such conceptions. This reinforces previous studies suggesting that it may be particularly important to help trainees reflect on their beliefs (Brown & McGannon, 1998).

Goldin, Rosker and Torner (2009) claim that “beliefs now constitute ‘a no longer hidden variable’ in research on the teaching and learning of mathematics” (p. 14). Findings suggest that teachers’ beliefs regarding the nature of mathematics are significant factors in the way they teach mathematics in class (Cross, 2009; Handal, 2003; Spitek et al., 2001). Many mathematics teachers conceive of mathematics as a static body of knowledge, involving a set of rules and procedures that are applied to yield one right answer (Thompson, 1992; Nisbet & Warren, 2000). Inquiry-oriented mathematics educators take a more dynamic view of mathematics conceptualizing it as a discipline that is continually undergoing change and revision (Prawat, 1992). Handal (2003) in his review of teachers’ mathematical beliefs argues that a large number of teachers still perceive mathematics in traditional terms dominated by a-priori rules and procedures. Zakaria and Musiran (2010) investigated beliefs among one hundred pre-service teachers. They found that many of the teachers believe that mathematics is a formal way of representing the real world and that it should be taught as a collection of skills and algorithms.

It is interesting to note that studies on teachers’ beliefs regarding the nature of mathematics have no explicit reference to mathematics as a language. Exposing teachers’ beliefs toward mathematics and English as languages is important for understanding the influence, if any, of these beliefs on the way they teach in class. This might also open channels for collaboration between mathematics and English teachers.

1.5 Anxiety

English and mathematics are considered core subjects and are highly regarded by students, parents and educational systems in our country, as in many other countries. Mathematics and English are the gate keepers to universities, either in the form of psychometric exams, or as threshold standards required for admission into academic institutions. The consequences are that parents and school stakeholders are ready to invest much effort in order to promote success in these two subjects. But for some students these subjects are accompanied by a feeling of anxiety.

Mathematics has a reputation of one of the most difficult subjects in school and many students suffer from math anxiety. Mathematics anxiety is expressed by a feeling of fear, tension and panic when asked to perform mathematical tasks. Many students in school and later as adults suffer from math anxiety. Wigfield and Meece (1988) identified two components of mathematics anxiety, affective and cognitive: negative affective reaction to mathematics, such as nervousness, fear and discomfort and worries about doing well in mathematics.

Jackson and Leffingwell (1999) examined the type of teacher's behavior which might create or exacerbate mathematics anxiety in students. They asked prospective elementary mathematics school teachers to describe their worst or most challenging mathematics classroom experience from kindergarten through college and found that for some, math anxiety occurred as early as 3rd grade of elementary school. Research studies suggest that the way teachers teach mathematics is the key to reducing mathematics anxiety (Arem, 2010; Rayner et al., 2009; Scarpello, 2007; Ashcraft, 2002).

In the last 20 years there has also been a great deal of research into second language anxiety (Woodrow, 2006). It has been regarded as one of the most important affective factors that influence language acquisition (Na, 2007). Much earlier Young (1991) identified six potential causes of language anxiety which related to learners, teachers and instructional practice. He mainly pointed at personal and interpersonal aspects, learner beliefs about language learning, teachers' beliefs about language teaching, teacher-learner interaction, classroom procedure and tests. MacIntyre and Gardner (1995) contend that anxiety might increase as a result of a learner's bad learning experience or continued bad learning performance. It can also be caused by the need to perform in a language other than one's native tongue (Jackson, 2002).

In a study investigating the relationship between anxiety and achievement in language among Israeli seventh grade students it was found that anxiety was negatively and significantly correlated to FL achievement on all FL Tests. Also, the teachers' attitudes to teaching as perceived by the students indicated a significant prediction of L2 anxiety (Abu-Rabia, 2004).

2. Design of Study

The study is exploratory and part of a larger study investigating different aspects of English and mathematics as two languages. The present study explores what teachers of both disciplines think of mathematics and English as languages. Our research questions focused mainly on the similarities and differences between the two languages as perceived by the teachers, pertaining to ways of teaching and anxiety. We were also interested to know about teachers' opinion on the feasibility of collaboration between teachers of the two disciplines. We found interviews as the most suitable way to achieve our aims as they enable the respondents to demonstrate their unique way of looking at the phenomenon of investigation and to provide their definition of the situation (Silverman, 1993). Thus the study employs an inductive approach (Bogdan & Biklen, 2003) in order to gain insights on the teachers' perceptions of mathematics and English as languages.

Four in-depth interviews with five teachers studying at a teacher education college are presented. All five participants are the authors' students in different courses: two are mathematics teachers, three are English teachers. One of the English teachers used to be a mathematics teacher. They are all in-service teachers and study at the college for different degrees: three for an M.Ed degree and two for a teaching certificate.

Both researchers conducted the interview according to a set of predetermined themes not organized in a particular sequence. The interviews were conducted in the office of one of the authors. Each interview lasted between 40-50 minutes. One joint interview was conducted with two of the five teachers assuming that a discussion will develop and the interviewees' interaction between each other would yield insights that might not otherwise have been available in a straight forward interview. This interview lasted 60 minutes.

All interviews were recorded and transcribed. Transcriptions were read by the two researchers independently in order to obtain a holistic view for emergent themes related to English and Mathematics as languages. The independent reading was followed by discussions between the researchers in order to arrive at common grounded

themes. The interviews are described in a narrative style in order to maintain the holism of the interview and also to capture the dynamics within the interviews (especially, the joint interview).

2.1 Interview with Neal

Neal is a mathematics teacher with 30 years of teaching experience. He teaches in the upper grades of elementary school. The first question addressed to Neal was the possible relationship between mathematics and English. Neal hesitated for a second and said that he never thought about it. We further probed whether mathematics and English are both languages, he replied: "Mathematics to me is the language of all languages. It is the language of reality. However, while English is a language with an element of emotion... a means by which reality is reflected by words of sentiment... mathematics describes reality in an objective way".

Neal noted that although English and mathematics are both languages they differ from each other. He described throwing a stone as an example. "In mathematics this will be described saying that the stone has a parabolic trajectory. In English this can be described by saying that the stone cut through the blue sky disappearing behind the mountains." He added that different languages have different emotional elements, suggesting that Shakespeare would not be the same when translated into other languages; mathematics however, seems to be the same everywhere. "If mathematics is the same everywhere" we asked, "isn't it more of a communication language than English?" Neal explained that mathematics might be compared to the language spoken by all people before the "Tower of Babylon" after which each created their own language and creativity flourished. Neal mentioned the issue of creativity and said that in English creativity is expressed by the variety of interpretations that can be attributed to the same concept. He gave the example that "a rose is a rose is a rose" can have multiple interpretations, but in mathematics there is rigidity: "3 is 3 and 3+4 will always be 7". It becomes creative when mathematics interprets reality by a "word problem".

To the question concerning students' anxiety in English and mathematics, Neal said that mathematics causes much more concern among students than English. He explained that the stronger the "emotional element" involved in the subject, the lower the anxiety level. He further explained that every language has its music and you just "hear" when a sentence is correct or incorrect by its musicality. The same applies to mathematics: "mathematics has its own music; the right thinking is the musical thinking... A child who can "catch" this musicality, who can "hear" the logic of mathematics is good at math, but if they cannot identify connections and relationships, they are doomed to much difficulty." To make himself more explicit, he added that "musicality of mathematics" means to understand the reality. For example: "to understand 'ratio', is music... the relationship between two tunes is a mathematical ratio and the more beautiful the harmony between two tunes, the more mathematical ratios are created."

Neal seemed to be taken by surprise at the question concerning collaboration between English and mathematics teachers and said that it never occurred to him, albeit the logicity of it. He also highlighted similarities in the way the two languages are taught and explained that a child learns his mother tongue by listening and speaking. English taught in the first grades is very much focused on listening skills, and only afterwards the child learns the grammar. Similarly, in math, one first learns how to solve problems and only later the mathematical logic behind it. In music it is quite the same, you first learn the song and then you decompose the melody.

2.2 Interview with Sean

Sean is a mathematics teacher with eight years of experience in elementary school. He did not hesitate for a moment when we asked about English and mathematics as languages: "they are both interesting international languages existing from the beginning of history, used in everyday life". His concern was about the way it is taught. He said that it is taught in a manner which is detached from reality detracting from its beauty and usefulness. His personal belief is that "children need to understand that mathematics embodies meaning, it needs to be taught in context. One cannot escape the fact that it is part of the media, the culture around us... it is a language containing grammar just like any other language". He further explained that mathematics is meaningful and creative: "when you describe the classroom as a three dimensional shape, you are actually telling a story. Mathematics can be a joy and make children wonder and curious about things around them. It all depends on how you teach it."

As far as anxiety towards mathematics is concerned, Sean criticized the educational system and asserted that it had failed: "teachers teach for the test and destroy the 'wonder' of mathematics. It raises antagonism, unhealthy competition and high level of anxiety among students. Teaching mathematics in this way, is not teaching it as a language should be taught. Students are engrossed with mechanical exercises and do not see the story in the numbers and formulas". He compared it with teaching English: "we have two teachers one is teaching the language showing its usefulness in life, the other bombards the students with grammar exercises". The teachers,

he said, also play an important role in forming a positive stance to the subject. His opinion is that the fact that English and mathematics are considered the most important subjects in school causes a lot of social pressure on the students. In his school there is no collaboration between the English and mathematics teachers but the questions provided some food for thought.

2.3 Interview with Nina

Nina is an English teacher in elementary school and has 12 years of teaching experience. She has no doubts about the logical connection between English and mathematics. "They are definitely languages," she said, "in both languages there are patterns and rules. They are both taught through visualizations and illustrations. Teaching vocabulary is like teaching fractions. You need to illustrate in both languages and practice a lot. First you drill and then exercises become more meaningful until you gain autonomy and speak the language automatically. Thus the sequence in both languages is cumulative and incremental."

She believes that anxiety might be caused by a traumatic experience. "There are lots and lots of rules", she says, "and one needs to learn them or even memorize them. This is not easy for some learners." She also mentions social pressure, mainly from parents. These are two subjects that open doors on the employment market. Parents put a lot of pressure. They see them as the key to success. Regarding collaboration, Nina notes that in her school there is no collaboration between English and mathematics teachers.

2.4 Sue and Ann (Joint Interview)

Sue teaches English as a foreign language in elementary school. She has eight years of teaching experience. Hebrew is her first language and English is her foreign language. She used to teach Hebrew and Mathematics in a school in the United States. Ann teaches English as a foreign language in elementary school. English is her native language and Hebrew is her second language. She also speaks fluently French.

As a teacher of both languages, Sue could immediately see the similarities between English and mathematics. "The analytical thinking, she said, is applicable to both languages. The left hemisphere helps learn grammatical structures in English just like it helps learning formulas in mathematics." Ann moved uncomfortably in her chair, "I disagree", she says "It did not work for me and many others I know. I am very good at languages; I speak fluently three languages and learned them quite easily. I almost failed mathematics. Sue explained that certain skills in English, such as, learning new vocabulary or learning grammatical structures, are a sort of mathematics. Some pupils would look at a 'problem solving' activity as a problem from real life and not as a mathematical problem." She then provided an example from her own learning experience: "I remember when I learned math in school I used to look at the mathematical problems as a puzzle, or even a game. This is why I enjoyed math. The language, serves as a means to express ideas and turn the problem into a game."

Ann was hesitant and said: "Well...this sounds quite reasonable. If I see a math problem, I will not be able to solve it even though I understand the words. The same is when I encounter a language I do not speak or read. If I do not have the grammar and the literacy, I will not be able to read or understand." Concerning "anxiety" Ann added that this is something that comes from home: "If you have good grades in these two subjects, you are on the road! All the rest receives less esteem." Sue thought that anxiety develops later when students realize that it is not as easy as they thought it would be. Ann said that the negative attitude develops due to failure or an unpleasant experience with a particular teacher. She explained that in languages or math it is inborn: "one can have a mathematical talent and succeed without exerting too much energy. In history, for example, one can make some more effort and do well." Ann seemed to be convinced that mathematics is a language after all.

This led us to the question on the teaching strategies of the two subjects. Ann was probably still hesitant due to her "revelation" that mathematics is a language and chose not to react. Sue believed that teaching mathematics and teaching English is, in a sense, similar: "It is presented through real life situations, just like in English. If I want to present a math problem of percentage, for example, I will tell my pupils that they are going on holiday and have a certain amount of money. They have to plan the expenses by percentage. This is something taken from their own life. It is real and not a mere math problem."

Collaboration between math and English teachers was a bit too overwhelming for both Ann and Sue. Ann was surprised: "it seemed illogical before the interview and I would have never thought of it. Now, I am quite convinced we can learn from each other. Sue's final comment was that it brought back memories from her teaching math. When she started teaching English, she completely shut off from math. Now, we gave her an idea. Maybe she could feed on some of the ideas she used in teaching math."

3. Discussion

3.1 *Interpreting the Interviews*

The five teachers seemed to be enthused by the topic. Linking mathematics and English opened new ways of thinking about their teaching. Their views as displayed in the interviews were based on their beliefs concerning the two disciplines, and on their personal experiences as teachers and students.

All teachers, except Ann, related to mathematics as a language. Ann's (English teacher) initial belief was that mathematics is not a language, but then the interaction with Sue convinced her otherwise. Several characteristics of languages were mentioned by the teachers, most of them supported by the literature: English and mathematics are both universal languages ((Making Mathematics Count, 2004); they are languages of communication (Kachru & Nelson, 2001); they both contain rules and structures and share analytical thinking (Dekeyser, 2007). Neal added one more insight, suggesting that both English and mathematics describe reality, however, descriptions in mathematics are more objective; while in English descriptions are more subjective using emotive discourse. Hence, a "sentence" in mathematics has always one interpretation ($3=3$), while a sentence in English might have different interpretations.

The teachers expressed their beliefs about the way mathematics and English are taught. Two main aspects emerged: Using real life situations as a way of teaching and the aspect of rules and logic. Regarding the first aspect, one mathematics teacher was concerned that many teachers teach mathematics in a technical way, detached from reality. Regarding the second aspect, English and mathematics were compared in the sense that in learning English one learns first to speak and only then learns the grammar, and in mathematics one first learns to cope with problems and then learns the logic that underlies them.

The metaphor of music was used to compare between the two languages, explaining that both English and mathematics have their unique music. One needs only to "catch the musicality" of the sentence or the formula to know whether it is correct or not. Teaching vocabulary was compared to teaching fractions as both entail illustrations and practice.

Teachers' views on anxiety accord with some aspects mentioned in the literature. Firstly, they agreed that anxiety exists in both English and mathematics, though it might be more acute in English due to the element of emotion which might reduce the level of anxiety. Teachers' behavior (Arem, 2010) and bad learning experiences (MacIntyre & Gardner 1995) were mentioned as a source of anxiety. The need to learn many rules, to solve mathematical problems or perform in a language different from one's own, were mentioned as reasons for failure and anxiety. The aspect of social pressure by parents and education institutions was strongly emphasised as a cause for tension.

All interviews clearly showed that in spite of the fact that teachers highlighted commonalities between English and mathematics they were quite surprised at our question concerning possible collaboration between teachers of both disciplines. This might be due to the fact that in the educational system English and mathematics are commonly conceived as two completely distinct disciplines which do not seem to have anything in common. Consequently, English and mathematics teachers would usually not find any reasons to collaborate and discuss issues related to teaching and learning the two subjects.

3.2 *Emerging Insights*

The study set out to explore teachers' perceptions of English and mathematics as two languages. Five teachers, including two mathematics teachers, two English teachers and one English teacher who used to teach mathematics in the past, were interviewed. The interviews exposed some interesting insights concerning communal features between English and mathematics, and raised practical questions pertaining to teaching in schools and teacher education.

The interviews with the teachers made us wonder: what could be the mutual contribution of collaboration between teachers of English and teachers of mathematics? Could such collaboration encourage sharing of ideas and thus enhancement of professional development of teachers? The interviews also reinforce the contention that it is important to understand the influences that shape teachers' conceptions about teaching and learning and it might be useful to help teacher to reflect on their beliefs (Brown & McGannon, 1998). Ann started off with a firm belief based on her own experience that mathematics could not be a language since she was very good at learning languages, but never took to mathematics. In the course of the interview, her views were challenged when she realized that there are similarities between the two disciplines and mathematics might indeed be a language. Sue, as well, was surprised at her own state of mind when she realized that in spite of the fact that she considered both as languages, she never thought of the similar teaching strategies she herself used being an English and mathematics

teacher. Thus, the interviews unveiled predispositions and values that have not been challenged before and provided food for thought that might have an impact on the teachers' teaching.

We believe that teachers from the two disciplines could feed on each other's knowledge and reflect to the students the possible links between mathematics and English as two languages. The students who are strong in one discipline could be encouraged to try and get better at the weaker one. The modeling of collaboration could reduce the level of anxiety for those students who have difficulties in these disciplines. The re-framing of Ann's beliefs about mathematics as a language in the course of the interview could also happen to pupils who are concerned about failing mathematics. As teacher educators it provided food for thought concerning our teacher education programmes in our respective faculties. Gilles and Wilson (2004) suggest that teachers need to reflect critically on their beliefs and dissonance between beliefs and actions. They need opportunities to learn about, discuss and reflect upon how their knowledge is put into practice (Helmann, 2006). Could we enhance this notion by collaboration between our English and mathematics faculties in our college?

This initial small scale study emerged from our mutual professional practice as teacher educators. It explored teachers' beliefs concerning English and mathematics as two languages. Our intention is to further explore the issue in a wider population of teachers from elementary and secondary schools. Our interests will focus on thinking processes in problem solving in the two languages. This will entail observations of English and mathematics lessons in schools to identify unique teaching strategies of both subjects. As teacher educators we believe that insights from the study pose challenges for thinking outside the box and enhance interconnectivity and expansion of traditional boundaries (Tsui & Law, 2007).

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Note

Note 1. http://en.wikiquote.org/wiki/Galileo_Galilei