Perceptions, Challenges and the Resources of Learning Mathematics in English for a "Mathematically Intelligent" Bilingual Arab University Student tith Weak English Background

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Abstract: *This paper is an attempt to get some insight on the perceptions, challenges as well as the learning resources of mathematically high performing students at the university level that are handicapped with very weak background in English – the new language of instruction. The data of the study consist of the response of twenty three of these students to the series of an open-ended survey. As expected, lack of proficiency in English is found to be one of the major challenges of learning mathematics in English for these students. However, in line with Cummins' Developmental Interdependence Hypothesis, students' strong background in Arabic is speculated to be the major learning resources of this class of students. Although the participants believe that the language switch from Arabic to English have some negative impact on their mathematical understanding and performance, surprisingly most preferred to continue with English rather than going back to Arabic as a language of instruction.*

Keywords: *Bilingual Students, Mathematics,Mathematics Education,Cognitive/Academic Language Proficiency (CALP), Language Change, Second Language.*

I. INTRODUCTION

Education at all levels in Saudi Arabia is mediated through Arabic. Not only mathematics, all other subjects are taught in Arabic. English is usually introduced much later in secondary schools. However, students o not use English anywhere outside the classroom. As a result, most of the high school graduates in Saudi Arabia have limited proficiency in English. This is the case with most of the graduates of public school. However, the small number of private schools have different regulations. Despite, the number of universities in Saudi Arabia that are gradually switching the language of instruction from Arabic to English are at the increase. This is especially true for medical, engineering and science oriented courses. And there is no background study done to make the teaching or learning during the transition easy for the teachers or students. The only policy in this English medium is not to teach in Arabic!

Although the last three decades has witnessed global research resurgence in language issues as they relate to mathematics among mathematics educators, not much is known on how these bilingual Arabs university students are coping with the language switch. Also, the consequences of the language switch to the teaching and learning of mathematics in this context is unclear [1].

Consequently, this study is part of an ongoing project that is looking at the language issues as they relate to the teaching and learning of mathematics at the university level in this context. In particular, this study concentrates on students that were classified as very weak in English, but are surprisingly performing outstandingly well in mathematics exams conducted in English. Specifically, this study reports the perceptions of this class of students on the language switch from Arabic to English; their challenges in learning mathematics in English due to their lack of proficiency in English; as well as the learning resources that might have helped them to overcome the difficulties.

II. MOTIVATION FOR THIS STUDY – "ESH YA QUL"!

We have reported recently [2] that the proficiency level of the bilingual Arabs (including the participants of this study) in English is strongly related to their performance in mathematics. And some anecdotal evidences have shown where bilingual Arab students are facing problems while learning and doing mathematics in English ([3], [2]). Despite, you find some students that are classified as very weak in English but are performing excellently in mathematics examination conducted entirely in English. I noticed this very interesting phenomenon long time ago, however, the motivation for this study emanate from a heartfelt personal encounter I had recently with one of this students: A student who believe on his strong talent in mathematics, but challenged with lack of proficiency in English. The student – Hassan, graduated from high school with excellent result. He was among those admitted into a highly selective university in Saudi Arabia - King Fahd University of Petroleum and Mineral (KFUPM). However, like many of his colleague, all his twelve years of education was in Arabic medium. He has very little contact with English. Hassan was so excited to be at KFUPM, and to be in mathematic class which is one of his best subjects in high school. However, it appears that Hassan did not find the excitement in mathematics that he was expecting. In the first week of classes, I saw Hassan listening attentively and intermittently whispering to students next to him "Esh Ya Qul" meaning what is he saying? In the second week of classes, Hassan came to my office to inform me that he was going back to Riyadh (his home town). Why? He said he has been very good in mathematics throughout his school life, and mathematics has been one of his best subjects. However, now he could not follow the lesson due to his weakness in English language.

I talk to Hassan nicely, and gave him all the necessary encouragement, and assured him that with his kind of zeal, hard work and interest, it is a matter of time things will get better. That encounter seems to give Hassan some confidence, and he started to pick up in his class participation and in the quizzes. Many a times he will use a sign language to indicate that I should repeat what I said. Later on Hassan started to verbally say "please, again and again"- meaning that I should repeat. At the end of the semester, Hassan passed the mathematics course with grade of B+, which places him among the top 20th percentile.

During my almost two decades of teaching this class of students, I have come across many "Hassans", but this one is one case of students that display resilience and willingness to overcome the difficulty. Most importantly, he has vocalized the problem to me, which gave me the chance as a teacher to intervene and give him special attention. Many similar students could not survive in the system because they are unwilling to expose their weaknesses. This is true especially with this class of students who have good history of mathematical success

After the semester, I therefore, took the interest of investigating what is in Hassan and other similar students like him that made them to succeed despite their apparent language problem. This paper reports the results of this investigation.

III. Theoretical Background

In the last three decades or so, there has been an increased interest into the issues related to language and mathematics. This has been attributed to the increased number of people migrating from different cultures to the developed countries, and for the fact that English is increasingly accepted as a language of instruction in many developing countries [4]. As a result, researchers are interested in knowing the role of language in the students learning of mathematics in their second or third language; and if bilingualism or multilingualism is advantageous or detrimental to students' cognitive development [5]. In particular, researchers are interested in knowing if there is any relationship between student's first language (L1) and second language (L2) ([6], [5]). The issue has been investigated from both sociolinguistic and psycholinguistic perspectives (see [7] for review). And the efforts of these researches have resulted to some research monographs ([8], [5], [9], [10], [11]).

Initially, bilingualism and multilingualism has been viewed as a disadvantage to the students' cognitive development. And hence, they "actively sought to rid bilingual students of the encumbrance of their mother tongue" [5:173]. However, this perspective is now considered out dated and naïve [12]. Studies have shown that students use multiple resources in learning mathematics, and hence bilingualism and multilingualism can be an advantage or disadvantage for the cognitive development of the students [6]. Therefore, instead of looking at the issue from the "deficit model", it has been call upon to investigate the resources that bilingual or English learning students use for mathematics reasoning [11:19].

Now the most challenging question is at what level or stage is bilingualism or multilingualism is an advantage or disadvantage to the students? Cummins [13] speculated that there might be a threshold in which bilingualism or multilingualism can be advantage or disadvantage to the cognitive development of the students. The hypothesis popularly known as Cummins's 'Threshold Hypotheses' states that for learners who speak two or more languages, the interplay in the learning process between the language codes may either assist or detract them from learning. On one hand, if a bilingual or multilingual student has reached a "threshold" of competence in the two or more languages, then the learner may have a cognitive advantage. On the other hand, those bilingual or multilingual students who are not really fluent in either of the two or more languages tend to

experience difficulty in mathematics [14]. Although the hypothesis "remains speculative" [5:37-38), it has attracted a lot of attention of researchers in the area. However, the Threshold Hypothesis did not tell us the relationship between the students' first language (L1) and second language (L2). Perhaps to address this, in 1979 Cummins suggested another hypothesis known as Developmental Interdependence Hypothesis (DIH), which had a more in-depth focus on the relationship between a student's two languages [15]. The DIH proposed that the level of proficiency already achieved by a student in their first language would have an influence on the development of the student's proficiency in their second language [16]. That is to say, the greater the level of proficiency achieved in the first language will allow for a better transfer of skills to the second language. According to Baker [16], children taught in their L1 develop higher order cognitive and linguistic skills known as Metalinguistics in addition to L1 skills (see also [5], [12]). These skills will consequently transfer to the L2 leading to its development. There are many empirical studies that supported the DIH in many different sociolinguistics contexts (see for instance [17], [18], [5], [19], [20], [12]).

IV. The Study

As rightly noted, part of learning mathematics is acquiring fluency in the language of mathematics which includes "words; phrases; symbols; abbreviations; and ways of speaking, reading, writing, and arguing that are specific to mathematics" [21:448]. This research is an attempt to get insight on how are the students that are classified as very weak in all these aspect of language skills in the language of instruction are learning mathematics in English. In particular, the study concentrates on the case of bilingual Arabs university students who were classified as very weak in English but are performing excellently in mathematics exams conducted in English. Specifically, the study looks into the perceptions of this class of students with regards to language switch, and the impact of the language switch in their mathematics understanding, thinking and performance. Furthermore, the study reported the challenges the students faced in learning mathematics in English as well as the learning resources that might have helped them to overcome the challenges.

Twenty three students classified as very weak in English with an outstanding performance in mathematics exams conducted in English participated in the study. An open-ended survey was designed and published on the web for the students to respond at their convenient time. E-mail was send to these students inviting them to visit the link and respond to the form. Two reminders were sent to them after the first announcement. The purpose of the exercise was stated clearly to the students, and they were given the options to answer the questions in either Arabic or English.

A. What do I mean by weak in English?

KFUPM admit more than one thousand five hundred students every year. This is usually among the top twenty per cent of the applicants to the university. On the first week of their arrival, students take English qualifying exams. The result is roughly divided into three: Those classified as proficient in English to the KFUPM requirement, usually around 7%; those that are partially proficient, around 13%; and those that are classified as weak in English which account for almost 80% of the admitted students (see [2]. In this study, very weak in English means those students that are at the bottom of the 80% that the results of the qualifying exams classified as weak.

B. What do I mean by mathematically intelligent

Students admitted into KFUPM take two pre-calculus mathematics courses as they undergo the English training. The mathematics courses are taught in English. In this study mathematically intelligent here means any student who obtained grade B+ and above in the first prep year mathematics. These are usually the top 30th percentile.

V. Results and Discussions

As stated earlier, this paper emanate from a heartfelt personal encounter with a phenomenon that seems contradictory with the Cummins' Threshold Hypothesis. This is a case of a student that believes on his strong talent in mathematics, but challenged with lack of proficiency in the new language of instruction – English. After his triumphant success in mathematics exams that was conducted entirely in English, I arranged an interview with Hassan to investigate the challenges he faced in learning mathematics in English, as well as the "survival of the fittest" strategy he used to pass his mathematics exams despite his weak English background. The outcome of that interview revealed to us that the major challenges that Hassan faced in his first semester at the university were:

- *language barrier*
- *Away from parents*
- *Feeling shy for not understanding English language*
- *Feeling shy to ask questions in class.*
- *Knowing the answer but not knowing how to say it in English.*

It was noticed that four out of the five major challenges that Hassan faced in his first semester were related to his lack of proficiency in the new language of instruction. Consequently, twenty three other similar students were sorted out to validate the findings in the Hassan case.

Here, we present and discuss the responses of these students to the series of open ended questions in the three broad areas of the study. Since the survey was open-ended, the responses go beyond our questions, and hence the data collected also revealed the mathematical beliefs of some of the students as well as the political side of the language of instruction. Now the findings:

A. *Perception of the language switch from Arabic to English*

Many researchers encourage the use of the learners' home language for teaching and learning of mathematics until the students developed reasonable proficiency in the language of instruction (see [21], [22]). Since the participants in this study were not given that chance, part of what this study explores is their perceptions of the sudden language switch from Arabic to English. We want to know their opinion if this sudden change has any impact on their: a) understanding of mathematics, b) performance in mathematics, and c) mathematical thinking and problem solving. The results in these three aspects are as follows:

1. *Effect on students' understanding of mathematics*

It was reported that students' level of proficiency in the language of instruction has an effect on their mathematical reasoning and in fact general cognitive activities (see [23] for review). We therefore asked the participants if their lack of proficiency in English affects their understanding of mathematics. Majority say YES (50%), while 45% do not think so, with only 5% undecided. Some of the responses of those that say YES include (Where R.n indicate a response of a participant number n):

R.7: "Because participating during the class time is major factor in the understanding process."

R.14: "I can't understand the professor in some problem. But with preparing before the lessons this problem will disappear."

R.16: "My attention will be increased if the explanation was in my Mother language."

R.19: "I can't understand the very long questions and some word from the doctor."

R.21: "There are some new vocabulary I couldn't understand during the lecture."

R.13: "I am facing some problem with understanding the teacher and understanding the material."

On the other hand, the responses of those that think their lack of English proficiency did not affect their understanding include:

R.2: "I don't think so, because Numbers are a very well-known language."

R:12: "No, But if the exam contain some new vocabulary, the answer is yes."

R:18: "No because I won't let any information or word without understanding it."

R.10: "There is a huge dictionary in the pyp [prep year program] math website for the math terminology. Main point is to understate the instructors' language."

However, most (65%) of the participants agreed that their understanding of mathematics would have been better if they were taught in Arabic, while a good number of the participants (45%) are of the opinion that they do not think that their performance could have been different. And certainly, this percentage of those with later opinion (45%) is higher than what we anticipated.

2. *Effects on students' performance*

In terms of assessment, it was reported that one of the factors that contributes to differences in students' performance is linguistic [24]. And there is a connection between students' proficiency level in the language of instruction and their mathematics performance ([25], [26], [2]). Some other studies have shown that sometimes students skip a question in exams because they do not understand the meaning of a key word in the question

[27]. This certainly has consequences on students' assessment. As a result, the participants were asked if they think their lack of proficiency in English affect their performance in mathematics at the Prep Year. The result shows that the respondents were sharply divided. However, majority are of the opinion that their lack of proficiency in English does affect their performance (50%), while others say they don't think so (40%), with (10%) undecided. Some of the responses of those that say their lack of proficiency in English have affected their performance include:

R.4: "Some questions depending on Understanding the meaning."

R.3: "I remember in one final exam I faced one vocabulary I didn't understand, so I couldn't solve this question."

R.?: "Because if I found one new vocabulary I wouldn't understand the problem."

R:5: "Some time I couldn't understand the problem and not solve the problem"

R.6: "Some time I found some difficulty in understanding some new vocabulary."

R.22 "It lost me 7 marks!"

However, when asked if they think they can do better if the exams were in Arabic, most (60%) of the students do not think so with (30%) who are of the opinion that they can do better if it were in Arabic and 5% are undecided. It should be noted that this are high performing students that are on the average A-grade students in mathematics exams. So, very few ambitious ones can think of getting better grades

3. Effect on mathematical thinking and problem solving

As it was reported that students' level of proficiency in the language of instruction has an effect on their mathematical reasoning and in fact general cognitive activities, the respondents were asked the language (Arabic or English) they use in their mathematical thinking during mathematics problem solving. Surprisingly, most of the respondents reported that they think mathematically now in English most of the time (60%). Only 30% of the respondents claimed that they think in Arabic then translate into English, with about a 10% undecided.

However, some respondents indicated that during their high school - when learning was in Arabic, they think in Arabic, while now that medium of instruction is changed to English, there was a switch in their mathematics thinking as well to English.

R.13: "In Arabic before I enter the university but English after I enter the university."

R.14: "In the university I am always think in English."

It is interesting that even those that say they think in English some indicated that they sometime switch back to Arabic when they are stuck:

R.1: "I think in English but if there is problem, I will switch to Arabic."
R.10: "Usually I think in English but sometimes I think in Arabic"

Similarly, those that think in Arabic also indicated that they sometime switch to English as the need arises.

R.12: "Some time in English but in Arabic most of the time."
R.15:"I don't change the terminology but I think in Arabic."

This seems to show the flexibility of the human cognition, and seems to be in support of the argument that bilingual students that were taught in their L1 develop higher order cognitive and linguistic skills known as Metalinguistics in addition to L1 skills ([5], [12]). These skills is reported to consequently transfer to the L2 leading to its development and also development of Metacognitive abilities [12].

B. *Challenges of learning mathematics in English*

It is a fact that many students face challenges while learning mathematics. This challenge is likely to be more compounded if the learners are bilingual who are at the early stage of acquiring a language of instruction. Here, they have to cope with the tasks of learning a new language as well as that of learning to understand the special terminologies and syntax of mathematics in the new language ([28], [29], [25], [22]). More interestingly are the participants in this study who despite their language deficiency, are doing exceptionally well as if there were no problem. However, they still narrate their experiences.

Top among the challenges that this class of students reported is "demanding course contents" (43%). This is understandable from two perspectives: First from the mathematics side; the treatment of the content, though not new, but is much deeper and faster than what they were used to in high school. On the other hand, there are high chances that most of the respondents considered prep year program in general rather than mathematics program as in the questions. In this case, they might include twenty hours of English course per week that leave very little time for students. In either case, most of the respondents considered that as a challenge.

However, relevant to this study is the fact that second top among the challenges of the participants is the "weakness in English" (38%). With regards to this, some of the participants have the following to say:

R.1: "My weakness in the English is the main challenge facing me which force me to study hard in my room."

R.5: "My major challenge is English."

R.10: "My language wasn't good when I started studying at KFUPM."

R.21: "My major challenge is English and some problem with my eyes."

Similar to what was reported in [26]. In particular, most of the participants in this study rated mathematical Vocabulary (41%) as the most problematic among the language factors. This is followed by the mathematics semantics (32%), mathematics syntax (17%), and mathematical concepts (10%). No students reported having any problem with Mathematical Symbols. This hierarchy of difficulty level seems to make sense for this class of students. They need to understand the vocabularies in order to understand the sentence, and they need to understand the semantics and the syntax of the sentences to make sense of the definitions, theorems and rules, which are the concepts.

The participants were asked to elaborate on the way their lack of English language proficiency actually hinders their learning of mathematics. Some of the issues they raised can be categorized into two: Lack of classroom interactions, and conflicts between Arabic and English. We look into each to see the participants' responses.

1. Lack of classroom interaction

According to some of the respondents, their language deficiency has limited their class room interaction. Some of the respondents submitted:

R.4: "My lack of proficiency in English limited my participation in class"

R.8: "You can't participate with your teacher during the class."

R.17: "I can't understand some word during the lecture and I can't participate in the class."

Similar finding of lack of classroom interaction due to lack of proficiency in language were reported by some other researchers ([29], [22]). In particular, Riodria [26] submitted:

> The main problems they encountered were in understanding the lecturers/tutors, as well as comprehending the content of the modules. This in particular was in relation to the mathematical terminology in use in these modules, which led to confusion and misunderstanding (p. 80-81)

2. Conflict between Arabic and English

Another peculiar problem reported by some of the respondents is conflict between Arabic and English; this is in all the language skills: Writing, Reading and Speaking, as well as in Calculation. This has to do with the major linguistics differences between Arabic and English. At least the writing in Arabic is from right to left, while in English is from left to write which create some confusion to some of the students [22]. This includes for instance what some students reported below:

R.2: "At the beginning but not now. I remember one time I confuse between 5 and 0."

R.11: "When I start from right side of the page."

R.17: "The place of the sign [positive or negative], which change the answer 180 degree."

I have reported this in greater details in [3] and [30]. In particular, some respondents reported that they found difficulty in reading mathematics in English, especially at the beginning. They said:

> R.1:"It was hard at the beginning, but it become easier with time."
> R.3: "Hard and not understandable."
> R.3: "Medium to difficult some time."
> R.8: "I face some difficulty sometime."

Similar finding was reported by [26] where she concluded:

> Overall, the respondents found studying through the medium of English difficult, with two of the participants quoting it as being "extremely difficult (p. 80-81)

C. ***Learning Resources that might have helped the students to overcome the problem***

Different students utilize different learning resources; therefore, it has been call upon to investigate the resources that bilingual or English learning students use for mathematics reasoning [11].

The participants were asked on what were the learning resources that might have helped them to overcome the challenges. The summary of the responses are as follows:

a) Student commitments - 29%
b) Adequate instructional materials – 17%
c) Competency of the instructors – 17%
d) Strong desire to succeed in life – 8%
e) Good background in Mathematics – 8%
f) Strong interest in Mathematics – 8%
g) Allah's guidance – 8%
h) Self-confidence – 5%

However, looking into the data more closely, we were able to get more insight and better interpretation of the data. Earlier in the survey, the respondents were asked to rate themselves in a scale of 10 as per their proficiency level in Arabic, English and mathematics respectively - where one means very weak and ten means excellent. The respondents on the average rated themselves as 8.8, 8.55 and 5.7 out of 10 in Arabic, mathematics and English respectively.

As can clearly be seen, the respondents confidently reported high proficiency level not only in Arabic but also in mathematics, which they previously learned in Arabic. The difference between the three factors is found to be statistically significant ($F=5.659>3.150$). And the difference is statistically significant only between Arabic and English and between Arabic and mathematics, but not between Arabic and mathematics.

In line with the Cummings' Interdependence Hypothesis that suggests that the students level of proficiency already achieved in their first language (Arabic in this case), have an influence on the development of the student's proficiency in their second language (English in this case). Not only that, the greater the level of proficiency achieved by the students in their first language, it will allow for a better transfer of skills to the second language.

This strong background in mother tongue (Arabic), and the strong background in mathematics, which was also taught in Arabic might be part of what minimizes the transitional challenges of the switch of the language of instruction from Arabic to English. And hence, this might be the major resource (perhaps unknown to the students) that is helping them to quickly adjust to the new language of instruction. Some other studies have strongly alluded to this. For instance, according to Freeman and Freeman [20], due to already developed academic language and skills in L1, this class of students have the potential to catch up academically at a relatively fast pace. Freeman and Freeman [20] concluded that students' L1 academic knowledge which develops through formal education can significantly benefit the English language learners' academic performance in their L2 in two ways: First, it provides the academic content knowledge which can help these students to develop academic language proficiency and academic achievement in L2. Second, it develops the literacy skills in L1, which can transfer to L2. Other studies have shown that this high performing bilingual students who have strong background in their first language, and are now learning mathematics in their second language, make good use of their two languages and develop Metalinguistics skills that give them not only the skills to tackle problems, but the confidence in their approach to solving difficult problems [12]. This explained the resources this class of students is perhaps utilizing.

It is interesting to see that top among the factors that that the respondents reported that contributed to their success is their "commitment to their studies". This coincides with the necessary conditions stated by Cummins [31] for a proper transfer to take place from L1 to L2, which is "adequate motivation to learn in Ly". Other factor mentioned by the respondents that contribute to their success is "competent instructors and sufficient reading material". This is also in line with the necessary condition of the transfer as stated by Cummins [31] and that is "provided there is adequate exposure to Ly".

Some other factors mentioned by the respondent that help them to success in mathematics despite their weak background in English include: "good background in mathematics", "strong desire to succeed", and "God guidance". It is interesting that strong background in mathematics is among the last factors that the respondents reported. It is also surprising that in deeply religious country like Saudi Arabia, God guidance is also coming also at the end.

One other factor reported by the respondents is the role of teacher in students' performance. From the response of the students, it appears that this class of students considers teachers as one of the major resources for their success. It is interesting that the respondent consider teachers support as second to their commitments among the top on the list of factors that contribute to their success. It has been noted that many students acquiring English receive little encouragement to speak about their ideas, in part due to the belief that they will find it too difficult to express themselves [32].

D. *Additional Findings*

As the survey used in this study is open-ended, more information can be deciphered from the data. Two prominent ones among them are the Students Mathematical Beliefs, and the political dimension of language of instruction. We give a brief on each.

1. Students Mathematical Beliefs and Conceptions

Studies have shown that students have many different views about mathematics. These conceptions not only guide students on studying mathematics but also determine what mathematics is all about for them ([33], [34], [35]). In their response to the question if they think their lack of proficiency in English affect their performance in mathematics, some of the response of those that say NO includes:

R.2: "As I mention before Math is unique language."
R.9: "I think Math doesn't depend on language."
R.12: "I am weak in English and I didn't face any problem with math."
R:20: "There is no link between the English and calculations."
R.20: "There is no relation between math and language."

R.11: "Math is language of number, and learning math terminology is easy."

R.15: "Math is language of number neither English nor Arabic, Understanding depend on analyzing."

From these responses, it is clear that these students could not see any connection between mathematics and language. Consequently, could not see the rationale behind the survey. Students with such conception of mathematics are likely to be from what Skemp [36] called instrumental view of mathematics, or what Earnest [37] call Absolutist. According to this school of thought, mathematics is 'abstract', consists of immutable truths and unquestionable certainty and hence removed from human activity and the context of everyday life [38]. Therefore, mathematics is a game that all that you need to do is to know the "tricks" then you will succeed. Students with this conception are unlikely to connect their mathematics problems with lack of proficiency in the language of instruction. Riodria [26] concluded:

> However, given the large emphasis that all the subjects placed on mathematics terminology it was surprising that the majority of them did not perceive language as a component of mathematics. Perceptions of mathematics ranged from "just solving stuff", to "loads of formulas for solving problems" to "figures and computations and working out answers". (p.82)

Studies have consistently shown that perhaps as a result of this misconception, this class of students might be ignorant of what they are missing due to lack of proficiency in the language of instruction (see [39].

2. Political side

It has been argued that some influential decisions in education, such as curriculum development, assessment and selection of language of instruction are not free from politics [21]. Drawing from the work of many researchers, Setati [21] concluded that language is always political and a determining factor of power and 'often defines adherence to group values' (p. 451). The respondents were asked if they think they could understand mathematics better if they were taught in Arabic? Most respondents agreed that their understanding of mathematics would have been better if they were taught in Arabic (65%). Then we asked them if they have a choice, which language of instruction will they prefer now between Arabic and English? Surprisingly, most students prefer to learn mathematics now in English than in Arabic. Some of the response reads:

R.4: "Yes, but I prefer it in English with its hardness."
R.2: "No, and I think it will be better in English to help student to be familiar with

university."

R:14 "Yes a little bit. But The English is better because the university depending on English."

R.17: "For sure, but it wouldn't help me to success on my educational life."

R.18: "Not that much, because the university depends on English."

R.5: "Very useful. The English language is now the language of the world. Most of the writers, researchers and scientists write their books in English. It is noted that if a student wants to expand and in-depth research in one of the lessons, most probably are that he'll find it in the English language."

R.14: "It help in improving my language it gave me a new and different way of thinking."

The responses indicated a dilemma between epistemological access and socio-economic access. A similar dilemma was reported by Setati [21] for a teacher Kuki. Setati found that teacher Kuki was in a tension between the status of English and Setswana. In particular, "Kuki is expressing a tension, in wanting to honor the African language on the one hand and on the other hand ensuring that the learners have access to English" [21:459]. A similar kind of tension was reported in Nigeria, where parents were not very keen in their children learning in L1 [40].

I have earlier speculated in another place [3] that the perception of the students to the language switch is most likely going to be either political or religious. However, none of the respondents reported the religious perspective, though I heard them opined it informally.

VI. Summary, Conclusion and Recommendations

The situation of bilingual Arabs students who are learning English at the same time learning mathematics in English is complex. King Fahd University of Petroleum and Minerals is a well-known English medium university in Saudi Arabia that is highly selective when it comes to admission. In spite, the failure rate in mathematics at the preparatory year ranges from 20% – 30% every semester. Each year, you find many "Hassans" among the admitted students, who came to the university confidently thinking that they are mathematical genius, but within a first week of classes they got confuse; their confidence shattered; and excommunicated mathematically. As Hassan said, it soon became a "do or die" affairs and a survival of the fittest. A good number of the students do survive the system, while some reasonable per cent got withdrawn despite the strong high school record.

In this study, Cummins Interdependence Hypothesis seems to give a better interpretation and understand on why large percentage (more than 70%) of the annually admitted students are surviving the system in spite of the fact that large percentage (around 80%) are annually classified weak in English. The reason is perhaps due to strong formal education this class of students had in their first language – Arabic.

Although the participants in this study are high achievers in mathematics, many are of the opinion that the language switch has some negative effect on their understanding and performance in mathematics. Most also agreed that they could have learnt more mathematics in Arabic, but they prefer learning mathematics now in English than in Arabic. This highlight the political side of the language issue (see [21]).

Surprisingly, most of the students reported that their mathematical thinking is now more in English than in Arabic. Similarly, some of the students reported that they had conflict between Arabic and English while doing mathematics. This is in writing, reading and speaking as well as in calculation. But largely at their first semester, and substantially reduced with time.

The following recommendations will go a long way in minimizing the students' problems.

A. *For Research*

As stated earlier, not much is known on how this class of students is coping with the language switch. Therefore, there is need for more research in this area and context. The initial findings in this study confirmed the findings of many similar studies, and paves way for further investigation in the area. In addition to looking into other issues related to language in general, we would like to replicate this study with average and low performing students. This will certainly complements and provide more complete picture of the situation.

B. *For Learning*

Despite the fact that the perceptions of most the respondents is that the change of language of instruction from Arabic to English has negative impact on their mathematics understanding and performance, most would like to continue with the English as a language of instruction rather than going back to Arabic. This confirms the preference of economic benefit to the epistemology. With this interest in English, students will likely put more efforts to overcome the difficulty associated with lack of proficiency. However, the students need to be aware of the connection between language and mathematics. This will go a long way in making them have a correct belief as well as positive attitude towards learning mathematics.

C. *For Teaching*

Findings in this study indicate that teachers have a role to play in developing the confidence of the students with deficiency in the language of instruction. It is not enough to be aware of the difficulties these students are passing through; rather, a conscious effort must be made to carry them along in the classroom activities. Therefore, teachers should initiate discussion in the class and should encourage weak language students to participate in classroom discussion.

> In addition to simplifying oral language, teachers should expand on student responses and build on those when posing their next question. Some students pass through what is known as a silent period when they are just beginning to learn a second language; during this time, they are listening and trying to make sense of the rules for conversation in the classroom as well as in the larger world. Teachers will need to give students time and look for nonverbal clues as to whether they understand the gist of the lesson" [32].

D. ***For Policy makers***

As for the policy makers, there is a need to do a serious background studies before taking a major educational decision like changing the language of instruction. I have argued in another place that for a successful transition,

> Perhaps, what is required in this context is to conduct a thorough investigation of language as it relates to this class of students. Then, a detailed instructional strategy should be developed based on the results of these studies. These instructional strategies must take into account the common learning process of these students. Moreover, the learning process should aim at developing students' English and mathematics abilities at the same time (Secada, 1992). This kind of approach will hopefully provide the learner with socio-economic as well as epistemological access (Setati, 2005), and will take care of the caveat posed by some researchers concentrating on one aspect (Morgan, 2007). While doing that, the system must learn from the results of various research and practices conducted on bilingual education over a long period of time in the US, Canada, Australia, New Zealand and South Africa. After that, it should be evaluated periodically [3:924].

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