AN ETHNOGRAPHIC RESEARCH:

THE CULTURAL PORTRAITS OF MIDDLE SCHOOL MATHEMATICS CLASSROOMS IN AN INTERNATIONAL SCHOOL

by

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ABSTRACT

The reality that classrooms are becoming more multicultural each day, partly due to globalisation, has changed the classroom cultures from the way they were in the past. Classrooms in international schools are extreme examples of this change. The purpose of this ethnographic study was to describe the formal mathematical enculturation of the middle-school students in an international school. It examined the entire academic year during the on-going creation of a specific mathematical culture within the classroom and revealed and portrayed how each of its members defined, maintained, and shared the unique mathematical culture of the classroom.

Ethnomathematics and mathematical enculturation theories, as well as mathematics as a component of culture became the foundations of this study, providing invaluable contribution in explaining the mathematical culture of the research setting.

This study sought answers to questions starting with "how" and "what" instead of answers to questions that start with "why". The best qualitative approach to describe the everyday life of participants in this particular research was through ethnography. The quantitative analysis was used to supplement the findings.

The data obtained from this study proved the dynamic nature of the creation of the culture in an international school mathematics classroom. Thus, the central theory of this study, Bishop's (1988) mathematical enculturation – was verified in terms of its ability to

describe the mathematics culture of an international school and to explain the approaches of students to enculturation and acculturation processes.

ÖZET

Günümüz dünyasinda sinif içi kültür, küresellesmenin de etkisi ile geçmis yillara göre büyük degisim göstermektedir. Bu degisimin en yogun olarak yasandigi siniflar uluslararasi okullarda bulunmaktadir. Bu etnografik çalismanin amaci, uluslararasi bir okulun orta okul matematik siniflarindaki matematik kültürlenmesini betimlemektir. Bir akademik sene süresince yaratilan matematik sinifi kültürü incelenmis, ögrencilerin kendi özel sartlarinda yarattiklari sinif içi matematik kültürünü nasil yorumladiklari mercek altina alinmistir.

Etnik Matematik (Ethnomathematics) ve Matematiksel kültürlenme (mathematical enculturation) teorileri ile matematigi bir kültür ürünü olarak gören yorumlar bu çalisma sonucunda ortaya çikan veriyi açiklamakta arastirmaciya büyük kolayliklar getirmistir.

Bu tez, "neden" sorularina degil, "nasil" ve "ne" sorularina yanit aramakta oldugundan nitel analiz metotlari içerisinde günlük hayati açiklamakta özellikle basarili olan ethnografi yöntemini kullanmistir. Tezin nicel yönü, sadece destekleyici mahiyette kullanilmis, ulasilabilen deneklerin sayica azligi bu kararda önemli rol oynamistir.

Arastirma sonuçlari göstermistir ki, uluslararasi okullardaki matematik sinif kültürü dinamik bir yapiya sahiptir. Bishop'un (1988) mathematical enculturation teorisi bu özel durumu açiklamakta oldukça basarili olmustur.

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LIST OF ABBREVIATIONS

IB	International Baccalaureate
IBO	International Baccalaureate Organisation
ISGI	International Survey of General Information
IT	Information and Technology
ESL	English as a Second Language
ETS	Educational Testing Service
MYP	Middle Years Programme
PYP	Primary Years Programme
VAMP	Values and Mathematics Project

1. INTRODUCTION

People share beliefs, social values, and understandings about life. They agree on sets of laws and behavioural rules to shape their society's culture in terms of traditions, customs, and laws by using a common language and common symbols. What happens among students, together with the teachers in today's classrooms is much the same. Not much time has passed since the notion of "a classroom as a society" became an issue in the theoretical discourse of mathematics education and a basic unit for analysis of classroom interaction to provide deep insight into teaching and learning mathematics in school (Cobb & Bauersfeld, 1995; Lampert & Blunk, 1998; Voigt, Seeger, & Waschescio, 1998, cited in Ju, 2002).

When people from different cultural backgrounds come together, they agree on new rules, new values, and new norms to build a peaceful intercultural environment, which may not occur without putting forth some effort. The effort required may be more than expected since some aspects of every culture are on the visible part of the "iceberg" (Fennes and Hapgood, 1997) or "onion" (Hofstede, 1997), such as its laws, rules, language, and symbols, while others are hidden beneath such as traditions and habits. (Allan, 2002, p. 42).

Many researchers today believe that mathematics is not the language of the universe, as it was once thought to be, but embedded in a cultural context to give mathematics its purpose and meaning (Wiest, 2002). Barta (2001) claims mathematics is a reflection of the culture of those using it, and according to him we should use this knowledge to understand the people with whom we share the planet. In the end, he suggests mathematics may provide an opportunity to create healthy connections among different cultures.

The reality that classrooms have become more multicultural each day, partly due to globalisation, has changed the culture of the classrooms from the way they were in the past. Classrooms in international schools are extreme examples of this change. This new situation requires instruction to be differentiated in terms of content, level, and teachers'

approaches towards student learning. A "one-size-fits-all" type of school offering mathematics puts many students at marked number of disadvantages.

Sims (2000), however, conducted a similar study on high school students, which was purely qualitative and found that there was still a need for further research on the enculturation of mathematics classes in international schools. Furthermore, the exploration of the relationship between mathematics and culture is crucial for successful teaching in the mathematics classrooms in modern societies.

With this in mind, the purpose of this ethnographic study is to describe the formal enculturation of the middle-school students studying mathematics in an international school. It examines a specific interval of time during the ongoing creation of a specific mathematical culture within the classroom and reveals and portrays how each of its members defines, maintains, and shares the unique mathematical culture of the classroom. At this stage in the research, the enculturation taking place in the mathematics classroom will be generally defined as "… a creative, interactive process engaging those living the culture with those born into it, which results in ideas, norms and values which are similar from one generation to the next but which inevitably must be different in some way due to the re-creation role of the next generation" (Bishop, 1988, p. 88).

Due to the small size of the classes in international schools, when any student joins or leaves a class, it has a major effect on the enculturation process. Moreover, the transition through the generations is accelerated because of the transient nature of international school students.

The following is therefore the central question:

- How might formal enculturation of students in middle-school mathematics classes in a certain international school in terms of ideas, norms, and values be described and interpreted?

The sub-questions are as follows:

- What is the social situation to be studied?
- How do the students approach the enculturation process?
- How do the students approach ethnomathematics?
- What impact does the acculturation process have on the mathematical enculturation of the students?
- What beliefs, norms, and values do the students possess related to mathematics?
- What is recorded about this process?
- What is observed about this process?
- What categories emerge from these observations?
- How does the researcher write the ethnography?
- How does the quantitative analysis of the teacher's assessment relate to the finding of the qualitative analysis?
- To what extent does the teacher share the values of the culture into which he is acculturating the young, in terms of curriculum, textbook, teaching styles, and interactions with the pupils?

2. LITERATURE STUDY

2.1. Enculturation and Acculturation

As they are referred to in many articles and studies, enculturation and acculturation (including the related terms such as integration, assimilation, separation, and marginalisation) are all about the relationship between the change and the culture. The differences basically lie in the outcome, subject, and degree of change.

Mead (1963, p. 187) defines enculturation as "the process of learning a culture in all its uniqueness and particularity". Umorem (1995) takes Mead's definition one step further by emphasizing that the process is a life-long one with learning occurring from infancy until death. He argues that the contents of this learning include values, attitudes, beliefs, etc., as the material components, and artefacts such as a hoe or a mask, as the non-material component. Enculturation is simply the socialisation process of a newcomer with a blank cultural history into an already existing and developed culture. However, the existing culture should not be perceived as a stable and non-changing culture, because this process over time will change the culture itself, too. As Bishop (1988) explains,

> Enculturation ... is a creative interactive process engaging those born in it, which results in ideas, norms, and values which are similar from one generation to the next but inevitably must be different in some ways due to the re-creation role of the next generation (p. 88).

Enculturation helps a society preserve its core beliefs and values, helps the learner be an acceptable member of the society, and acts as a protection that minimises the effects of change on the society.

Acculturation, on the other hand "… comprehends those phenomena which result when groups of individuals from different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups" (Redfield, Linton, Herskovits, 1936, p.149). The acculturation concept has a long history indeed, going back to Plato. "[Plato] … recommended that foreign visitors be restricted to the port, outside the walls of the city, so that cultural contamination might be minimized"

(Rudmin, 2003, cited in Lonner, et.al, 2006). According to Rudmin (2003), Plato argued that acculturation should be minimised so that there would be less likelihood of learning bad foreign ways. It is not difficult to understand Plato's point of view, since the change in society due to acculturation is harder to control than the change due to enculturation over time, and it may be uncomfortable for some members of the society, since the consequences of this contact are usually unexpected, unpredictable, and often rapid.

A more contemporary approach of Kim and Omizo (2006) rejects the traditional understanding of enculturation being subsumed under the construct of acculturation. Kim and Omizo, who quote Kim and Abreu, define acculturation "as the process of adapting the norms of the dominant group where else enculturation is the process of retaining the norms of the indigenous group" (Kim & Abreu, 2001, cited in Kim & Omizo, 2006, p. 247).

> Integration occurs when an individual becomes proficient in the culture of the dominant group while retaining proficiency in the indigenous culture; this status is also known as biculturalism. Hence, individuals in this status are both highly acculturated and strongly enculturated. Assimilation occurs when an individual absorbs the culture of the dominant group while rejecting the indigenous culture. Hence, individuals in this status are highly acculturated, but not enculturated. Separation occurs when an individual is not interested in learning the culture of the dominant group and wants only to maintain and perpetuate the culture of origin. Hence, individuals in this status are strongly enculturated, but not acculturated. Finally, marginalization represents an individual with no interest in maintaining or acquiring proficiency in any culture, dominant, or indigenous. Hence, individuals in this status are neither acculturated nor enculturated (Kim & Omizo, 2006, p. 247).

Bishop (2001b) claims it is the person's own perception that decides whether this experience is mathematical enculturation or mathematical acculturation. According to Bishop's (2001b) understanding of mathematical acculturation, many young people in the world experience a dissonance between the cultural tradition outside the formal educational institution (for example in their home, or in their previous cultural environment) and that represented inside the institution.

Figure 2.1 summarises the relationship between enculturation and acculturation as it is understood by the researcher of this study. The process of the vapour particles turning into water form represents one dimension of students' enculturation as a new experience to be learnt. Water particles mixing in and forming a pond represents the other dimension, which is specifically called the acculturation into a new situation. Students mix in and

create a class with other students with different previous experiences, who are also new, or some who have been there for a longer time.

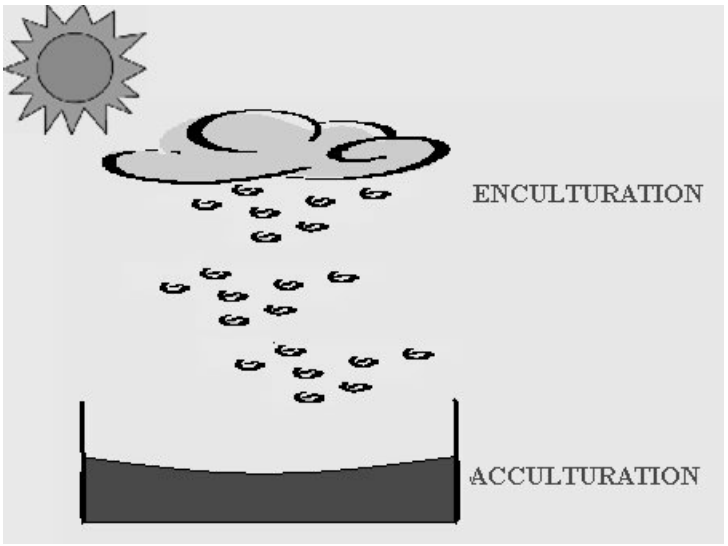

Figure 2.1. Enculturation/Acculturation

The water particles in the pond still preserve their identity as water, but they are changed into something else by mixing in, say, a pond. In the same way, the students' home culture and the new culture they are acculturating into change the way they are but still preserve their identity. In the figure, the sun naturally represents the cause of the dynamic nature of both of these concepts, where reversing is always possible during or at the end of this process.

In terms of this study, the acculturating experience of the participants is a part of their mathematical enculturation adventure. Thus, the process of enculturation will not stop until they die.

2.2. International Schools and the IBO

Today, international schools are spreading all over the world, offering a multi-cultural K-12 education, mainly for the children of expatriates of their host country.

According to Murphy (2003), the foundation of these schools lay on the desire for an education across the borders to help the adults of tomorrow learn to live peacefully. "… the expansion of world markets brought a sharp increase in foreign travel for globalization, mostly Western … this fact, and the desire of the non-English-speaking world to learn enough English to share in the wealth created in this new economic order …" (Murphy, 2003, p. 48) sounds like a stronger reason behind the existence of international schools than the former.

Malpass (2003, p. 44) says international schools "… illustrate the revolution in education that has occurred over the past few decades" and argues that this revolution took place in the way curricula were structured, in the way material was presented, and in the involvement of students at all levels of the learning process. He accepts the criticism that these elitist schools are exceptions but says they exemplify the ideal schools of the future.

Increasingly, more international schools today use the services offered by an organisation called the International Baccalaureate Organisation (IBO). The definition of International Baccalaureate (IB), the programme offered by the organisation of the same name, is hidden in its objectives stated as follows:

> The aims of IB have always combined the practical and the idealistic—practical, because pupils who come to international schools need to leave with qualifications that are accepted back home—idealistic, because having young people of different nationalities studying together can help to keep the world peaceful (Daniel, n.d.).

Today, according to the IBO's official website, there are 1900 national and international schools all around the world applying one or more of three programmes offered by the IBO.

2.3. Mathematics in IB (MYP)

The Middle Years Programme (MYP) is a five-year IB programme that covers grades 6 through to 10. The programme is flexible in the way that the courses are organised by the school. However, the framework being advised in the MYP Mathematics Guide Book follows a common understanding: the basics of elementary mathematics; such

as numbers, algebra, geometry and trigonometry, statistics and probability, and discrete mathematics (2000, p. 10). The guidebook requires that the teacher embed the three fundamental concepts of MYP in the instructions, which are basically holistic learning (integration of maths to other disciplines), intercultural awareness (how cultural forces lead to developments in mathematics), and communication (universality of the language of mathematics) (IBO, 2000).

2.4. Enculturation of Members of International Schools

Merryfield says many scholars in multicultural education believe that our world's future rests upon the abilities of young people to interact effectively with people different from themselves. (Banks & Banks, 1995; Carnoy, 1974; Case, 1993; Cushner, McClelland & Safford, 1992; McCarthy, 1990; Rennebohm-Franz, 1996; Slavin, 1992; Sleeter, 1996; Zeichner, Grant, Gay, Gillette, Valli & Villegas, 1998, cited in Merryfield, 2000). She found out that many researchers do not believe that the teachers of today are prepared to teach in diverse classrooms, challenge inequities or even recognise the effects of internationalism in the lives of their students and communities. (Grant, 1992; Ladson-Billings, 1994; Merryfield, 1991; Sleeter, 1992, cited in Merryfield, 2000).

Specifically teachers in the field of international education are not trained to teach in international schools, but have started their careers in regular schools in their home countries (Oord, Kranenburg, 2004). Research conducted on educators teaching students from diverse cultures shows that a period of enculturation is necessary before teachers can expect to become effective in their classes. (Pepin, 1998). However, a good thing for teachers is that the students at international schools within this respectful relationship, understand the difficulties that their teacher is going through, and do not to take advantage of the teacher or dislike the teacher because of her uncertain, dissatisfied, or admonishing behaviours (Oord, Kranenburg, 2004).

What all members of an international school share in common is the fact that the conditions are different from what they are used to. The expatriate students and teachers have to survive under the influence of at least three cultures: Their own culture, the international culture of the school, and the culture of the country hosting them, where the

outcome is a possible cultural dissonance. The dissonance theory says: "The existence of dissonance, being psychologically uncomfortable, will motivate the person to try to reduce the dissonance and achieve consonance. … the person actively avoids situations and information which would likely increase the dissonance " (Festinger, 1957, p. 3).
A response to this kind of a dissonance is possibly to develop different sets of behaviours in school, at home or on the street, thus having multiple identities, which Stryker calls "situated identity" (1980).

If social contact between students who have had little previous contact is to be positive, Bennett (2001) talks about four basic necessary conditions in his explanatory article of Social Contact Theory:

> … (a) opportunities to become acquainted and develop friendships; (b) equal status among students from the different groups; (c) experiences that require inter-group cooperation to achieve a common goal; and (d) authority figures who encourage, model, and support comfortable inter-group contact and relationships.

Murthadra-Watts and D'Ambrosio (1997) suggest students sharing their life experiences, which may serve as starting points for teaching critical thinking, analysing oppression, and alternative viewpoints.

In general, the aspects of the school culture may be manifested in many ways. Allan (2002, p. 42) lists these aspects as the status of languages, and their accompanying cultures, the school ethos, management culture, teaching and learning styles, use of different cultural contexts in the curriculum, ideas of behaviour, discipline, and pastoral care. These are all difficult challenges for newcomers joining the unique culture of the school. In an international school, enculturation is a serious concern of every member of the community. Moreover, this enculturation period may be long and tough for all parties since the culture in these communities is unique, created differently each time. The main common point among international schools is that they are all different from one another, and the change never stops (Corlu, 2005).

2.5. Mathematics as a Component of Culture

On many occasions throughout history, mathematics was created as a solution to practical problems. "Human beings everywhere and throughout time have used mathematics" (Bishop, 1991) and it became a vital aspect of their culture. Barta (2001, p. 305) says "mathematical principles may not in and of themselves be cultural, but as soon as human beings use those principles, what is done becomes culturally influenced".

Ladson-Billings (1997) criticise those who suggest that mathematics is *culture free* and that it does not matter who is doing mathematics. He says "… these are people who do not understand the nature of culture and its profound impact on cognition" (Ladson-Billings, 1997, p. 700).

Barta (2001) claims that mathematics is an innate ability we all possess but develop in different directions and a language we all speak but in different dialects. Some other authors even reject the universality of mathematics. Many researchers today believe that mathematics is not the language of the universe, as it was once thought to be, but embedded in cultural context to give mathematics its purpose and meaning (Wiest, 2002).

D'Ambrosio (1985) disagrees that mathematics is the language of the universe. The evidence is based on research carried out by anthropologists who found that mathematical practices such as counting, measuring, locating, designing, explaining, and playing, (which are six universal behaviours found by Bishop (2001a) in which mathematics can be observed) were done in different cultures in radically different ways from those which are commonly taught in today's school systems.

> …cultural contexts establish a "mathematics mind-set" that varies among individuals from different subgroups; accordingly cultural norms and values influence mathematical activities, as well (Wiest, 2002, p. 49).

According to Hofstede (1997), values are the tip of the iceberg for culture. Values determine one's behaviours or why one prefers certain states of affairs over others. Bishop (1988) without claiming the universality of his theory, lists six major values of mathematics as rationalism, objectism (later changed to empiricism (Bishop, 1991)),

control, progress, openness, and mystery. Further information on his project "Values in mathematical and Science Education" is given in Appendix G with the written permission of Prof. Dr. Alan Bishop.

Bishop sees mathematics as a *symbolic technology* (1988, p.82), as a way of using signs, techniques, procedures and the like in practise (Pinxten, 1994). According to Bishop (1988), just as each cultural group generates its own language, religious beliefs, etc., so too, it seems that each cultural group is capable of generating its own mathematics.

Guberman (1999) suggests "a culturally-relevant mathematics instruction" and Ethnomathematics offers several such suggestions for educators in the next section.

2.6. Ethnomathematics

Ju (Berger & Luckmann, 1966; Bloor, 1991; Joseph, 1994; Restivo, 1994, cited in Ju, p.6) refers to the studies of several researchers from diverse disciplines whose work has shown that knowledge is socio-culturally constructed. D'Ambrosio (1977) defines ethnoscience as the study of scientific and technological phenomena in relation to their social, economic and cultural backgrounds. One may ask the question whether mathematics is an exception for the studies of the researchers that Ju referred. D'Ambrosio's (1985) answer to this question together with, why "there has been much research already on ethno-astronomy, ethno-botany, ethno-chemistry and so on, [but] not much has been done in ethnomathematics" is probably because of the belief that mathematics is universal.

According to Hammond (2000) ethnomathematics is, "the study of the culturally related aspects of mathematics; it deals with the comparative study of mathematics of different human cultures, especially with regard to how mathematics has shaped, and in turn been shaped by, the values and beliefs of groups of people". (Hammond, 2000, p. 11)

Sleeter (1997) thinks ethnomathematics challenges the ethnocentric assumption that mathematics is largely a product of the intellectual work of Europeans. He claims

ethnomathematics derives from the study of the form that mathematical ideas interpreted in different socio-cultural contexts.

Joseph (1993) argues that disconnecting mathematics from history and culture supports the idea mathematics began with the Greeks and developed in Europe and the US, with minimal contributions from other civilisations. On the other hand, ethnomathematics should not be understood as the mathematics of African people, or Aboriginal people or other "traditional peoples" as Ascher (1998, p.188) names it. D'Ambrosio (2001) complains this point of view of the teachers who, "… usually refer to a culture's past and to cultures that are very remote from that of the children in the class" for making their lesson multicultural. Ethnomathematics can help teachers construct culturally relevant pedagogy to improve student achievement and motivation (Ascher, 1991; D'Ambrosio, 1990; D. M. Davidson, 1990; Gerdes, 1994; Wilson & Padron, 1994, cited in Sleeter 1997) and help us better understand the nature of mathematics but also better understand ourselves and the people with whom we share the planet (Barta, 2001). According to Barta (2001), understanding the evolution of mathematics may help students realise their role in this evolution by connecting mathematics and culture in the classrooms.

As a conclusion on this topic, D'Ambrosio (2001, p. 308) summarises ethnomathematics:

> Traditionally in mathematics classrooms, the relevance of culture has been strangely absent from the content and instruction. The result is that many students and teachers unquestioningly believe that no connection exists between mathematics and culture. Failing to consider other possibilities, they believe that mathematics is not cultural, a discipline without cultural significance.
>
> We can help students realize their full mathematical potential by acknowledging the importance of culture to the identity of the child and how culture affects how children think and learn. We must teach children to value diversity in the mathematics classroom and to understand both the influence that culture has on mathematics and how this influence results in different ways in which mathematics is used and communicated. We gain such an understanding through the study of ethnomathematics.

2.7. Cultural Specifics of Asian and Western Traditions

Literature on Asian versus West comparisons should be deducted from studies focussed on particular countries. The United States, England, and Germany on one side, and South Korea and China on the other, make up the two main country groups that well represent Asian and Western traditions of education. The quantity of research about the educational systems of these countries shows that their influence on other countries in their group is significant.

Paik (2001) stated that based on the Educational Testing Service (ETS) report that 68% of US students agreed with the statement, "I am good at math", ranking the highest in mathematical self-concept in the Second International Mathematics and Science Study. South Korean students ranked themselves the lowest out of all participating countries by disagreeing with the above statement. However, their perceptions do not fit the results of the achievement scores; South Korea came in first, and the US had one of the lowest score averages (ETS, 1992, cited in Paik, 2001).

Stevenson and Stigler claim that Americans in general believe innate abilities are an important component of success. (Stevenson and Stigler, 1991, cited in Sims, 2000). This kind of understanding gives rise to concepts such as differentiating the instruction and ability grouping, and lowers the stress on the students in the Western countries. Zhang (1998) finds that Oriental[1] students are under constant stress of failure, that "… the guilt and shame of not being able to cope academically have led to depression and suicide of even pre-teenage children" (Watkins & Biggs, 1996, cited in Zhang, 1998).

Various researchers (Ellinger & Carlson, 1990; Haynes, 1997; Kim and Kim; National Commission, 1983; Peng & Wright, 1994; Sorenson, 1994; Stevenson, 1987; Walberg, 1983, cited in Paik, 2001) have found that South Korean students spend longer hours in school and more out of school time studying than students in most countries. The average number of absences during a school year among US students is 20, where it is only three among Korean students (ETS, 1992, cited in Paik, 2001). Research shows that the proportion of students who spent more than 4 hours per week on homework is the highest

[1] For the sake of using a more politically correct term, the researcher prefers the use of the term *Asian* instead of *Oriental* or *Eastern*.

in South Korea and the former Soviet Union countries. (The Educational Testing Service, 1992, cited in Paik, 2001). The ratio of extra time (i.e., homework, studying for national examinations, private tutoring, and educational television) that students spent each day for South Korean students to students in US is 4 to 1 (Paik, 2001).

When comparing textbooks in South Korea and the US, Kim and Kim (cited in Paik, 2001) found South Korean textbooks emphasized certain concepts at each grade level, contained more "advanced" mathematical problems, and had fewer pages than American textbooks. US teachers use grouping and cooperative learning more often (Stevenson, 1987, cited in Paik, 2001), while South Korean teachers instruct the whole class in a lecture format (Zambo & Hong, 1994).

South Korea, Japan, Taiwan, and China consistently have had two or three times the number of students per classroom compared with the United States (Haynes, 1997; Sorenson, 1994; Stevenson, 1987; Stigler, 1988; IEA, 1996; Walberg, 1984, cited in Paik, 2001).

Teachers are generally more respected in South Korea than in the US (Sorenson, 1994) and the origin of this respect for teachers, starts at home (Han & Washington, 1989; Mordkowitz & Ginsburg, 1986, cited in Paik, 2001).

Like Chinese and Japanese students, South Korean students spend much more time on academic endeavours than on extracurricular activities (Paik, 2001). From Secondary International Mathematics and Science Survey (SIMSS), it was reported that 71% of South Koreans watch science programs on television compared to 37% of US students (Paik, 2001).

In Asian countries such as South Korea, Japan, and Taiwan, educational success and socioeconomic status correlate much more than in the US (Sorenson, 1994). Peng and Wright's (1994) study found that Asian parents made their children stay home more to study and receive more lessons outside of school than any other parents. Farver et al. (1995) found that South Korean parents often asked the teacher to give more homework to their children than US parents.

Given that the mathematics success of European nations is statistically below Asian countries (National Council for Education Statistics (NCES), 1996, cited in Sims, 2000), Zhang (1998) compares Western and Asian mathematics education in Table 2.1. According to data derived from Third International Mathematics and Science Survey (TIMSS) results. The countries under the Asian category in his article are China (Mainland, Taiwan, Hong Kong, and Macau), Japan, Korea, Singapore, and Vietnam. The Western countries are basically the countries with a Latin, Anglo-Saxon cultural heritage.

Table 2.1. Western and Asian Mathematics Education[2]

Western	**Asian**[2]
Various selection	Unified requirement
Mild assessment	Keen examination
Intrinsic motivation	Extrinsic motivation
Small classes	Large classes
Student-centeredness	Teacher-centeredness
Discovery	Expository
Ordinary basic drill	Rigorous basic drill
Informal approach	Deductive approach
Emphasis on understanding	Emphasis on practice
Meaningful context	Memorizing material
Creative thinking	Imitative action
Light exercise burden	Heavy exercise burden

Zhang (1998) advocates the superiority of Asian mathematics education despite the poor resources that Asian schools have. They have bigger class sizes, and academic research studies on mathematics education about Asian countries are far less than the studies on

[2] Although Zhang named the category as *oriental*, this research prefers using a more politically correct term, *Asian* instead of *Oriental* or *Eastern*.

Western mathematics education. Despite the fact that the Asian countries perform much better according to TIMSS studies, both sides of the world seem to be unhappy about their mathematics education:

> Mathematics education is often said to be in a state of crisis. Those in the Western world observe a "crisis of skills" and make unflattering comparisons with the relatively high levels of computational dexterity found in school populations in the Far East. But countries of the Pacific Rim also perceive themselves to be in mathematical crisis - a "crisis of creativity" (Hoyles et al., 1999, cited in Sims, 2000).

2.8. Mathematical Enculturation and Mathematical Enculturators

Ju (2002) suggests that a mathematics classroom as a community is deeply related to outside communities in the sense that each participant represents the indigenous culture that s/he is committed to. "Through interaction, a student begins to grasp different ways of doing mathematics, different epistemological style and begins to change" (Ju, 2002, p. 8). Repeating Bishop's (2001b) understanding of mathematical acculturation is necessary here. He found that many young people in the world experience a dissonance between the cultural tradition outside the formal educational institution (for example in their home, or in their previous cultural settings) and that represented inside the institution. In order to overcome this dissonance, Bishop (1988) suggests that the people who are responsible for the enculturation process, namely teachers, teacher educators, advisers, inspectors, curriculum developers, resource providers, and researchers should put a premium on knowledge, commitment, expertise, and professional responsibility. Bishop (1988), however, puts the major task on the shoulders of the teacher to act as the mathematical enculturator and to create a particular kind of social environment for the learner, where the learner's task is to construct ideas and modify them in interaction with that environment so that a dynamic equilibrium is achieved. Bishop (1988, p. 168) proposes four criteria for the selection of suitable mathematical enculturators:

- Ability to *personify* the mathematical culture
- Commitment to the mathematical culture
- Ability to communicate mathematical ideas and values
- Acceptance of accountability to the mathematical cultural group

This is still a tough challenge because the culture in the classroom has many variations, thus no two mathematics classrooms are exactly alike (Nickson, 1994).

3. DESIGN AND METHODOLOGY

3.1. Conceptual Framework

This study sought answers to questions starting with *how* and *what* instead of answers to questions that start with *why*. The nature of the research questions led the researcher to have an exploratory purpose, since "exploratory purposes are used in a study to discover what is happening and to search new insights" (Robson, 1993, cited in Delice, 2003, p. 30). The secondary purpose of this research was descriptive since descriptive purposes offer an accurate profile of persons, events, or situations portrayed by the researcher (Robson, 1993, cited in Delice, 2003). This research was not explanatory because it, in no way, sought evidence to provide explanations of cause and effect. Because of the purposes of this study, qualitative methods were chosen as the central component, and quantitative methods to support the findings obtained from qualitative study.

The transient nature of international school students makes the cultural setting in an international school mathematics classroom highly volatile. Thus, the change is an important part of the cultural setting which needs to be described, so that it could be analysed. Qualitative methods well satisfied the needs of this study because they were generally supported by the interpretivist paradigm, which portrays an ever-changing reality (Glesne, 1998). Sims (2000, p. 41) defines the interpretivist researcher as they offer subjective conclusions, due to the fact that their conclusions are determined in part by what the researchers already know and believe, and are therefore "not a reflection of the reality so much as a perception of the reality".

The researcher's interest in writing in a literacy style, probably under the influence of the interpretivist paradigm, and his determination not to exclude himself from the mathematical enculturation of the participants, brought about the idea of using the personal pronoun, "I" in this study. While using "I" statements, the researcher aimed to act as an active learner in order to tell the story from the participants' view. The study included a section about the researcher himself, which was due to two reasons. Firstly, Kirby and

McKenna (1989) say the researcher should identify himself as well, because that is the only way to give the reader a sense of why the research had been designed, implemented and analysed the way it was. Secondly, the research question was asking an important question about the researcher as the teacher of the participants and actually as himself being the mathematical enculturator for his students. *Participant observation* of Jorgensen (1989) let the researcher to be both a complete outsider and to be a complete insider in this sense. The researcher was aware of the fact that being an insider in an ethnographical study, or as Glesne (1998, p. 26) calls it, "studying the backyard", limited his ability to objectively observe processes in which the researcher was involved as a participant. However, there were only four international schools in the city in which the researcher is located and only two more elsewhere in the country, and their isolated nature to outsiders did not let the researcher implement his studies at another international school but the one in which he had been teaching.

The small number of available participants in the school in which the researcher was teaching was a strong factor that would limit the reliability of a quantitative study, thus it was only used as a supplementary component. As Glesne (1998) claims combining qualitative and quantitative methods should only be used in cases where one supplements the other, but not equally dominant. That's why the research included a section of quantitative analysis of the interpretations of the teacher on student performances on a variety of subtopics, and questions number 17 and 18 in the Initial Survey for General Information (see Appendix B). The sources of data analysed in the quantitative component of the study were the tools that the teacher used to assess his students problem solving ability and their cooperative learning performances during the year. These tools are given in Appendix D and Appendix E and the thousands of teachers using these tools are the experts increasing the validity values of these tools. Indicator behaviours for problem solving ability and cooperative learning were taken from the mathematics textbook of the participants (Addison-Wesley, Teacher's Edition). The items in the Initial Survey for General Information (ISGI) (see Appendix B) were adapted from TIMSS studies by Sims (2000) and the researcher modified the tool by adding items 23 to 27.

According to Creswell (1998), all good qualitative studies have five assumptions that guide the design: ontological, epistemological, axiological, rhetorical, and

methodological. This research was based on the ontological assumption because it used quotes and themes in the words of participants and provided evidence of different perspectives. The research was epistemological, because the researcher collaborated, spent time in field with participants, and became, or already was an insider. It was axiological, because the researcher openly discussed values that shaped the narrative and included his own interpretations in conjunction with the interpretations of the participants. It was rhetorical, because the researcher used an engaging style of narrative, and used the first-person pronoun. It was a methodological research, because the researcher worked with details before generalisations, described in detail in the context of the study.

The overall intent of the researcher in this study was to examine the student behaviours, attitudes, and beliefs in a group of students using description and a high level of detail as they became acculturated into the mathematical culture created within a mathematics class set in an international school in Istanbul. The best qualitative approach to describe the everyday life of participants is through ethnography since "… ethnographic fieldwork provides anthropology with its best source of data for understanding the cultural groups throughout the world" and for comparative studies and analysis (Zaharlick, 1992, p. 122). Creswell (1998, p. 39) supports ethnographic design to be chosen when one wants to study the behaviours of a culture-sharing group.

3.2. Selection of Participants

All participating students from grades 5, 6, 7, and 8 were included in the quantitative part of the study. The qualitative component only used data from grades 6 and 7. Grade 6 students were chosen, because although their acculturation had possibly already begun and developed at a certain level during their years in primary school, their formal mathematical enculturation was at a novice level since this was their first year in middle school, thus, it was the first time they had been introduced to a formal mathematics class taught not by their primary classroom teacher but by a teacher of mathematics. Grade 7 students had already had a one year mathematics course the year before. Therefore, that the researcher hoped to compare the two groups, and to gain a conclusion about their mathematical enculturation process and the current status of their mathematical acculturation experience. All students in these classes participated in questionnaires, informal interviews, and

activities implemented during the year, which were specifically planned to observe their mathematical enculturation.

Furthermore, in order to gain an in-depth analysis, a purposeful sampling was used to find information-rich cases, and four students from each class were chosen as the participants for focus group studies. A focus group is defined by Powell (1996, p. 499, cited in Gibbs, 1997) as, "…a group of individuals selected and assembled by researchers to discuss and comment on, from personal experience, the topic that is the subject of the research".

In the selection process of the participants of the two focus groups from each class, school records and data obtained from the Initial Survey for General Information (ISGI), (see Appendix B) were consulted. Moreover, the final decision on the selection of the participants for the in-depth research relied mostly on the personal judgement of the researcher, and was given according to the following criterion:

- To select students who can express themselves in English with no difficulty
- To select students whose parents are easily reachable and approachable
- To select one student from each subgroup

The subgroups determined were based on the countries that students thought they were from. Thus, geographically speaking the two main subgroups were students from Asian countries (including Turkey and Russia), and students from Western countries (including Europe and America). As a third subgroup, it was appropriate to consider students who were calling themselves half Turkish and half from another country, either Asian or Western (Figure 3.1). (All students in the school had foreign passports per the admission policy of the Ministry of Education for international schools). However, these half-Turkish and half-Western or half-Asian students, were asked to choose one side for the quantitative analysis section, where the two broad divisions were only Western and Asian. There were no students from Oceania or Africa in the school, with the exception of students who lived in African countries temporarily.

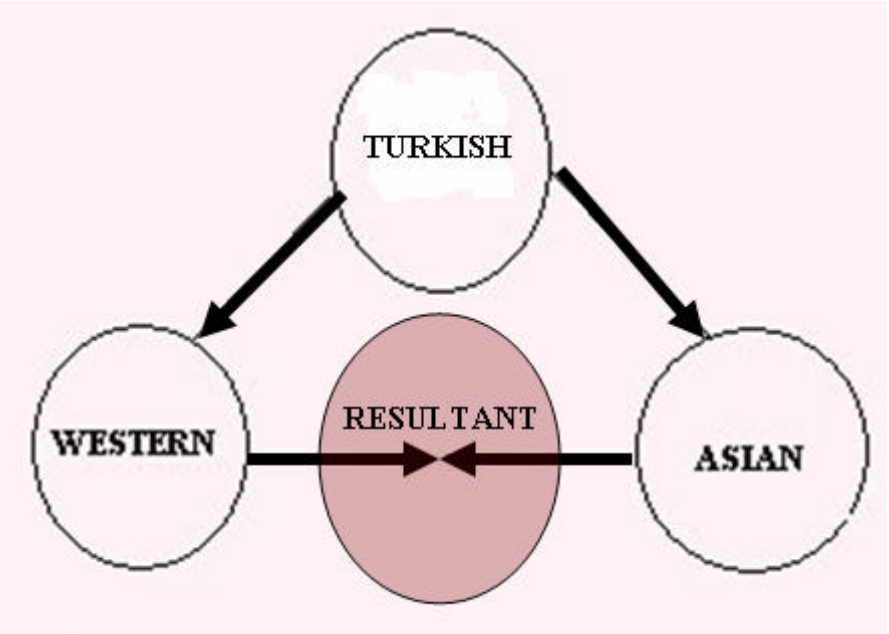

Figure 3.1. Resultant culture

Permission was obtained from all the gatekeepers, including the school board, learning support team, and parents of the students, in order to review the history of the participants and to conduct the research. They were informed about the purpose of the study, their right as participants to withdraw from the study anytime. Finally, four students from grade 6 and four from grade 7 were selected for the in-depth study comprising the two focus groups.

3.3. Data Collection

The four types of data collection in qualitative research that Creswell (1998) outlines are observations, interviews, documents, and audio-visual materials.

> Data collection … is an ongoing process that can extend indefinitely. There is always another person who could be interviewed, another observation that could be conducted, always more documents to be reviewed (Merriam, 1998, p. 125).

In addition to the data collection methods listed in Creswell (1998), more innovative data collection methods were used in this study, such as discussions within an online forum

(yahoo groups), students' comments posted to the researcher's website, students' personal mathematics diaries or other teachers' observations.

Data collection was first started as informal observations at the beginning of the academic year. As the literature reviewed grew larger and larger, these notes became corollary rich and data started to make more sense to the researcher. Before the selection of the participants, the research journal had only 20 entries, and by the end of the year it reached up to 200 entries.

The ISGI (see Appendix B) was used to collect information on students' backgrounds, attitudes, and beliefs about mathematics. This stage was completed by all the participant students in the first month of the school year. Robert Sims has modified this survey, (2000) from the document "International Versions of the Background Questionnaires" as published by the TIMSS. Small modifications were made, such as changing the name of the places or people, but otherwise, it remained the same. Still, the researcher added two pages to collect data more accurately, and increase the reliability.

Sims' (2000, p.158) free response questionnaire was modified and used as an integral part of data collection (see Appendix K). All students participating in the qualitative component of this research, that is grade 6 and 7 only, took this questionnaire home and returned it two days later.

Two activities specifically created for this research were, the Nokia Sets Project, and the Spy Game Project (see Appendix I). The Nokia Sets project was an icebreaker implemented in the first week of school, before the ISGI was delivered. The Spy Game project was a set of treasure hunt activities designed with a special focus on ethnomathematics. (Appendix I). The Spy Game was a long project that took a month to be completed. There were four missions to be completed, one for each week. The students were supposed to locate and solve puzzles during the double mathematics periods each week. At the end of each activity week, students' opinions were recorded in the research journal. The focus groups were then interviewed and were recorded by using a video camera. Classroom discussion was also added to research journal (see Appendix J for interview-discussion questions).

In addition to the field notes, which were incorporated into the research journal, four teachers, one for each group, were asked to keep a journal during the Spy Game activities. These teachers were the reporters, and their duty was to report how the groups worked, to detect any cheaters, and report and handle any unfortunate accidents or incidents that happened during the activities.

The six values of mathematics (Bishop, 1988) inspired the researcher to compile the interview questions to gather some information about the participants' mathematical values (see Appendix G). The researcher wrote two or three questions related to each category in Bishop's values (see Appendix H). These questions formed the third interview, which was implemented on the students in the focus group. This interview was a structured interview.

All interviews took place within the school day, mostly at lunch or snack breaks. The transcribed records were reviewed with each participant, to increase credibility. Their comments were also recorded as a photo (video) elicitation technique (Creswell, 1998).

The teacher's assessment tools were used in order to support the study, and analysed as the quantitative and qualitative components of this research (Appendices D, E, and F).

Finally, the research journal, appraisal results written by the school principal and the deputy, recommendation letters, student journals, and teacher evaluation forms filled-in by the students were used to collect data about the teacher who was responsible for acculturating his students.

3.4. Data Analysis

The three stages of data analysis as described by Creswell (1998) are description, analysis, and interpretation of the culture-sharing group. These guidelines were followed as Creswell described them, bearing in mind that simultaneous analysis and data collection would go side by side, in order to direct data collection phase more productively as well as develop a database that is relevant (Merriam, 1988). The description part of data analysis began with the introduction of the characters, key events, and making up the story.

Second phase analysis was about highlighting the material introduced in the description by putting the information into tables, charts, diagrams, and figures. In short, this section involved the search for patterned regularities, and an effort to categorise data. Before conducting the research, the researcher expected to analyse data in some certain categories, such as curriculum perceptions, roles of student and teacher, teacher methods, class size, and class atmosphere, perception of cultural differences. However, during data collection many new categories emerged. The final categories were grouped under four main divisions:

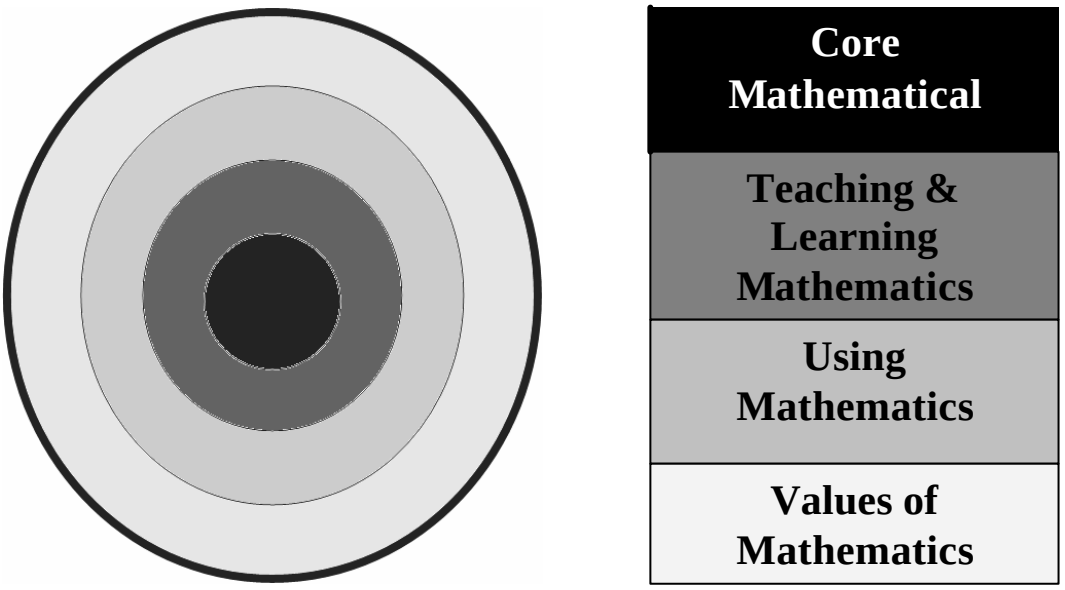

Figure 3.2. Four main divisions

- Core Mathematical: Student attitudes towards mathematics, cultural aspects of mathematics
- Teaching and Learning Mathematics: Roles of teacher and student, classroom atmosphere, teaching methods, curriculum perception, assessment perception
- Use of Mathematics: Use of symbols (mathematical notation), perception of homework, study skills and habits(exam preparation), parent involvement.

- Values of Mathematics: Six key values of mathematics: rationalism, empiricism (later objectism, Bishop(1991)), control, progress, openness, and mystery (Bishop, 1988).

The third stage of data analysis was the speculation of data from a personal point of view. The researcher speculated comparative interpretations that would raise doubts or questions for the reader (Creswell, 1998). This process was an attempt to relate the practise to theory.

4. THE MATHEMATICAL CULTURE UNDER INVESTIGATION

This chapter presents data collected throughout the study. The first section provides information about the researcher as the mathematical enculturator, and introduces the setting in which the research took place. It then describes the students participating in the study, and draws the picture of the culture through the voices of the students and the interpretations of the researcher.

4.1. Researcher

As the researcher, my interest in culture had its roots in the mixed structure of my family and my upbringing. It first started in my family, when my Turkish father decided to marry my mother who was Albanian. I always appreciated the differences in my parents' approaches regarding my education, which indeed helped me become who I am. My father, who majored in physics, is the type of person who believes mathematics should be taught as an applied discipline. He spent hours explaining the simplest problems by using examples based on physics, whereas, my mother was more concerned about the neatness of my writing or how well I learnt the way that the problem had been solved by the teacher. The educational system at the school I attended was highly competitive. Success in mathematics was an indication of intelligence, and I was happy to be labelled as an intelligent pupil. However, both of my parents were disapproving of the reasons for my interest in mathematics, and they laid the blame on my teacher at school.

My first contact with a foreign culture occurred during my years at middle and high school. I was accepted to a state-governed school with English as the medium of instruction after passing a competitive central examination. For the first time, I met non-Turkish teachers at school and friends from all over the world as pen friends. Then I started getting interested in books and journals written in English. This period of my life during my middle school education helped me to recognise and appreciate the value of the diversity of cultures.

However, as a young mathematics student during my years in middle school I was fed up with the lack of variety in the problems I was asked to solve at school. My own mathematical enculturation at school was turning me into a factory worker where I was working as a problem-solving machine and had to repeat identical actions thousands of times for the sake of mastery. Pool problems were interesting at the beginning but I always wanted to have a pool, and try it myself, but that never happened. Unfortunately, it was not only the subject that bored me. The teachers were worse. I do not remember any of my maths teachers at school bringing anything into class other than their big fat books and their one type, one colour pieces of chalks. I never found mathematics teachers in middle school impressive at all. For sure, they knew more than me, but were they better than me?

Things changed slightly at university. As a mathematics major in Bogaziçi University, I was now expected to memorise questions from past exam papers in order to pass courses. Interaction was minimal and lecturing was essential. The culture enforced by the professors at the mathematics department was about preparing students who are going to become researchers. Luckily, I found some people interested not only in mathematics as a pure science but also interested in the teaching of it. Many of these were trained in Teachers' Colleges in high school. This shift in my interest towards education helped me to make up my mind about my future. Now I knew what to do with the mathematics I learnt.

Bogaziçi was hosting a number of international students as well. These were exchange students from Western universities, or full-time students from countries mostly located in Central Asia. They were literally not speaking the same language that the majority spoke and language was an important barrier to overcome in order for them to be comfortable at Bogaziçi, since English was only available in classes. Once we got out of class, no one was willing to speak English. I am sure they were not happy to be outsiders. One thing in particular that I always admired about them was their note taking skills. They were fast; their notes were neat and always accurate. Generally speaking, my classmates at the university were all motivated and that provided me with the necessary satisfaction towards my subject and ambition to complete my degree as a teacher of mathematics.

During the practicum course, student teachers have the experience to see real-time teaching at schools. This excerpt was taken from an assignment I completed in my observations during my visit to a Turkish national curriculum school:

> I took my seat and waited for the students to salute their teacher. They were all standing next to their desks, and the teacher was right in front of them, looking a bit harsh as if these young men and women had done something horrible recently. She was pointing her eyes directly into their eyes angrily, with no smile at all. I was impressed with this one-minute silent moment, and could not stop myself from recalling my national security class in high school.

What I observed during my entire education and in my four years of teaching was this kind of formal relationship between the teacher and students that is a common practice in national schools in Turkey. I have serious doubts about the existence of a peaceful environment, or either party finding joy in the subject. In general, the main concern of teachers in national schools is the successful testing of their students in selective central examinations. In this kind of system, based on competition, teaching mathematics is of secondary importance.

In one of my grade Algebra 10 classes in Turkish school, I was particularly excited about teaching the relationship between astronomy and trigonometry. One of my students approached me after the class to complain about the time I spent talking about things that would not be asked in the central exams. This is what she told me, which is a good example, demonstrating how students tend to approach mathematics: "Only two questions were asked from this topic in the last five years, but we have been stuck on this topic since the beginning of the term. Can't we just skip it quickly?"

Once again, bored with teaching a highly structured and centralised curriculum, I decided to look for a post at a school that did not follow Turkish curriculum guidelines, so I applied to international schools in Istanbul.

As I look back on the hiring process two years ago, I recall that it was difficult for an International School to employ a teacher who was not a native speaker of English. I sent my CV via email and waited three weeks to be invited for an interview. The school was looking for a teacher who could teach at least two classes from mathematics, computer studies, or science. The head of the school at that time was a Canadian, named John, or Can, as he called himself, similar to the Turkish name. He was particularly concerned

about possible parent reactions towards a non-native speaker teaching their kids. Being a graduate of an English-medium high school and university helped me obtain a distinct fluency in English, resembling an accent of a Briton's rather than an American. However, I was aware that the culture created at this school may not welcome me. I was ready to take that risk, but the school might have had bigger problems. During the interview, I told John about the things that I had always wanted to do in class and about the things I did not have the chance to do in my previous post in a national school. I discussed things like embedding the recreational side of mathematics into my lessons, being free to plan the curriculum by linking it to other subjects and to real life, and when possible, using technology and the Internet without having to hear complaints about time restrictions or exam statistics.

After two years of working, I am happy that John made a brave decision and employed me. I think both the school and I gained a lot from this. John's words on my appraisal form can give you an idea about me: "You exemplify the type of educator I have always sought when recruiting: you are positive, supportive, and contributing. Knowledge of subject matter, technology in the classroom, and planning are areas of real strength for you".

It has been two years since I signed a contract with an international school in my home country as a teacher with local hire status. This unique opportunity has already become a stepping-stone for my career in international education. With the help of this experience, I have recently found a teaching job in Morocco at an American International School for the next two years. I hope to work further on my research in the coming years with the additional experience I will gain from Morocco. My future ambition is to become an international educator or an academic specialising in international education.

Being an international educator is a challenging experience in many ways, I must say. Teaching students from all over the world or working with colleagues from different regions of the planet seem like superficial aspects of a more complex phenomenon. There are several apparent differences among all these people, and we can categorise them according to some obvious attributes: such as skin colour, the music they fancy listening, or the restrictions that they have to follow because of their beliefs. However, there are

deeper differences than that, and this especially true in a mathematics classroom where every student brings a different understanding of the subject. This is fun but also makes it very difficult to find the best way to reach everybody. We have to agree upon some principles and create our own understanding or mathematics culture in our class.

4.2. Setting

The pupils participating in the study were from diverse cultures and came from a variety of countries from around the world. Although a minority of the participants had a Turkish parent (or parents), none except 3 of the participants were born in Turkey, and all held foreign passports. The participating students in this study were in grades 5 through 8. However, the focus classes were students from grades 6 and 7.

The classes took place in an international school, which was a full preschool to IB school (ages 3–18), situated in central Istanbul, in an area of the city favoured by expatriates. The motto of this Western style school was *Building Bridges between Countries and Cultures*, and the appreciation of other cultures, people, and languages was evident within the more than 30 nationalities represented in the student population and 16 nationalities in the staff population. The respect and understanding of many cultures represented within its community, the host culture of Turkey, and other cultures throughout the world were openly appreciated in practice. *The International Peace Day* celebrated on the 21st of September each year, or other various activities like *The Fun Day*, fostered school spirit . The related entry about *The Fun Day* in my journal was the following:

> I enjoyed the Fun Day today. I tasted Indian, Italian, and Mexican foods, and they were delicious. Four Indian girls from primary school shared their traditional dance with the audience. It was a great experience to see all those different people in one place, enjoying themselves in peace.

As one of the two focus classes, the grade 6 students were not used to subject teachers, and I was their first formal mathematics teacher. The entry at the beginning of this year indicated the following:

> The introduction session with grade 6 went very well. I explained my expectations and classroom rules. I had a good experience with these pupils last year for two periods when I was asked to cover their lesson as a substitute teacher. I had talked with them about the relation

> between arts and maths. They all had seemed to be very interested but had been surprised to hear that maths was not just about numbers or shapes.

There were 17 students in this grade and a further inner-focus group had been composed of four selected students; Sara, Hugo, Eda, and Burak.

Table 4.1. Geographical distribution of the home countries of grade 6 students

Grade Level	Asian	Western
Grade 6	53 %	47 %

Students are placed in categories according to their choices. Turkey and Russia were considered as being in Asia. The other focus students in grade 7 were already known to me from last year. We had a good history and had already been involved in the enculturation process together in the previous year:

> I am happy to be assigned as the grade 7 homeroom teacher for this year. This will give me extra time to know these guys better, which is a great opportunity for my study. They are all aware that I am determined to show them Maths is not only for clever people, but that it can make them clever. Grade 7 was my favourite class last year, because they always appreciated my efforts to make the subject interesting for them.

There were 12 students in this grade; the inner-focus group consisted of four students; Selin, Lysha, Defne, Gabe.

Table 4.2. Geographical distribution of the home countries of grade 7 students.

Grade Level	Asian	Western
Grade 7	42 %	58 %

Students are placed in categories according to their choices. Turkey and Russia were considered as being in Asia. I had difficulty getting permission from grade 5 parents. The parents didn't know about me, and I was a total stranger to the students. I received eight replies from this group of 30 students, so I decided to use data to support my findings from the other two focus classes. The grade 5 students

had not been considered in any part of this project except when specifically mentioned.

Table 4.3. Geographical distribution of the home countries of grade 5 students

Grade Level	Asian	Western
Grade 5	50 %	50 %

Students are placed in categories according to their choices. Turkey and Russia were considered as being in Asia. Grade 8 was not very useful for my study either. There were only six students in this class, and only two of them were fluent in English. In general, they were very grade oriented and did not show the necessary enthusiasm to participate in my study, although, they all agreed to fill in the questionnaires and do the audio interviews without video recording.

Table 4.4. Geographical distribution of the home countries of grade 8 students

Grade Level	Asian	Western
Grade 8	50 %	50 %

Students are placed in categories according to their choices. Turkey and Russia were considered as being in Asia. Because of the difficulties explained above, data collected from grade 5 and 8 were only used in the quantitative component of my study.

4.3. Participating Students

In this section, each student in grades 6 and 7 will be introduced briefly, except the members of the focus group who need to be brought into the discussion with detailed information. The information presented about each student was obtained from observations, interviews, and their answers in the ISGI (see Appendix B).

4.3.1. Grade 6

Sara was born in the United States and spent the first 10 years of her life there. She and her family moved to Turkey temporarily because of her father's business. Their plan was to return at the end of 2006. I had taught her older sister Sila in grade 8 the year before, and neither of these girls were happy about living in Turkey, and actually were quite angry with their father about forcing them to stay here. Sara, like her sister, identified herself as an American, a New Jersey girl, despite the fact that both of her parents were Turkish. The language spoken at home was primarily English with some Turkish, and she was fluent in both languages. Sara was a popular girl who was always cheerful in and out of the classroom, a leader for girls and a popular figure among boys. She was generally a successful pupil, but her maths grades fluctuated greatly during the year. She had shown a particular strength in explaining her methods and strategies. As she explained, "I am sometimes good at maths, Mr Sench. I am successful only if I like the topic. I loved the ratio unit because then you taught us golden ratio, Fibonacci numbers, or other fun stuff. Then I did well at tests". I chose her as a member of my focus group, because she was able to put her ideas into words beautifully, she was talkative and a good representative of the large student population whose parents were Turkish.

Haruka was a calm and successful girl from Japan, who had previously lived in her home country for five years then moved to the Arab Emirates and finally to Turkey. She had been in Turkey for two years, and was able to speak English fluently. Her mother is particularly worth mentioning as she was her private tutor and homework guide. Her homework never had mistakes because it was being corrected by her mother at home before she submitted it for the teacher's consideration. She always obtained very high scores on tests and was especially determined to finish her work as quickly as possible in order to have some free time. She was one of those students who teaches you the meaning of the educational term *differentiation*. As she said, "I find maths fun only when you give me a problem, and I solve it on my own. But I don't like you when you give me extra problems after I finish them. It is like you are punishing me because I finish my work early".

Hugo was from France, and had lived in France, Poland, and Turkey each for four years. He had a good command of English and was fluent in Italian and Spanish as well. He was physically and emotionally weaker than his peers. On a number of occasions, I found Hugo crying in class due to verbal friction with Burak, who was not a close friend to Hugo. Hugo was very fond of my class, always a good listener, and a good contributor to discussions. He was particularly interested in activities and projects. It was fun to see him being proud of the mathematicians from France. He said, "I think I will get a very good grade from maths this year. Well, because obviously all the clever guys are French; like Pascal, or the guy you told us today, Leibniz".

Burak was a new member of the grade 6 class who had transferred from one of the other international schools in the city. He was born in the United States and had been living in Turkey since birth. He did not spend a day in the US after his birth, both of his parents were Turkish, and he defined himself as more Turkish than American. Burak was a unique personality, who enjoyed challenging anybody, including his teachers, about anything. He enjoyed himself by finding alternative solutions to problems, although not correct all the time. My entry in my journal about Burak indicated the following:

> Burak today asked me to play tic-tac-toe on the board. I accepted his challenge with pleasure. I thought that might give me a chance to have a positive start with this so-called tough guy. At the beginning of the year we, the teachers, were given a speech on Burak from the guidance-counselling office. The new counsellor asked us to monitor his behaviours closely. Apparently, his former school did not give him a very positive reference about his behaviours. However, my first impressions are quite positive; he tended to annoy Hugo and some of the girls a couple of times, not particularly disturbing.

Slava was a very smart and successful pupil from Russia and had been in Turkey for three years. He was half Russian and half Ukrainian. In addition to his native language, Russian, he could speak Turkish and English very fluently, with no accent. I was a keen admirer of his talent in arithmetic and especially his ability and speed in finding answers to exercises in arithmetic.

Nikita was another Russian student in grade 6, and unlike his fellow country man, he was not particularly successful in Maths, mainly due to his poor behaviours, lack of concentration and under developed study skills.

Ashad was the third native speaker of Russian in grade 6 class. He was from Chechnya, a semi-independent republic within Russia claiming and fighting for independence. He came to Turkey with his family eight years ago, which was right after the war broke out in his homeland. Ashad was inconsistent in his attitude towards mathematics and was too ready to give up when difficulties arose. He had an older brother studying engineering in a university outside of Istanbul, who occasionally came to Istanbul to help Ashad with his exams. When Ashad studied with his brother, he was successful, and I was happy. At other times he usually came to class unprepared.

Lorenza was an Italian girl, who had been in Turkey for three years. Lorenza many times was the high scorer of maths tests. Lorenza was a capable young mathematician, who had made excellent progress throughout the year and had greatly improved her confidence in maths. She had shown a particular strength in presenting information clearly in tables, charts, and graphs.

Jasper was another Turkish-American, who had lived three years in the USA, and nine years in Turkey. He was not only very successful in maths but also was a very popular boy. Basketball was his life. During my pre-year talk with his former grade 5 teacher, she had told me, "He is very clever, but it's hard to make him work. If you like basketball, then you are a good friend of Jasper's". With this invaluable advice, on the second week of the year I assigned him to keep his favourite basketball player's statistics, and then to present the results as a report to all the middle-school students. I definitely had won his heart. This extremely able and clever boy was fluent in both languages, Turkish and English; however I noted in my entry, "Jasper is not a verbal person for sure. He has so many things in his head, but all mixed, and he suffers from not being able to explain his ideas so that they can make sense for everyone".

Sam was a silent member of the class. He was half Turkish, half English, and identified himself as English. He was born in the UK, but had been in Turkey for 10 years. He and his cousin Selim, who was in grade 7, were going to leave at the end of the year to attend a boarding school in the UK. Sam showed a keen and interested approach towards maths, and made steady progress throughout the year.

Diana was the second Italian in grade 6, who was born in the USA, lived there three years, and then lived in Italy seven years, before coming to Turkey due to her father's work. Diana was usually very silent, and neither a competitor, nor an active participant. She was capable of achieving great success in maths, but according to her mother, "Diana is too modest, and so shy. She has to learn to be ambitious and assertive".

Emil was raised in Turkey by his Turkish mother and Costa Rican father, who were both teachers in our school. He was an able, successful and a very friendly pupil who could speak English, Turkish, and Spanish fluently with no significant accent at all.

Eda was born in the United States, but then moved to Turkey with her family after two years. At the beginning of the year, her self perception and attitude towards maths was awful, "I am math disabled, Mr. Sench. Don't try to help me, you can't. Nobody can". She was the only student that had not memorised her times table yet, and had no idea about long division so I allowed her to use a calculator. I followed a modified programme with her, and the lady from the school's learning support team was assisting her during the exams with her times table. At the end of the year, she was much happier, and her report card comment in maths was, "Eda has a conscientious approach to all areas of the work covered, she has made excellent progress throughout the year and persevered to overcome aspects she found difficult. She has greatly improved her confidence in maths". The learning support team report included her comments about her performance this year, "This year, I'm better at mathematics because I like my teacher. He teaches in a way that I understand and in a fun way".

Asya was very similar to Eda in many ways. They were good friends, and their families were close. She was also born in the US but then moved to Turkey after two years. Her parents were both Turkish like Eda's. Her confidence progressed inconsistently and she was too ready to give up when difficulties arose.

The next student to be introduced is Clarissa, who was born in Turkey, and spent her entire life in Turkey. Her mother was a Romanian lady married to a Turkish man. Clarissa was never interested in the subject of maths despite all my efforts. Her written work, while usually acceptable, was rarely as detailed or as well presented as I would have

wished. Among these three very similar girls, only Eda's year was a success, unfortunately nothing much changed for Asya or Clarissa.

Jonas was a very nice pupil from Norway, who had never been abroad before this year. His first experience abroad did not start very well. He was a very anxious boy, and had suffered severely from culture shock until the middle of the second term. His presentation was untidy, which at times caused him difficulties, such as mixing columns of numbers, and made checking his work more difficult; however, his projects were always at a very high standard, showing nice examples of his creativity and imagination.

Luis, the last student on our list was another newcomer. He was from Spain, and he was not able to speak a word of English. Instead of attending subject lessons, the learning support team decided that he should study English with the ESL teacher. Maths was an exception. As the researcher, I was aware of the fact that mathematics is not culture-free, and as the enculturator I honestly believe that mathematics is not an one-type uniform universal language but interpreted in various ways by each culture. However, I also cannot deny the fact that it is the only language that a Spanish-speaking student and an English-speaking teacher can communicate in. So I insisted Luis attend my class. Luis was the oldest of six brothers, and he was shy and quiet but very clever. Emil, who was the only other Spanish native speaker in the class, was usually a bit bored with his job of translating my words to him. Fortunately, Luis and Hugo became good friends during the year, and Hugo helped me a lot to explain what I wanted Luis to do. He took the exams with the help of the Spanish teacher, and got very high scores. In February, suddenly he started to speak English. Apparently, Luis was a perfectionist; mastering this new language without speaking a word of it in class for six months, and then one day he suddenly started to speak fluently.

4.3.2. Grade 7

Selin was a clever and extremely emotional girl who was half Turkish and half Taiwanese. She lived in Taiwan for five years, and then her parents decided to move back to Turkey permanently. She went to elementary school in Taiwan, and returned to our

school in grade 5. A few times during the year, I visited the guidance counselling office to complain about Selin's emotionally unstable and childish behaviours, and was advised,

"You should be patient with Selin. She is experiencing the difficulties of adolescence a bit earlier than her peers, and it is not easy for her".

Selin was a local swimming champion, generally good at all sports including soccer, which was not a very popular branch of physical activity among other girls. She never managed to get along well with other members of the class, and I heard a lot of complaints about her from her classmates that she was arrogant and whiny. Throughout the year, I witnessed many occasions where Selin was arguing with a boy, which resulted in her crying in a rage. She vocally disliked mathematics, often screaming out "I hate maths"! My personal observations and what her mother said to me were just the opposite. As her mother told me during our regular meeting, "Thank you for everything Mr. Sench. She really likes you. She talks about your class all the time at home". She was an able girl who was especially strong in understanding new topics, and her test results were always well above average.

Lysha was the Malaysian girl of our class, who had lived in Hong-Kong, Malaysia and Thailand before coming to Turkey four years ago. This was her last year in Turkey, and she was very sad about returning to Malaysia. As she explained, "I was just becoming good at maths. It is so hard in Malaysia. I will fail again". She was the thoughtful member of the class with a very developed commonsense and sense of responsibility. She was the one who never forgot birthdays, or special days, and was a great help for everyone in need. Lysha's maths anxiety many times prevented her from asking the questions she should have asked in class. She did not like to be seen as the only one who did not understand the topic and this unfortunately did not help her on tests. She got an average grade in both terms, and her great projects contributed to her grand total more than her test results.

Defne was a new member of the grade 7 class who was half British and half Turkish. She was born in the UK, lived there for 10 years, then moved to Botswana for two years, and finally came here, to the country of her mother. It was not long before she made good friends and became a popular person among the middle-school kids. Her warm personality and cheerful nature made her transition period very easy for her. She had been attending a British international school in Botswana, and as her reference letter from her

maths teacher indicated, she was well above the average and a successful student. According to my personal observations, Defne was an able and conscientious member of the group who displayed a real interest in the subject and appeared to enjoy all aspects of the work. She was not a very active participant, and there were times she was losing her concentration during lectures, however, she was always willing to share her ideas with the rest of the class during discussion. Test results were very good.

Jung Min was the only Korean boy in grade 7, and one of three students attending English as a Second Language (ESL) class instead of a foreign language. He had been here in Turkey for three years, and had not lived abroad before. His creativity in his projects proved the power of his imagination. His analytical ability to deal with numbers was his strength in Math; however he was suffering in problem solving because of his low level of English. That was an obstacle to him achieving top scores on the tests. He was particularly interested in computers, and many times was the person asking how he could get the copies of the software I used in class. He claimed to have a high IQ result, which was likely to be true, and it was a kind of a sign to prove how clever he was.

Amuktha, the daughter of the IT teacher of our school, was a smart and hard-working member of grade 7 from India. Amuktha was an extremely able and enthusiastic member of the group who took a keen interest in maths and appeared to enjoy all aspects of the work. Her projects were rich in content but were never presented well. She was a big fan of the famous British popular mathematics book author, Ian Stewart, and had a dream of becoming a scientist.

Yannick had been in Turkey for 11 years, and had never lived in his home country, Switzerland. He was a very smart boy complemented with his warm personality and was a popular figure in his class. He developed an excellent general mathematical knowledge and was always willing to help his peers and share his ideas with the rest of the class during discussions. His test results were outstanding, and he was particularly good at understanding new topics with ease. Maths was fun for him because he was good at it, not because he enjoyed it as a subject.

Rodrigo was from Spain and away from his home country for four years; two years in Egypt and the last two years in Turkey. Rodrigo was a conscientious pupil, who made consistently good progress and persevered to overcome aspects he found difficult. Rodrigo was usually very silent, and seemed to understand the ideas presented to him. However, despite his proficiency in English, he was not particularly comfortable in understanding complex materials unless they were repeated. And unfortunately he was not very comfortable with asking questions either.

Gabe was another new member, who joined grade 7 with a two month delay. He came to Turkey with his father, leaving the rest of the family in the United States. His father was taking his sabbatical leave in Turkey with a one-year Fulbright exchange programme for university professors. Gabe was a smart kid who had an alternative point of view on almost everything. He was outspoken and blunt, which caused friction between some members of the class and him from time to time. Gabe was clever enough to manage difficulties with his unique manners.

Jorge was an ESL student from Venezuela. After an intensive ESL study programme last year, but losing a lot of class time in other subjects, he returned with enough English to communicate effectively. He still had some trouble in understanding new concepts. As I had done last year, I continued to send the classroom materials I had in Spanish home, in order for his mother to explain them in his own language. Jorge never managed to achieve high scores in maths, and barely passed.

Devi was another ESL student from Albania. Devi was also on a modified programme and he was given modified tests designed according to the specific objectives planned with the help of the learning support team. The aim of the programme was to give Devi some time to catch up on the topics he missed over the years. Devi was in Turkey for 12 years, and visited his father and family on summer vacations only. Devi's native language was Albanian but he was able to speak in Turkish with no accent and it was hard to understand that it was not his first language. It was very hard for Devi to understand and follow the class in English, and as the learning support team wrote in their report, "Devi is a perfectionist; he does it or leave it", which never helped Devi to learn a new language or master the topics we did.

Selim was a friendly student, who was half Turkish, half German. His father was a journalist for one of the national newspapers in Turkey. I became good friends with his mother, who was a music teacher in another school in Turkey. Selim was leaving the school at the end of grade 7 to attend a boarding school in the UK. When I first met Selim in grade 6, his confidence about mathematics was very low and he was describing himself as a "Maths Hater". However, at the end of the year things changed in a very positive way, as her mother wrote me", He particularly enjoys maths and it is one his favourite subjects". His grades rose significantly and he became one of the most active participants in my class.

Andrea was an Italian boy, who had lived 5 years in India before he came to Turkey 5 years ago. He was impish in his manners and his existence was fun for everyone in class. He was a very smart kid but never successful enough to reach his potential. His behaviours caused him some negative reaction from his teachers, and many times he spent his Saturdays in school on detention. I did not have any particular discipline problems with him; however he was extremely untidy, unorganised, and very absent minded.

4.4. The First Days of School: Nokia Sets Project

I used the Nokia Sets Project during the first week of school as an ice-breaker. I called it *Nokia Sets* because its purpose was me to connect with students, the message of a commercial of the same-named telephone company. I hoped to reveal our singularities and common threads. I have always believed that a class was not only a community but a team whose members played to achieve common goals.

I introduced Nokia Sets as a mathematical ice-breaker. His hand raised and a hesitation in his weak voice, Burak said, "But, but, this is the very first week. We can't do maths!". Burak seemed to speak for himself, or maybe acted bravely. No other students apparently wanted to disagree with me during the first week of school. The majority of students sat silently, trying to figure out their new life in middle school.

Students in Grade 7 felt more comfortable toward complaining about doing maths during the first week of school. However, it was not long before Lysha helped the class

recall an event during the last week of the previous year; “Come on guys, this is Mr. Sench. Remember, he continued teaching ‘till the last bell sounded last year”.

Despite muttering voices, the Nokia Sets began. I wanted to gain insight about the students’ knowledge for pattern seeking and organizing simple data and discover their attitudes toward group work and behaviour working in groups. This exploration project required the students to decide how to organise their common and different interests in a single paper. I divided each class into groups of two, which included one Western and one Asian member. I served as the third member of each group, but without actually joining any group. I answered their questions about me.

I identified the following rules for each class member in each group to follow:

- Identify your singularities that the other two members in your group do not share
- Identify common threads common you share with only one of the other two members of your group
- Identify the common threads shared by all members of your group
- Express your thoughts in the form that suits you

The patterns of behaviour I observed during this first class session of the year were important for understanding the character of each class. The strengths and weaknesses of students were obvious and easy to observe. I entered these words in my journal about my students in Grade 6:

> The Nokia Sets activity went well, and I learnt a great deal about my new students today. Three new students joined Grade 6 this year, and two students had never been abroad before. The students seemed well-behaved who would work cooperatively in groups.

Among eight groups formed with 17 students; two used a separate list of items for each member of the group. The six other groups used diagrams, two of which also used colour pens. Their diagrams were all very much alike, different versions of Venn diagrams, indeed. However, only one student had actually heard of Venn diagrams.

I received many questions especially from the Turkish speaking students, some of whom asked their questions in English, but most of them preferred to speak in Turkish with me. That made it difficult for me to remind them that school policy was to speak English during class time. It was somehow understandable since I was not only their first mathematics teacher, but also their first teacher who was fluent in Turkish. I still did not want to discourage them in feeling free to ask questions, I however did not want to break the rules on the first day of school either.

The conversation I had with Emil and Diana was noteworthy:

E: Mr. Sench, I think I know what you are trying to teach.
R: What is it?
E: It is Venn diagrams, isn't it?
R: Well, Emil, you may call it whatever you want only if it fits in the rules.
E: Oh, yea? Look then, I will draw a map of countries with peace areas between them, and call it the United Nations. (While he was drawing the diagram, I interrupted).
R: Good idea, Emil, did you discuss this idea with your mate? (Diana was shaking her head in a negative response).
E: No, but I am sure she will like it, too.
R: Diana, what do you think?
D: I am fine.

The same activity was repeated with grade 7 although they had a mathematics class together last year. The entry in the journal was as follows:

> There are 2 new additions to grade 7, who are both native speakers of English. Both seemed to have warm personalities, and did not seem to be anxious about their first days at their new school. The project was a success. It was also pleasing to witness that all of the groups remembered last year's *Sets Unit* and used Venn diagrams in their papers. Two of the groups, also used the set notations to support their diagram. I discovered that Amuktha in the first group, and Yannick in the second were the ones who decided it would be a good idea to use special set notation.

4.5. Initial Patterns from the ISGI

This section includes the specific patterns observed in the responses of grade 6 and seven students to ISGI (see Appendix B) which was implemented at the beginning of the year. From the students' responses to the ISGI, it became apparent that they all were of high socioeconomic status, were economically privileged, and culturally aware. They all held the belief they would be going on to university, as all of their parents had, except Eda's mother and both of Devi parents. Further, they all held the belief that this was

expected of them by their parents, teachers, and friends as well. They all had at least one translating dictionary, and all of them except Rodrigo and Gabe indicated two or more languages were spoken in their homes. They also all had the basic materials for studying, and the parents of Eda, Asya, Haruka, Clarissa, and Devi were paying for private tutoring after school. In terms of social privilege and educational support they were remarkable.

In terms of their attitudes towards mathematics, the grade 7 students found learning mathematics more enjoyable than the pupils in grade 6 according to their responses to the ISGI (see Appendix B) question 17 – item (a), "I enjoy learning mathematics". Relatively, in the question number 17 – item (b), "mathematics is boring", the mean value of responses of grade 6 students was significantly higher than the responses of the students in grade 7. (independent t- test with the p value = 0.05).

Supporting the idea of mathematics as a cultural issue, in response to the statements "Mathematics is taught the same in every culture" and "Mathematics is the same in every culture", grade 7 students disagreed to a significantly higher degree than the grade 6 students (see Table 4.5).

Table 4.5. Grade 6 and 7: Mean values of the responses to ISGI question 17[3,4]

	GRADE	N	Mean
a) ENJOY *	6	17	1.82
	7	12	3.17
b) BORING *	6	17	2.59
	7	12	1.83
c) EASY	6	17	2.41
	7	12	2.00
d) IMPEVERY	6	17	3.06
	7	12	3.58
e) IMPYOUR	6	17	3.41
	7	12	3.33
f) JOB	6	17	2.71
	7	12	2.50
j) MATHSAM *	6	17	3.18
	7	12	2.33
k) TEACHSAM *	6	17	2.76
	7	12	2.08
l) WASHARD	6	17	2.59
	7	12	3.00

Regarding their perceptions on the cause of success in mathematics according to their responses to ISGI question 18, students in both grades agreed “hard work studying at home” with the highest mean, followed by “to do a lot of textbook exercises”. Both classes ranked the “good luck” as a bottom reason to do well in mathematics.

[3] The comments in ISGI “strongly agree, agree, disagree, strongly disagree” were converted to numerical scale, respectively as 4, 3, 2, and 1.

[4] Categories with asterisk indicate there was a significant difference between groups ($p = 0.05$).

The only significant difference ($p = 0.05$) between two classes occurred in item (e), where grade 7 students believed that it is more possible to succeed if the teacher explained everything (see Table 4.6.).

Table 4.6. Grade 6 and 7: Mean values of the responses to ISGI question 18[3,4]

	GRADE	N	Mean
a) TALENT	6	17	2.65
	7	12	3.25
b) LUCK	6	17	2.29
	7	12	2.00
c) HARD WORK	6	17	3.41
	7	12	3.67
d) MEMORISE	6	17	2.88
	7	12	2.92
e) TEAC EXPL*	6	17	2.53
	7	12	3.25
f) BOOK EXER	6	17	3.06
	7	12	3.33
g) PROJECT	6	17	2.65
	7	12	2.92

What was obvious from my observations and the quantitative data obtained at the beginning of the year that a year in the mathematics course caused a significant improvement in the enculturation process of grade 7 and helped them develop a cultural understanding of mathematics, whereas grade 6 students were socially acculturated to an international school setting but not yet enculturated to mathematics.

Analysing the same two questions in ISGI according to Asian - Western difference showed that the only significant difference between two groups was in item (i), in which students were asked to compare the curriculum in their home countries to our curriculum (See tables 4.7. and 4.8.).

Table 4.7. Asian and Western: Mean values of the responses to ISGI question 17[3,4]

	REGION	N	Mean
a) ENJOY	asian	21	2.67
	western	22	2.59
b) BORING	asian	21	2.05
	western	22	2.18
c) EASY	asian	21	2.33
	western	22	2.55
d) IMPEVERY	asian	21	3.05
	western	22	3.32
e) IMPYOUR	asian	21	3.48
	western	22	3.36
f) JOB	asian	21	2.52
	western	22	2.73
g) MATHSAM	asian	21	2.67
	western	22	2.77
h) TEACHSAM	asian	21	2.24
	western	22	2.36
i) WASHARD *	asian	21	3.19
	western	22	2.05

Table 4.8. Asian and Western: Mean values of the responses to ISGI question 18[3,4]

	REGION	N	Mean
a) TALENT	asian	21	2.90
	western	22	3.18
b) LUCK	asian	21	2.33
	western	22	2.00
c) HARDWORK	asian	21	3.52
	western	22	3.45
d) MEMORISE	asian	21	3.33
	western	22	2.64
e) TEACEXPL	asian	21	2.86
	western	22	2.59
f) BOOKEXER	asian	21	3.14
	western	22	3.14
g) PROJECT	asian	21	2.33
	western	22	3.05

4.6. During the First Term

After the end of the *Nokia Sets* activity, my students and I were happy to know more about each other's interests. However, as the teacher, I still needed to assess as to what extent the grade 6 students were ready for the coming year. Before the end of last year I had a talk with the grade 5 teacher in order to gain some information about my prospective students. Their class teacher had informed me about their IBO's Primary Years Programme (PYP). I had observed many common points between PYP and MYP, such as the intercultural links. The teacher had told me that she had been very pleased by her students' performances in the PYP programme. So I had been convinced that they could do the grade 6 curriculum with ease.

Despite the information I had obtained from their previous class teacher, I had to modify my pre-planned yearly plan according to my first observations in the grade 6 class. I realised that not all students had mastered some basic skills, so I changed the places of a number of units, and decided to extend the time allocated for some units. There were three students, namely Eda, Asya, and Clarissa who would need a modified remedial plan because they were at a significantly lower numerical ability level than the rest of the class. I decided that they should work on their times table first and do extra drill exercises. They were quite resistant to memorising the times table, but I explained the benefits of memorising in that it would help them reach the answer faster, so they could study and learn more. Personally, I never understood this prejudice towards memorisation. I was not telling them to memorise the times table because they could not understand but just not to waste time and to move one step further. This was a dissonance on my account, and needed to talk a lot about this.

During the first term, and the majority of grade 6 students were not very comfortable with being in middle school. They were still trying to adapt themselves to the chaotic nature of middle school. The year before, they had only one class teacher and subject specialists like PE, music, arts, and languages. However, last year the core subjects, such as maths, science, humanities, and English were all taught by the subject teachers. They were learning to cope with the different requirements of several subjects.

Grade 7 was going to learn many new topics like integers and equations. I was satisfied with grade 7's performance in the first term; they knew what I wanted them to do, and I knew what they could do. With respect to the new members of the class, Defne and Gabe, I must say they were very clever youngsters who understood very quickly what I was doing in class. Defne's ability to adapt quickly was understandable since she had lived in two different countries before moving to Turkey. But Gabe, who had never been abroad, was very comfortable and it was surprising. When I asked him about this transition period, he said: "I am good at maths, so it does not matter much who the teacher is, and you teach from American books. We used to use the same books in the US". The only frustration for Gabe was my research assignments. Gabe had just moved to Turkey with his father, and they did not have Internet access for a couple of months. He had suffered from lack of resources.

During the month of November, I announced that I would need volunteers to help me publish a mathematics gazette for the school community. There were five students from each grade. Haruka, Slava, Burak, Emil, and Jonas from grade 6, and Selin, Jung Min, Amuktha and Gabe from grade 7, volunteered for this major event. It was noteworthy to have only two Western students and eight Asian students in the group. The paper unfortunately was published twice, as it was not easy to gather and work at a time that suited all of us. I regretted that I had voted in favour of limiting the recess time to five minutes at the teachers assembly.

Volunteer students were expected to write an article related to mathematics. I put no limits on the degree of creativity and imagination. Emil, and two Western students Jonas and Gabe produced great articles and merged their imagination with mathematical concepts but the rest preferred to copy and paste from the Internet.

The first term ended with success for most of my students. Just to provoke their curiosity, I told my classes to get ready to become double zero agents. The Spy Game was coming soon…

4.7. Spy Game: (February–March)

The Spy Game was a four-week treasure hunt game consisting of four missions (Appendix I). After a careful planning period of 10 days, the game commenced with the training session in February. Since the game is about spying, when quoting from my research journal about the conversations with students, I will refer to myself as Instructor of Headquarters" - HQ. The participants of this game were all students from grades 6 and 7 and the game and the discussions were done together. Then the interviews with the focus group took place.

4.8. The report of the Spy Education Programme

Headquarters was responsible for the safety of its secret agents so that the training sessions were followed with great attention and the skills taught were mastered quickly. The training session was about learning the basics of cryptology and the history of code breaking. This part was implemented with the help of Simon Singh, who was the author of the *Code Breaking Book*. The video material supplied with the book helped HQ to deliver a broad history of code breaking, including Caesar's transition method, freemasons' pigpen method and scytale as well as the pioneers of code breaking such as Al-Kindi, Morse, and Turing.

Agent Hugo was very motivated like other agents at the start of the programme. After the end of the first video session, he jumped in the air and said, "I am Go, Hu-GO". Agent Sara's interference was full of teasing, "Oooh, yes, Hugo, shaken but not stirred". Although the Instructor did not make any verbal reference to James Bond, the music playing in the background was deliberately chosen to be the theme of the famous movie.

Some agents had obviously heard about cryptology before. Jasper asked about the Enigma machine, and Yannick asked whether barcodes were examples of cryptology. Gabe was anxious about the safety of his father's credit cards during a purchase via the Internet. Only 2 agents out of 29 were somehow paying less attention than the others. The two Russian boys Nikita and Slava were too busy discussing a football game:

I: Did you not find this interesting, Nikita?
N: Yes, it is interesting. [quickly] is this going to be in the test?
I: I may or I may not ask anything. I have not yet decided. What do you think about code breaking, is it worth asking on the test?
N: It looks hard, please don't ask.
I: What makes you think it is hard; it is just the first training?
S: They don't teach these in Russia, I never saw a thing like that.
I: Did you know there were Russian cryptologists trying to break the codes of the USA during the cold war?
S: Really? I don't know. Will you talk about them? I'd like to learn about Russian cryp-tolo-gists [he had some difficulty in saying the word]
I: I can lend you the Code breaking book and you can find in it, then share it with Nikita. Maybe then he would be interested, too.
N: Give the book to me, I can find it myself.

The instructor was happy that these two Russian boys from grade 6 were back in the training and became interested in code breaking. So, the training session continued with the testing of the handy spy instruments. Agents tested *Caesar's shifting method* on alphabet wheels. This instrument was developed by the instructor, but should have been fixed by the agents. They wrote the letters of the alphabet on the edge of two concentric circles. These circles were not identical, as one of them had a smaller diameter. Agents discovered that by rotating the inner circle, they could substitute each letter by another letter. Thus, cipher or decipher texts. Then the instructor announced the teams, and each agent was assigned to one of four groups. This grouping was decided according to the houses to which the agents belong in school. Thus the groups were mixed, and in all groups asian-western and grade six-seven ratio were approximately one.

When it was time for the first mission, (Appendix I.1.) agents spread out to locate the four posters hidden at different places around the school. Each poster contained very important information about the real names of our top directors whose undercover names were the names of four mathematicians from India, Turkey, England, and France. This mission was about learning who our directors really were.

Amuktha was confused. "But how do we know how many shifts were used during the ciphering". The answer came from Defne. "You try all, there are only twenty-six chances". Two houses discovered some tricks; those came from Yannick and Andrea. They explained the trick at the end of the mission to everyone in the class. Andrea's trick was an educated guess. He hypothesised that the Turkish mathematician was me, and confirmed his answer by checking the first few letters. With this information, he said, the rest was a

piece of cake. Yannick, on the other hand, realised that all the names started with QW or QV and followed by a dot. He guessed that was a prefix, and could be either Mr. (Mister) or Ms. (Miss).

Gabe surprised me by finding the method of a famous Arabic cryptologist, Al Kindi, whose discovery was a milestone in the history of codes. Gabe took a look at the encrypted text and guessed that the most frequent letter G should have been substituted by E, the most frequent letter among English words. Gabe had discovered "Frequency Analysis". He shared his idea with the rest of the agents in his group, they tried to see whether his guess made sense, and then tried to crack the code, but they failed.

I: How did you know the most frequent letter was 'E' in English?
G: From the Internet, I read that kind of stuff, but it did not work.
I: Why do you think it did not work?
G: Because only one teacher had an English name, [looking angry].
I: [smiled] Then Gabe, do you think would your method work with any four English words?
G: It should, you have to guess it too.

Then I chose four random words from the dictionary, used a random shift and asked Gabe to use his method again. The rest of the class was curious about where this challenge was going.

I: Why do you think your method did not work this time?

Amuktha was at the back listening, and then raised her hand. She said:

A: I think you need more words, Gabe, with four words it is impossible.

The instructor was impressed that Gabe indeed discovered the method of Al-Kindi. He was congratulated by the instructor. Gabe seemed to have forgotten his anger and enjoyed the praise. Agents were all surprised to learn that Blaise Pascal was their French deputy principal, Aryabhata was their Indian IT teacher, and Isaac Newton was their guidance counsellor from England. Finally, Ulugh Beg was their mathematics teacher from Turkey.

The instructor found out that some further patterns emerged during the other missions of the game. One significant pattern was about the pigpen ciphering game. Thirteen of the agents knew of this game (see Appendix I.3.). When asked, seven agents

replied that they had learnt this game from their friends in their former schools. Four of them said they had learnt this game from their friends and saw it in newspapers or books. Two of them replied that they had read about it in a book. The students who said they had heard about it from their friends either were Western or had attended an international school previously. The students who said they read it in a book were both Asians.

The third mission, scytale, was about finding a stick or making a tubing with the correct diameter. They were then supposed to roll the paper with a message in mixed letters on and decipher it. All students worked well on this mission. Instructor had noted down that grade 6 students took leading roles, more often than the previous missions, and Asian students in grade 6 started to participate with enthusiasm.

Some other interesting patterns also appeared in the "Unlucky Triangle" game (see Appendix I.5.), in which students had to place numbers from 1 to 8 to circles located on the side of a triangle. The goal of the game was to find the sum 13 at each side. Although neither I nor the other teachers helping me noticed any negative atmosphere during our observations in the game, Jonas brought to our discussion in the class that the number 13 had made him feel sick during the game because of its "evil powers". Six other students also confirmed that they felt the same way. Although, the majority of the participants except Clarissa, Sara, Asya, and Andrea, disagreed with Jonas, everyone agreed with the idea of some numbers having special powers. Sara explained:

> First of all, I do believe that numbers have special powers in the way that it affects people. For example, if a person sees his lucky number in a math problem, they will do it better, because it is in their brain.

Then she continued speaking in an excited, rapid tone of voice,

> I do believe some numbers are scary, for example this year something going to happen on the 6th of June. It is the Devil's birthday, and it is 666. I am not going to leave my room on that day, and, and I have 13 in my life, so bad things happened to me. I fell down the stairs and broke my leg last year, and it was the 13th of the month, and many other bad things happened to me on 13s.

Gabe had a totally different perception of the number 13. He actually said it is a lucky number for Americans, because, "on the flag there are 13 stripes and 13 colonies" and about the 6th of June he said, "I will feel so confident that I will insult the devil on that day". Jasper explained:

> I think if you search for a certain number you will find it, everywhere. Let me pick, say, hmm, let's say 134 is my unlucky number. Ok? Is there going to be something bad in 20 minutes? Because it is now four past one. Or does it mean anything if you open your emails and find 134 emails in your inbox

Further in the conversation, students tended to agree that the powers of numbers are limited to individuals and that is psychological or as Yannick said, "we just notice it because we say that number is lucky or unlucky". We all also learnt that there are other numbers having special meanings in different cultures, as Amuktha explained six has a very spiritual and positive meaning in Indian culture.

I also wanted to learn their opinions about the mathematicians that appeared in the game. No one but Amuktha knew Aryabhata, and nobody had heard about Ulugh Beg. There were 19 students who knew Pascal, and Isaac Newton was known by all 29 students. The 10 students who did not know Pascal but knew Newton were all Asians, except Jorge and Devi.

During the class discussion, I asked, "what would happen if Newton was born in India and Aryabhata in England?" Diana's point was interesting. She said "Newton could not have found gravity in India, because I don't think there are apple trees in India". Jasper, Luis, Sara, and Hugo pointed out that with the vast opportunities Newton had in England, Aryabhata could have found greater things in England than Newton. Rodrigo and Gabe both believed that Newton was much more advantageous than Aryabhata because he had many more mathematicians around him to exchange ideas. However, Aryabhata and Ulugh Beg were the only clever people in their countries, they said. Apparently my students mistakenly believed that England had always prospered and that India had always been poor throughout history. When I criticised their point of view and asked, "India was once as rich as England is now. Why do you think we all know about Newton but no one knows about Ulugh Beg, or only Amuktha knows Aryabhata"? Then Lorenza raised her hand and said, "I think it is because of TV or that all books are written in English, and I think English people are more sensible towards their culture. Because I did not know Fibonacci before you told us about the golden ratio. I never saw his name in Italian books before".

Everyone seemed to agree that cultural background has an effect on the success of a mathematician, except six Asian and three Western students who claimed if a person is clever, it does not make a big difference where he was born or raised. These students were all in grade 6 except two students from grade 7.

All the students in grade 7 and only the Western students in grade 6 knew at least one mathematician from their culture, and none of the Asian students in the group of grade 6 students could name a mathematician from their countries. The reason that grade 7 students knew of a mathematician from their country was simply because of a project they had worked on the year before. They had all presented the life and works of a mathematician who was born in their home country.

The majority of the discussion was dominated by the Western students, whereas, Asian students in class were silent and would not join the discussion unless I directed a question to them.

In the focus group interview, I asked Amuktha her opinion about mathematicians in the game:

> I: What do you think would happen if Newton was born in India?
> A: I think, he was anyway going to find gravity theory, maybe not with the help of an apple but perhaps a rock would hit him.

At the end of the game, everyone was happy about being a part of this training. All students expressed their appreciation and said that they had never had such activities in their home countries. When I asked Sara what was special about the Spy Game, her answer was "Spy Game was a multicultural game, and we learnt that there were mathematicians in all cultures". Defne said that she had previously participated in classroom activities like Spy Game in her school in Botswana, but those were not as well planned as this one. Jonas' mother wrote a letter of thanks to the HQ for training her son as a multicultural spy, and expressed her appreciation for decreasing his anxiety caused by leaving his home country.

The game ended with the presentation of gifts to students in the winning group. I was happy to be their instructor.

4.9. More Specifics

In this section I will analyse data according to the data obtained from the interviews with the focus group. Quantitative analysis of relevant data will be used to support my findings. Figure 3.2 will be our guide in the categorisation of data to be analysed.

4.9.1. Core mathematical

The quantitative analysis and my observations and interviews showed that the pupils in grade 7 mathematics classes were more positive towards mathematics than grade 6 students. Neither group found mathematics to be an easy subject but students in grade 7 were enjoying being in a mathematics classroom more than grade 6. I also observed a slightly positive change in the way that grade 6 students approached mathematics during the year. Hugo who was a grade 6 student wrote in his journal as follows:

> I think mathematics is not something you need every day in life. It is something to make our life difficult at school … Maths is important for my future and I know I have to succeed. I just do not like it much but I don't hate it anymore.

Lysha defined the change in her attitude as dramatic after she started attending international school:

> I hated maths when I was in Malaysia and Taiwan, but I think I like maths here. I didn't know I was using maths in my life this much, except during shopping of course. Now I know, for instance, in photography, shutter speeds are fractions.

The quantitative analysis of the question number 17 in the ISGI supported the qualitative findings that there were no significant differences between Asian and Western students in terms of their answers to items "I enjoy learning mathematics", "Mathematics is boring" and "Mathematics is an easy subject" (see Appendix C); however, in commenting on mathematics, Asian and Western students showed some variety in the reasons why they liked or why they did not like maths. Amuktha defined mathematics as "an exercise for her brain and refreshment for her mind". Defne said she likes mathematics because it was "like a rainbow with many colours in it".

During the interview with Amuktha, I recognised that she often used ordinal numbers to describe her past achievements. She was assessing her success in mathematics by comparing herself to other students. I noted many similar comments that came from Asian students. Amuktha was actually explaining the real reason behind her interest in maths:

> In my old school, I had fun with mathematics because I used to come 2nd in my class and all teachers liked me".

Although mathematics was a matter of being better than others for Amuktha. Defne, who was from a Western country, seemed to have a closer understanding of mathematics as a way of refreshing the mind:

> I really feel good when I am learning something new. In maths we learn new things, we don't repeat old knowledge. It has many different stuff in it, and if you don't like one topic, there is always something else you may find interesting.

Eda, who was from Turkey, had mixed opinions about mathematics. She knew maths was important to be successful in life; however she was still not sure about including mathematics into her area of interests.

> I: How does it feel to be in maths class?
> E: In your class or in general?
> I: Answer generally and include your past experiences.
> E: Ok, hmm, it was scary last year; don't tell this to Ms. G, ok? But I think I am better at it now and it is good, I don't have stomach ache before maths lessons anymore.
> I: Why was it scary last year, and what changed your opinion this year?
> E: I was a terrible student last year and I think my mother was putting too much pressure on me. She is now better because Ms. C. [learning support team specialist] talked to her not to stress me out. I also have a teacher coming after school. I feel much better this year and you teach better than Ms. G.
> I: How do I teach better?
> E: Well, you prepare lots of different things for us, I like to solve your puzzles, or listen to your mathematical jokes and you also have lots of cartoons. The projects are fun, and interesting, but you give too much home work.
> I: Hmm, would you like to do some maths just for fun, after school not as a study but as a hobby?
> E: No, sorry, I still hate maths. I just find the way you teach easy. Maths generally is for clever people, I will just learn enough to pass my grade.

According to Gabe, mathematics in school was a way of making students work more. He was still aware of the fact that maths out of school was a life skill needed to get a job; however, he still did not see a practical benefit in his life yet, "I don't know, how

many times a day do you think, Wow, if this problem were an equation, then x would equal 7.5?"

Mathematics was an important subject for everyone in order to be successful in life, or at least was necessary to be admitted to good universities. However, mathematics was not a fun thing to do after school. Defne's entry in her journal explains everything:

> Although Maths can be intellectually stimulating, I think the fact that whether I enjoy it or not is less important than the reality I need to work hard at it because of its importance in daily life.

More or less all of the students agreed that the cultural environment affects our decisions about life. But when it comes to mathematics, as a cultural science, differences occurred between grades 6 and grade 7 students. Grade 7 students believed mathematics was differently interpreted in different regions of the world. Selin wrote examples to support her argument. Her entry in her mathematical journal was the following:

> It was good to learn Indian people, or people in Africa did some mathematics, too. They created several games to amuse themselves and develop their thinking. Many of them used pebbles to count their sheep. But they never needed big numbers so they did not invent googolplex. Or for example, sun was a religious thing for them, so they invented astronomical calendars. They developed architecture in order to build big temples to salute their kings and they needed sines and cosines or angles….I believe our beliefs shape the way we understand and use maths. I think I have a different mathematical understanding than many people in my class.

Hugo from grade 6 believed mathematics was the same everywhere:

> I think the numbers and shapes do not change if you go to Africa or Canada. People use the same things for different reasons but still use the same rules mostly invented by French mathematicians.

Students described the mathematical culture of their classrooms by using words like; mixed, very cultural, and colourful.

> Selin said, we have very different approaches in class, Gabe for example is a math geek, and confuses us by asking weird questions or Jung Min asks brainteasers all the time. I think it is good to have so many different people in class, because I will not have any difficulty on my next destination and I'll be more prepared.

Defne agreed with Selin's point, "I agree, having different perspectives will make us more flexible to future challenges".

4.9.2. Teaching and learning mathematics

Students' comments on this division were diverse and mixed. The data were hard to break into sentences and categorise further, so I preferred to let the students talk first. I will analyse the data as a summary and conclude.

All students in both focus groups agreed that international school teachers are friendlier than the teachers in their home countries. Students defined the role of their teacher in their current school by using words like, "like a friend", "someone who understands what we feel," or by using adjectives like, "funny", "relaxed", "understanding", "hyperactive", and "young". The role of their teachers at home was defined with words like, "strict", "good mathematician", and "old".

Defne, (was not a member of the focus group) who had been in an international school before wrote in her journal:

> I think teachers teaching at international schools have more preparation and spare time than my teachers in the UK. Teachers here are more relaxed, like my teachers in Botswana. They don't look like they are doing a stressful job and I think that makes them more understanding and not very strict. They are usually funny people, like you or Mr. Mac. [the science teacher] and you both can make the lesson fun. So I think you are like a friend to us. It was amazing to see you at my birthday party at McDonalds. Teachers in the UK do not do that. Once the class finish, we never see them.

Selin wrote in her journal:

> You do a thesis, asking questions to us to know us better, or how we learn. You were not doing a thesis last year, but still giving us lots of forms to complete. I've never seen a teacher asking me to grade his teaching before. I think you really care each of us, and this is I like about your class. I do not feel forgotten, but it is also impossible not to do homework, because you write everything down.

Hugo defined international school teachers as social people who do not avoid spending time with their students:

> You are my first mathematics teacher and you can play football so good. In France my teachers were old and they were all women. Never playing with us but just watching us. I think a good teacher should share similar interests with his student; he has to understand what we like.

Amuktha described her teachers in India as strict but as good mathematicians:

> My teachers were very very strict, and the lesson was too advanced sometimes and I was bored and feeling sleepy. When I say I don't understand, the teacher was just repeating the same way. He was a great mathematician; he was always solving all problems in blink of an eye. The teachers here are hyperactive, and you especially do not stop moving and that sometimes is annoying me because it is hard to follow you. And I think you like to teach us mathematics but I am not sure you like to do maths. Because you never solve it on board, always ask us to solve it.

Lysha was most impressed with the perseverance of her teachers:

> What I most like here, teachers, generally speaking, never stop explaining until everyone understands. And if there is still someone didn't understand, he can ask after school or can ask help from the learning support teacher…You know I don't feel comfortable in asking questions but you come and ask me privately not to embarrass me and I appreciate it.

Burak was happy with the metaphors I used in class:

> He tries to make methods simpler for us with little stories and ways of thinking about equations like the fireman method, which is 3*(6-2) = 18 – 6 = 12. The fireman which is number 3 in this example frees all people in building. Or the bullet/men method in negative numbers … says the problem is "what is -5 + 12?" Here the + are people, and – are bullets so if you have 5 bullets they can only kill 5 people and 7 left …

According to Selin, Eda, and Burak, the role of a student was to study hard, and to behave well, whereas Gabe, and Yannick responded as "to learn to be clever" and "to learn to be successful in life". Defne and Sara answered as "get skills needed to be admitted to a good university" and "become socialised".

Selin, Burak, and Lysha, who were both from Asian countries remembered how hard their classes were in their home countries. The entry in Lysha's journal was the following:

> I am going to leave and go back to Malaysia at the end of this term. What a pity, I was just becoming good at maths. Maths is so hard in Malaysia, I will fail again. I love my teachers in international school because they are friendly and I think we are doing student-centred education.

Selin and Burak described our curriculum to be challenging and they said mathematics here requires more thinking. Lysha and Eda agreed that they spend more time here

deciding what to do rather than actually finding the answer. They said the situation in their home countries was the opposite. Gabe described his maths class in United States:

> I think Math was easier in States. Instead of concentrating on one subject and learn everything about it, the teacher was changing her point every week. That never let the topic become an advance topic for us. Like we were eating appetizers but the main dish never came.

The curriculum I prepared for grade 6 and 7 followed a spiral model, too. Topics were revisited over years and became more challenging as the grades progressed. Since Gabe never had complained about my curriculum, I assumed the diameter of the spiral of our curriculum was larger than the spiral of the curriculum that Gabe's school used.

The most obvious pattern was that all Asian students found mathematics in their home countries as more difficult. Hugo was the only Western student who described the mathematics in France as more difficult.

Students as a rule like projects and activities more than drills. However, Asian students did not believe in the usefulness of the projects, and favoured drill exercises. Problem solving was generally an unpopular activity for Asian students. The conversation I had with Haruka was a beautiful example to show how she thinks:

> H: I don't understand this question.
> I: Did you identify what is asked? Givens?
> H: I tried but everything is mixed?
> I: Is the problem about understanding the language?
> H: Yes, a bit. But I know all the words, just the question is like hidden.

Haruka's comments on projects or investigation assignments were generally negative and she did not believe that mathematics without numbers is mathematics. Eda had a similar problem about a worksheet I prepared. In this activity they were supposed to visualise how the lengths of pipes are inversely related to the frequency of a note.

> E: There are no numbers in these questions. What am I going to do?
> I: There are no numbers because those people invented the panpipe before they invented the numbers.
> E: How come? So you say they used mathematics before they knew mathematics?

The projects and activities are important to help kids link the real life and mathematics, however I believe mathematics lessons should include a variety of instructional methods;

including enrichment, interdisciplinary team teaching, practise, problem solving, remediation, and technology. Projects are one of the major components of MYP, and however not the only method. When asked her opinion about the MYP programme, Jasper replied:

> The MYP program is Ok. But I think it should focus more on the fundamentals such as Math, science and so on instead of always focussing on doing projects not related to the fundamentals.

Based on my experience working within the MYP for 4 years, I agreed with Jasper that a complete mathematical education cannot be achieved without teacher-centred lessons and textbook practise in addition to projects. Jasper's disagreement was a general complaint about the hours we had to spend to do school-wide non-curricular activities initiated by school admin or MYP coordinators, which resulted in wasting time that could have been spent on our valuable mathematics lessons.

The two most important elements of teaching in MYP are cooperative learning and problem solving for Maths. During the year, I kept a separate paper for each student in my journal and assessed their performances by using different forms. Two of them were the "Problem Solving Teacher Assessment Tool" (see Appendix D) and the "Cooperative Learning Teacher Assessment Tool" (see Appendix E). While submitting their final grades at the end of the year, I took the averages and rounded them to the nearest whole. According to those final grades, I applied a quantitative analysis to those two forms, and compared results in terms of grade level and regional differences. This analysis showed that, there was not a significant difference in problem solving between the grades, however, there were a number of indicators that Asian students performed significantly lower than Western students, such as the following:

- Studies tables or graphs
- Can restate problems in own words
- Can identify question to be answered
- Estimates what the answer should be
- Shows solution in organised fashion
- States answer in sentence giving correct units
- Checks that the answer is reasonable

- Tries other ways to solve problem

In one indicator, "computes correctly", Asian students performed significantly better than their Western counterparts. See Appendix C for the details of the independent t-test with $p = 0.05$, in which a reliability value of 0.8859 was obtained.

Regarding the cooperative learning indicators, "*speaks quietly*" was the only indicator that there was a difference between grades 6 and 7. Apparently I assessed grade 6 students as they were quieter in class. In terms of the differences according to the regional separation Asian students better in these categories:

- performs assigned role,
- stays on task,
- works systematically,
- considers and uses ideas of others,
- speaks quietly,
- initiates questions,
- disagrees without being disagreeable

Western students performed significantly better at the following categories:

- demonstrates problem-solving ability
- works with others in the group

The most remarkable and surprising result was that the Asian students performed better under the "initiates questions" category. However, this should not mean that they were participating in the discussions more than the Western students but that they were asking more questions about the instructions or group work procedures. One other factor that must be considered is the fact that English was the second language for the majority of the Asian students. My observations indicated that the first person to direct a question about something they did not understand was the teacher. They preferred asking the teacher directly instead of asking their friends. See Appendix C for the details of the independent t-test with $p = 0.05$, in which a reliability value of 0.6239 was obtained.

At the end of the year, the overall grades were calculated according to my assessment in the following categories: "problem solving, cooperative learning, math writing, class work, homework, participation in discussion, quiz scores, and test scores. The grades did not show any difference in this summative assessment, whereas Asian students were out-performed in two categories:

- Problem Solving
- Math Writing

See Appendix F for the complete criteria and Appendix C for the details of the quantitative analysis of the final grades.

Assessment procedures in PYP and MYP differ significantly. Students in grade 6 were not used to formal tests, thus, not experienced in my one session, 10 questions, unit tests. However, after a week of preparation on how to study for tests, they were much more relaxed. Eda was pleased about these lessons that they learnt test techniques:

> I: How do you feel about my tests?
> E: I think it is a mixture of everything, you ask words problems, then you ask short exercises, but your word problems are funny, how can you ask a prime number question about Beckham's shirt number?
> I: Did you find the pre-test sessions useful? How?
> E: Yes, very much indeed, because we didn't write exams last year, and this year before the first test, I could not sleep all night. You told us some revision tactics, and you asked similar problems so I passed.

Students had varied perceptions about the teaching methods that they had been exposed to in different schools. To summarise the troubles that my students' experienced, Lysha's voice might be helpful:

> Well, ever since I moved, I noticed the different ways people teach. I was amazed at the different tactics they teach but I wasn't happy with my thoughts towards maths. Because my brain couldn't get used to the math they were teaching. Then as I moved to another country the methods changed. That's why I can't do maths, well, because I keep comparing them with different perspective and then I get mixed up. It's a problem of me.

Defne, Gabe, and Hugo described the difference between my teaching style and their previous teachers' as not significant. I asked Defne and Hugo to be more specific, and the

answer was that Defne and Hugo were particularly talking about their teachers in international school they had attended. Defne clarifies:

> No, not the one like in UK. I think you are like my teacher in Botswana. He had been in Botswana for years, and he taught us many things about African mathematics, we were playing weird games with him. That's why I said you are like him.

4.9.3. Using Mathematics

The established policy of our school, regarding homework load was to allow each core subject teacher to assign 30 minutes homework twice a week. During the first teacher assembly in the first month of the year, I raised the issue that my subject requires students to do more homework at home. I was successful in convincing other teachers and the middle school deputy principal on that matter. I was then allowed to give 45 minutes of homework twice during weekdays and an hour of work on weekends. The students did not welcome this update.

Gabe defined course work as being overwhelming because of the repetition exercises:

> When I first came here and saw that we were doing Integers, I thought this will be easy. And it was. But then Mr. Sench started giving us more and more work. So it was easier when I first came then it is now. Actually, it was how much that was overwhelming.

Homework was as an integral part of the course work in middle school and a good way of revision for the tests. Grade 6 students had difficulties in this respect during the first term; they were not used to get prepared for tests, or final exams. Grade 7 found my tests similar to quizzes but different from the exam questions they were used to. Lysha was starting to study two or three days before.

> I: How do you prepare for tests?
> L: I read and solve the problems in my notebook; I know you ask similar problems.
> I: What else do you do, or you think you should?
> L: I must start studying earlier I think, but you know, usually there are other stuff too, like everyone gives so much work to do.
> I: What would you do if you had started earlier?
> L: I'd study from the book; there are plenty of exercises in the textbook.

While Lysha did not mention for asking help, Haruka was studying with her mother on a regular basis.

> H: I study every day with my mother, she explains me the things I do not understand in the class.
> I: Haruka, that's what I don't understand, if there is something you don't understand why don't you ask in class?
> H: But, I like to study with my mother, and I feel like I understand it in class, but when I go home, I realise that I didn't.
> I: Ok, tell me how do you study with your mother? What is your hint to have good grades?
> H: We go over all the questions you solved in class, then she asks me similar questions, and I solve them.
> I: Do you ever study alone?
> H: Only to do my homework then after I finish them, I work with my mom a little more to repeat the day.
> I: Does she also help you during projects?
> H: Yes, she searches the Internet with me.

Parental roles in Asian countries were significant. If the parents were not capable or available to help, as it was in Eda's case, they hired someone to help their child after school. I asked Defne whether she studies with her mom, she said,

> I usually study on my own, or study with my friends. This term Lysha and I studied together. We revised your notes together. I think we both benefited from it.

The variety in mathematical notation systems used by the students was the most obvious difference I observed during my two years teaching in the international school. One of these differences was the long division notation. Some students wrote the dividend at the right of the divisor, including two Turkish students, Rodrigo, and Andrea but the rest the other way around. Another difference was also about division. Almost all students were using "÷", whereas ":" was enough for me and easier to type in word processors. The place of the percent sign was another difference. In Turkey, it is common to put the % sign before the number, whereas the rest of the world does it the other way around. However, the most annoying difference for many students was the measurement unit systems. Imperial system and IS system competed throughout the year; I used both in my lessons.

Although Gabe and others who are used to American currency were happy to solve problems using dimes and nickels in our textbook, this did not mean much to many of us. Another significant experience with Gabe was that he was insisting to correct me when I wrote "maths" instead of "math" as a way of shortening the word "mathematics". These were all small but obvious differences that anyone after spending two hours in an international school mathematics class would recognise.

4.9.4. Values of Mathematics

Students' values and beliefs are the foundations of their behaviour, and actually at the core of all the data obtained. But these values and beliefs are at the same time, the consequences of their enculturation.

Contrary to previous interviews, the questions to be asked of students were prepared beforehand, and these interviews can be defined as structured interviews. The questions were not changed or altered during the interviews unlike the previous interviews which were designed to collect data in order to portray the general culture of the classes.

Bishop (1988) does not claim universality of these values. Moreover, according to the summary of the Values and Mathematics Project (VAMP) website (see Appendix G) it is limited to Western understanding; however, since there was no valid literature on Asian values, I will look for patterns in the data obtained from all of the students.

According to interviews with the focus group and my observations as their teacher, all students preferred to get the right answer instead of finding an alternative solution, or develop their solution. However, Western students in both grades, and Asian students in grade 7 believed in the benefit of classroom discussions. Lysha said that she found it very useful to hear the opinions of her classmates and it helped her to have a better understanding of mathematics. However, Burak and Eda in grade 6 defined classroom discussion as a negative factor and thus that they became confused. Haruka and Hugo conversation was as follows:

> Haruka: I prefer solving problems rather than writing or talking. I sometimes feel like we are wasting our time with discussions. For example, you asked us "how can a negative number exist, if zero represents nothing?" That confused me and I don't understand why we discuss history, we do that in humanities.
> Hugo: We never learn mathematicians in humanities, I think it is good to know, for me at least, to know Pascal, for example, and he is French.
> Haruka: Yeah, but we never learn about Japanese mathematicians.

The chapter projects were comprehensive investigations that students should search Internet, find relevant information, collect data, and present their findings. All students

expressed their complaints that it took too much of their time and it was hard to find information on Internet. Defne disagreed:

> I think they are useful, because we see how people in the world use mathematics. And it is like a puzzle, you have to find information and answer questions, which in the beginning do not look mathematical but you see it at the end that you actually used mathematics to do all that stuff.

All students preferred reading graphical representations rather than reading an explanation in sentences in order to understand a problem. However, they admitted that they would prefer not to use it in their solutions but instead would just write the correct answer. All students in the focus group except Haruka disliked drill exercises and repeating the same type of problem more than once. Gabe especially complained about it:

> You certainly give too much homework, and most of the time they are all the same. I wish I would invent a calculator that can do the work for me.

Haruka replied that it was useful for mastering the topic and she said in order not to forget what to do later; she would prefer solving many of the same kind of problems. None of the students were actually checking their answers, but Western students were controlling their solution with the answers of others, whereas, Asian students were waiting for the teacher to check their answers. I observed that Asian students were highly confident in their abilities to find the correct answers.

Students' comments on lessons when we talked about the pioneers of mathematics were generally positive. They were especially curious about what kind of a life style they had or what caused them to realise or invent the secrets of life. They all believed that mathematics was the way that clever people expressed themselves. Lysha said,

> …when you told us about Fermat, the Italian guy, I felt so sorry for him. He was so close to find the answer but died and I think he was creative because he was finding something new, and in order to be creative I don't think you have to be musician, or artist.

Burak, on the other hand, accepted that mathematicians were creative but disagreed that it helps people to be more creative:

> I don't think mathematics has anything to do with creativity, actually I think it kills creativity because it sets rules about what is beautiful and what is not beautiful.

Students described our class environment as democratic because they were allowed to express their opinions and ask questions freely. Lysha explained the way we negotiate the meaning in class:

> You explain it, and if Rodrigo, or Selim still have questions, you ask someone to come and explain it on the board instead of you. And usually it is Yannick or Gabe, or sometimes Defne. One of them comes and explains the same problem like a teacher.

Haruka expressed her discomfort during her times at the board:

> Sometimes you say the class needs a different approach, but I think you want to torture me. So, I don't know, because you always pick me to explain it. I don't like to be on the board.

4.10. Ending the Year

On the last week of the year, I asked students to write their final opinions about mathematics while remembering all the activities we completed throughout the year. No member of the grade 6 class refused to acknowledge the connection between mathematics and culture. The vast majority of the class in grade 6, except Clarissa, Asya, and Luis directly referred to the cultural aspect of mathematics or used the word "culture" in their journals.

The journals of grade 7 students did not include any counter opinions to mathematics as a cultural phenomenon. However, there were only four students who referred to or used the word "culture" in their journals.

All students except, Burak agreed that mathematics is invented by human beings, but God has given them the necessary skills. Burak's point was humans discovered mathematics, but did not invent the rules of mathematics. He said the rules were already there. That he said, a Martian visiting Earth would find the same principles. Students do believe mathematics is mostly abstract but certainly is related to life. They believed that the invention process was abstract and then it became useful for others. Lysha said:

> I think in order to make the best out of maths, a country needs two kinds of people. The inventors and the people to find a way to use those inventions.

None of the students, except Amuktha had ever read a popular book related to mathematics. However, they had watched movies like Good Will Hunting, Beautiful Mind.

5. SPECULATION OF THE DATA

This chapter of the study speculates on the data, which were reflected on the portrayal of the culture-sharing group of the international school middle-school classes under investigation.

It relates the data to Bishop's (1988) theory, and intends to determine to what extent the theory was successful in explaining the patterns found in multicultural mathematics classes. It further looks deep in the data to find solid support from the literature to explain the singularities and common threads of Asian and Western students or grades 6 and 7. In particular, this chapter is the researcher's evaluation of the students' perceptions about their own ideas, norms and values, and a legitimate effort to generalise the results.

5.1. Culture of the Mathematics Classes

The transient nature of the school, and small class sizes were important barriers to the creation of a consistent mathematical culture within the classes. In order to help the reader conceptualise the nature of this fast-transforming change, an analogy from chemistry might be helpful:

The atoms of a molecule formed in gas are highly vibrant and they move at high speeds which increases their viable chance of interaction with other atoms. Chemical reactions happen due to these interactions so that new molecules are created. However, they are hard to control, do not move in one direction, can easily escape, and the bonds amongst them are weak.

The metaphor explains itself. Relating it to expatriate life is simple. This dynamic, fast-changing diverse environment is an extreme example of the change described in Bishop's (1988) enculturation definition, and it follows an accelerated cultural shift. This sort of a setting, which comes along a fast changing culture, puts many students at several disadvantages.

Firstly, the culture of the class becomes extremely brittle, and easily effected even from small changes, resulting in confusion and discomfort among kids and teachers. The introduction of two students in grade 7, for example had a dramatic effect on the formal enculturation of the students of that class. The researcher willingly admits in this particular case, the introduction of the two students had a positive effect on the success of the teacher's overall aims regarding the creation of a multicultural instruction. However, there were kids in this particular class, who were extremely uncomfortable with the introduction of these two students because of, they said, the change in the way the teacher taught his lesson.

Secondly, teachers' different interpretations of the MYP programme limit students follow successful steps for enculturation, which indeed results a relatively low performance in advanced mathematical thinking. The underlying philosophy of the unstructured and flexible nature of MYP programme, in which the IBO do not restrict teachers to follow a certain curriculum, is to enable the teachers differentiate their lessons according to the specific needs of their students. However, as previous experiences of the participants of this study displayed that this is not the common practise. On the contrary, teachers generally prefer to design the curriculum and plan their instruction according to their own values, beliefs, and norms. This explains the central role of the teachers in almost all students' responses when they were asked to describe the cultural setting of the mathematical classes in their former schools. Students' main goals that can lead them to success were to adapt to the teacher's cultural understanding of the subject instead of creating their own enculturation. That was a practical solution that students initially developed in order to avoid the confusion and discomfort. This adds a new dimension to "situated identity" as Stryker (1980) called it.

According to Bishop's (1988, p. 124) mathematical enculturation theory, the role of the teacher is to shape the ideas of the kids according to certain criteria, including designing a mathematical enculturation programme that is interpersonal, interactional, intentional, formal, and concerned not only with concepts, meanings, and processes but also with values. Despite all efforts of international organisations, and the support coming from several research studies offering a rich multi-culturally designed instructional and curricular materials, and the distinctive methodologies developed, the instruction at

international schools tend to become culturally more and more teacher-centred each day. Teachers, instead of playing their role as the mathematical enculturators (or Mathematical Enculturators[5]) to help students resolve their difficulties during their acculturation, prefer to impose their own values, norms, and beliefs on the students for the sake of maintaining their own comfort.

Of course, this study did not particularly analysed the patterns in the methods that the past teachers of participants used, however the collected data gave an understanding of that most of the teachers did not fit in the Bishop's (1988) characteristics of a good enculturator.

Finally, coming to the advantage of this dynamic setting for the students, who are moving around the world with their families and generally not staying in a country more than two years, it is possible to say that it prepares them for further challenges they may experience in future. Today, the world is re-shaping itself towards a new era, where international establishments are spreading all over the world. Mobility of individuals is becoming a routine for many people. These kids, who are being educated in international schools, will be highly demanded as international workers by the international companies seeking employees who had already internalised the idea of mobility, that the negative consequences of change are minimal on them.

This study found evidence towards the idea of mathematics as a cultural component in Bishop's enculturation theory, as well. The students, throughout the study, consistently associated their comments with the cultures in which they were initially enculturated. They expressed their perception of the current mathematics culture of their class in a comparing way to their home culture or other cultures in which they had previously acculturated. Moreover, they also explicitly expressed their opinions about the connection between mathematics and culture, describing it as a strong connection. Their remarks on the "unlucky triangle" activity indicated that they further believed their superficial or factual beliefs effect the way how they do maths, or how well they do in maths.

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[5] Bishop (1988) uses Mathematics with the capital (M) to refer to the mathematics as the product of all mankind not to a science created by one culture.

The notational differences in students' using mathematics was well explained the Bishop's (1988) definition of mathematics as a *symbolic technology*. The patterns in students' different study skills, their perceptions of the curriculum, the role of the teacher and the role of students in the class, parent involvements also proved that mathematical enculturation theory was successful in explaining the situation in the international schools as well. Thus the data in accordance with Bishop (2001b) suggested many students feel a strong dissonance between their home beliefs (or beliefs acculturated in their home cultures), and the beliefs mandated in the school. Students described this dissonance and discomfort to be increasing as they move from one country to another. The differences between two students were remarkable. While Lysha said she suffered and got confused each time she moved to a new country, Defne on the other hand responded that it was always a smooth transition for her. After digging their previous experiences, data showed that the experiences of Defne and Lysha were very different from one another, and Defne's enculturation at her former school in Botswana helped her to overcome the difficulties of acculturation, whereas Lysha had suffered a lot.

Interestingly, the students found the multicultural environment of their classes useful and pleasurable to learn more about different perspectives and to be prepared for future challenges. This seemed to be a contradiction to dissonance perspective of Bishop's (1988) theory, however considering the relationships between teacher and student, and among students, the first one had a remarkable influence on students enculturation, whereas the latter one had a secondary importance. This further explains why Bishop (1988) put the biggest responsibility on the shoulders of the teachers during the enculturation process rather than describing enculturation as a natural and unintentional phenomena.

The data also showed that a successful intentionally prepared enculturation programme should not only focus on projects to increase student awareness of the cultural aspect of mathematics and understanding society but also should be complemented by exercises and homework to let the students investigate mathematics for its own sake. This kind of a curriculum fits into what Bishop (1991) proposes, that is he offers a variety of enculturating experiences should be available to students.

The Spy Game project contained a different activity related to each six universal behaviours of mathematics (Bishop, 1988). The case that each student enjoyed and found something entertaining in all six components of *The Spy Game* brought a strong evidence for the affirmative universality of these behaviours. Students also expressed their compliments that this game as it helped them change the way they think about the people doing mathematics, that is mathematics was not a product of Western descent only. During this game, the students' explanation for the general public opinion that mathematics was invented and developed in West with minimum contribution from East, was because of the worldwide media power of West, or the rich resources of the Western countries helped these mathematician become superior to the mathematicians in East. Students strongly argued that under the identical conditions, people from both sides of the world would find the same theories but perhaps, they said, by using different tools, or by expressing their findings in unusual ways. In the cases of Hugo and Amuktha, the sharp increase in their motivation supported the theory of ethnomathematics as a powerful tool to support student achievement and attitude towards mathematics.

The data further suggested that the process of mathematical enculturation should be interpersonal and interactional. The teacher for the students was someone who should know a great deal about them, someone aware of their needs, and particularities, in and out of classroom. The students genuinely believed that a relaxed atmosphere with adequate motivating pressure was the ideal setting for maximum learning. As Bishop (1988) defines enculturation to be a dynamic process; the setting of the school, and its democratic and relaxed atmosphere were big factors that made this dynamic process easily created.

The data obtained in this study claimed that mathematics is a kind of a culture itself, and students are deeply influenced by its cultural effects. This idea of mathematics as a cultural phenomenon does not deny the universal principles within mathematics, but determines every culture creates its own dialect of mathematics and in return this created dialect shapes subsequent generations.

5.2. Comparison of Grade 6 with Grade 7

The student answers to the questions 17 and 18 in the ISGI (see Appendix B) showed that in the early days of the year, grade 7 students' beliefs in mathematics as a cultural phenomenon were stronger than the grade 6. The reason for this difference was because of the culturally rich mathematics curriculum, with a teacher who was aware of the cultural implications of mathematics, they had the year before.

Umorem (1995) defines enculturation as a life long journey, from infancy until death. The data in this study revealed that under a curriculum and instruction prepared with a strong focus on cultural aspect of mathematics and also implemented by a teacher that fit in the definition of a good enculturator (Bishop, 1988), one year of this sort of a mathematics class can make a significant difference in the mathematical enculturation of the students at this respect.

5.3. Comparison of Asian with Western Traditions

It was obvious from the data obtained that students with an Eastern cultural background were comfortable learning in a rigid curriculum, and with structured teaching whereas western students preferred to discover concepts at their own. The data obtained from this study were very much in accordance with the categorisation created by Zhang (1998). Turkish students, however were only slightly seemed to belong to eastern culture at this sense. Accordingly, Akarsu (1999, p.320) defines Turkish national curriculum as rigid and uniform at all levels. She also emphasises that the "…teachers lecture; students are passive learners". However, Akarsu (1999) makes it clear that the geographical ambiguity in Turkey's location reflects on the mentality and identity of its citizens as well.

"The dilemma between the past and the future, between East and West" (p.322) explains the dilemma of the Turkish students participated in this study.

6. CONCLUSIONS AND IMPLICATIONS

6.1. Conclusions

Mathematics as a positive science explains the rules of the universe by using its own unique language. Many cultures throughout the history contributed to the development of mathematics, used it, and shaped it. The key point, however, is that the people who shaped mathematics were not just "they". The "they" had some characteristics, the "they" had a culture, and each "they" someway used mathematics and made it a social product, or as Bishop (1988, p18) called it a "pan-cultural phenomenon".

The past tense used in the above statement should not reserve the statement as if it describes an event already had happened. On the contrary the evolution of mathematics has not yet stopped, and every culture around the world is still shaping it by using it in their own dialect.

The logical consequence following understanding mathematics as a "pan-cultural phenomenon" (Bishop, 1988, p. 18) was studying the cultural aspects of mathematical education and the individuals who were the actors of this important human endeavour.

The pioneers of this field were the researchers studied the cross cultural links and comparisons of cultures. However, this study was important because it had the opportunity of examining a living example, otherwise a theoretical or experimental situation, where cultures were brought together in one place not to compete but to collaborate towards a common goal.

International schools are thus, the unnatural, or better to say, unusual gathering pot of people from various cultures; particularly students, parents and teachers.

This study did not aim to display a portrayal of an international school from a macro level, such as an analysis on its curriculum or administrative setting. There are many such impersonal studies in the literature, all very valuable, and helped the researcher in his

quest. However, the researcher wanted to show to the curious minds what was undiscovered so far: the thing that only a few people attempted to describe. The researcher hopes that the readers had a better understanding of what actually was going on in these schools by reading this scientific story.

This thesis identified the patterns observed in students' voices as they were describing the mathematical culture of their class. The data presented supported the dynamic nature of the process as creating then re-creating of the culture in an international school mathematics classroom. Thus, the central theory of this study, Bishop's (1988) mathematical enculturation – was verified in terms of its ability to describe the mathematics culture of an international school and to explain the approaches of students to enculturation and acculturation processes.

Furthermore, this thesis discovered the importance of the teachers on creating the healthy enculturation experience for their students and consequently found that the quantitative analysis of teacher evaluations support the above qualitative findings.

The study also discovered that under good enculturation programme with a good enculturator (Bishop, 1988), it is possible to achieve a significant progress in mathematical enculturation of the students in a short time.

6.2. Limitations

The limitations of this study were not unique in any way. The small number of literature focussing on international school students comes before all other limitations. This caused the researcher to adapt theories of similar concepts and use findings of similar studies. However, the most important and the major limitation of this study is about the role of the researcher as the teacher of his students. Studying the backyard, as it is named by Glesne (1998, p. 26) was partly overcomed with the participant observation theory of Jorgensen (1989), however it still exists as the major limitation of this research.

However, considering the number of students willingly participated from grade 5, and also considering grade 5 was the only class in which my roles as the teacher and the

researcher were separated, it would be very hard to conduct this study as an outsider researcher. Thus, it is possible to perceive this limitation as a strength of this study, as well.

6.3. Implications

The international schools are open to and in need of researchers to examine their mathematical education at micro level. Most important of all, further research is necessary for the benefit of the kids who are, in a right or in a wrong way, being mathematically enculturated in these schools. The participating students of this research supplied more data than the researcher could analyse; the students of international schools are generally eager to talk and willing to describe themselves in detail. They are waiting for researchers to listen to their voices. Don’t you think there is a big story behind it, too?

APPENDIX A: CONSENT FORM

An Ethnographic Research:
The Cultural Portraits Of Mathematics Classrooms
In An International School

This study is being conducted by Sencer Çorlu as a part of his Master of Science studies for the Faculty of Education at Bogaziçi University. The purpose of this ethnographic study is to describe the formal enculturation of the members of mathematics classrooms in an international school. It examines a specific interval of time during the on-going creation of a specific mathematical culture within the classroom and it reveals and portraits how the each of its members defines, maintains and shares the unique mathematical culture of the classroom. At this stage in the research, the enculturation in the mathematics classroom will be generally defined as "Enculturation…is a creative, interactive process engaging those living the culture with those born into it, which results in ideas, norms and values which are similar from one generation to the next but which inevitably must be different in some way due to the re-creation role of the next generation". (Bishop, 1988).

Mr. Sencer Çorlu is the author of several articles, one of which has recently been published in one of the respected journals of international education. You may want to read his recent article on enculturation here at this link:
http://www.geocities.com/sencercorlu/SENCER1.JPG

Willing students will participate in their mathematics class in a way no different from that if they were not involved in the study. In addition, however, they will be asked to complete a pair of questionnaires administered at the start and end of *THE SPY GAME* activities. As well, selected members will participate in focussed interviews after or during these activities. Finally, throughout the year, informal interviews will be conducted to ensure that field notes are valid. All data collected during the study will be stored in a locked filing cabinet accessible only by the researcher to ensure confidentiality.

The university and those conducting this research subscribe to the ethical conduct of research and the protection at all times of the interest, comfort, and safety of its subjects. This form and the information it contains are given to you for your own protection and full understanding of the procedures.

If you have any questions or concerns about this research, please feel free to contact one of the following:

Prof. Dr. Fusun Akarsu, Faculty of Education, Bogaziçi University.
Telephone (work): 212 3581540 / 1596-1799 – Telephone (mobile): 532 331 0308
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Sencer Çorlu, Teacher of Mathematics, MEF International School.
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An Ethnographic Research:
The Cultural Portraits Of Mathematics Classrooms In An International School

I understand that participation or non-participation in this volunteer project will no way affect my evaluation in Mathematics. I further understand that if I choose to withdraw, I need only to inform the researcher. I agree to participate in the study during the time from September 20th, 2005 until June 20th, 2006 by:

a) Filling out the questionnaires at the start and end of the activities
b) Participating in informal interviews throughout the year
c) Participating in recorded, focussed interviews with the researcher
d) Allowing the researcher to make field notes of my in class activities and interviews
e) Allowing the researcher to take photographs while I am involved in course related activities
f) Allowing the researcher to videotape course related activities
g) Allowing the researcher to use m course related artefacts for study

Name (please print legibly):

_____

Signature:

_____

Parent Signature:

_____

APPENDIX B: INITIAL SURVEY FOR GENERAL INFORMATION

The following questions are intended to act as a general survey regarding your mathematical history and beliefs. Please read each question carefully and then select the answer which best suits your beliefs. Please be as accurate as possible with any of the questions regarding your personal history.

1. Name: _____
2. Date of Birth: (Year, Month, Day) _____
3. Are you Male of Female?: _____
4. Nationality: _____
5. Country of Birth: _____
6. Home Country: _____
7. Country of longest residence: _____
8. Country of Father's Birth: _____
9. Country of Mother's Birth: _____
10. Please list the places you have lived and the year(s) for which you lived there.

Place	Year(s)

11a. Why is your family in Istanbul? Give specific details.

11b. What language(s) are spoken in your home and how often?

Language	Always	Very Often	Often	Sometimes

12. Do you have any of the following in your home?

		YES	NO
a)	calculator	A	B
b)	computer	A	B
c)	study desk/table for your use	A	B
d)	English dictionary	A	B
e)	translating dictionary	A	B
f)	maid	A	B
g)	nanny	A	B
h)	driver	A	B
i)	gardener	A	B
j)	guard	A	B
k)	other household staff	A	B

13. How far in school did your mother and father go?

	Mother	*Father*
Finished what we would call primary school	A	A
Finished what we would call middle school	B	B
Finished what we would call secondary school	C	C
Finished vocational/technical school after secondary	D	D
Some university	E	E
Finished university	F	F
Professional degree after University (Law, Medicine, etc.)	G	G
Masters degree or equivalent	H	H
Doctorate or equivalent	I	I

14. What do each of the following people think you should do immediately after you finish secondary school?

		Father	**Mother**	**Teachers**		**Friends**
				(home)	*(here)*	
a)	go to university full time	A	B	C	D	E
b)	get a full time job	A	B	C	D	E
c)	get an apprenticeship	A	B	C	D	E
d)	enter military service	A	B	C	D	E
e)	travel	A	B	C	D	E
f)	other	A	B	C	D	E
g)	don't know	A	B	C	D	E

15. What do you think you should do immediately after you finish secondary school? (Choose from a through g above). Give details if you wish. (In which country?)

16. On a normal school day, how much time do you spend before or after school doing each of these things? *(circle ONE letter, A,B,C,D,E, for each line)*

	no time	*less than 1 hour*	*1 – 2 hours*	*3 – 5 hours*	*more than 5 hours*
a) watching television and videos	A	B	C	D	E
b) playing computer games	A	B	C	D	E
c) spending time with friends outside of school	A	B	C	D	E
d) doing jobs at home	A	B	C	D	E
e) working at a paid job	A	B	C	D	E
f) playing sports	A	B	C	D	E
g) reading a book for enjoyment	A	B	C	D	E
h) studying mathematics or doing mathematics homework	A	B	C	D	E

i) studying or doing homework in subjects other than mathematics	A	B	C	D	E
j) studying home country school work	A	B	C	D	E
k) studying a language other than your first one	A	B	C	D	E
l) reading newspapers or magazines for enjoyment	A	B	C	D	E
m) taking extra mathematics lessons	A	B	C	D	E
n) surfing the internet	A	B	C	D	E
o) reading/sending email	A	B	C	D	E

17. What do you think about mathematics?

(Circle ONE letter, A,B,C, or D for each line.)

	Strongly agree	*agree*	*disagree*	*Strongly disagree*
a) I enjoy learning mathematics	A	B	C	D
b) Mathematics is boring	A	B	C	D
c) Mathematics is an easy subject	A	B	C	D
d) Mathematics is important in everyone's life	A	B	C	D
e) Mathematics is important in your life	A	B	C	D
f) You would like a job that involved mathematics directly	A	B	C	D
g) Mathematics is the same in every culture	A	B	C	D
h) Mathematics is taught the same in every culture	A	B	C	D
i) Mathematics in my home country was harder than it is here	A	B	C	D

18. To do well in mathematics at school a person needs ...

(Circle ONE letter, A, B, C, or D, for each line)

	Strongly agree	*agree*	*disagree*	*Strongly disagree*
a) natural talent or ability	A	B	C	D
b) good luck	A	B	C	D
c) hard work studying at home	A	B	C	D
d) to memorize the textbook or notes	A	B	C	D
e) to have the teacher explain everything	A	B	C	D

f) to do a lot of text book exercises	A	B	C	D
g) to do project work	A	B	C	D

19. How well have you generally done in mathematics?

	Strongly agree	*agree*	*disagree*	*Strongly disagree*
I have usually done well in mathematics	A	B	C	D

20. How comfortable are you with mathematics?

	Strongly agree	*agree*	*disagree*	*Strongly disagree*
I am usually very comfortable with mathematics	A	B	C	D

21. What methods best help you to learn mathematics?

22. What are the main factors that lead to success in mathematics?

23. For each statement, record a ✔ to tell how you feel.

	Most of the time 3	Some of the time 2	Hardly ever 1
I am good in maths			
I need help on most problems.			
I think maths is used in real life			
I understand word problems.			
I can solve most problems.			
I like to try new strategies.			
I give up easily.			
I have an organised notebook			
I think math is fun.			

24. Describe a project you would like the class to work on.

25. What is your favourite branch of maths? Why?

26. Where do you use maths out of school?

27. My Maths Experiences

a. Maths is interesting for me because _____

b. My maths goals _____

c. Maths skills I am good at are : _____

d. Maths skills I need to work more _____

e. My biggest helper on my maths difficulties _____

APPENDIX C: QUANTITATIVE ANALYSIS OF DATA

Table C.1: Asian–Western: Problem solving teacher assessment tool
(See Appendix D for the legend of initials)

	REGION	N	Mean	Std. Deviation	Std. Error Mean
RPC	asian	21	1.76	.768	.168
	western	22	2.05	.653	.139
SATOG *	asian	21	1.86	.727	.159
	western	22	2.50	.598	.127
CRPIOW *	asian	21	1.62	.669	.146
	western	22	2.82	.501	.107
CIGI *	asian	21	2.10	.625	.136
	western	22	2.32	.716	.153
CIQTBA	asian	21	1.90	.700	.153
	western	22	2.68	.568	.121
CAS	asian	21	1.90	.831	.181
	western	22	1.95	.722	.154
EWTASB	asian	21	1.38	.498	.109
	western	22	2.45	.739	.157
WS	asian	21	1.76	.831	.181
	western	22	2.00	.816	.174
SSIOF*	asian	21	1.43	.598	.130
	western	22	2.32	.716	.153
CC *	asian	21	2.62	.669	.146
	western	22	1.64	.658	.140
SAISGCU *	asian	21	1.67	.730	.159
	western	22	2.64	.658	.140
CTTAIR*	asian	21	1.14	.359	.078
	western	22	2.45	.596	.127
TOWTSP*	asian	21	1.38	.740	.161
	western	22	2.27	.767	.164

Table C.2: Grade 6–Grade 7: Problem solving teacher assessment tool
(See Appendix D for the legend of initials)

	GRADE	N	Mean	Std. Deviation	Std. Error Mean
RPC	grade6	17	1.82	.809	.196
	grade7	12	2.00	.603	.174
SATOG	grade6	17	2.12	.857	.208
	grade7	12	2.25	.622	.179
CRPIOW	grade6	17	2.24	.903	.219
	grade7	12	2.33	.651	.188
CIGI	grade6	17	2.29	.686	.166
	grade7	12	2.08	.793	.229
CIQTBA	grade6	17	2.47	.717	.174
	grade7	12	2.25	.754	.218
CAS	grade6	17	1.76	.664	.161
	grade7	12	1.75	.866	.250
EWTASB	grade6	17	1.82	.809	.196
	grade7	12	1.83	.937	.271
WS	grade6	17	1.82	.809	.196
	grade7	12	1.75	.866	.250
SSIOF	grade6	17	1.94	.899	.218
	grade7	12	1.92	.669	.193
CC	grade6	17	2.00	.707	.171
	grade7	12	2.08	.900	.260
SAISGCU	grade6	17	2.06	.827	.201
	grade7	12	2.50	.674	.195
CTTAIR	grade6	17	1.76	.831	.202
	grade7	12	2.00	.853	.246
TOWTSP	grade6	17	1.88	.928	.225
	grade7	12	1.58	.793	.229

Table C.3.: Asian–Western: Cooperative learning teacher assessment tool (See Appendix E for the legend of initials)

	REGION	N	Mean	Std. Deviation	Std. Error Mean
PAR *	asian	21	2.43	.746	.163
	western	22	2.00	.535	.114
SOT*	asian	21	2.48	.750	.164
	western	22	1.68	.646	.138
DPSA *	asian	21	1.71	.717	.156
	western	22	2.41	.590	.126
WS *	asian	21	2.24	.700	.153
	western	22	1.68	.646	.138
WWOITG *	asian	21	1.67	.730	.159
	western	22	2.45	.671	.143
TAHO	asian	21	1.67	.796	.174
	western	22	2.09	.750	.160
CAUIOFO *	asian	21	1.57	.811	.177
	western	22	2.05	.722	.154
SQ *	asian	21	2.48	.680	.148
	western	22	1.73	.767	.164
EITO	asian	21	1.86	.793	.173
	western	22	2.23	.813	.173
IQ *	asian	21	2.33	.796	.174
	western	22	1.86	.710	.151
HAPA	asian	21	1.95	.590	.129
	western	22	2.14	.560	.119
SPAP	asian	21	1.71	.717	.156
	western	22	1.82	.733	.156
DWBD*	asian	21	1.43	.598	.130
	western	22	2.23	.752	.160

Table C.4.: Grade 6–Grade 7: Cooperative learning teacher assessment tool (See Appendix E for the legend of initials)

	GRADE	N	Mean	Std. Deviation	Std. Error Mean
PAR	grade6	17	2.00	.612	.149
	grade7	12	2.08	.793	.229
SOT	grade6	17	1.88	.781	.189
	grade7	12	2.00	.853	.246
DPSA	grade6	17	2.00	.791	.192
	grade7	12	2.00	.739	.213
WS	grade6	17	1.82	.728	.176
	grade7	12	2.00	.739	.213
WWOITG	grade6	17	2.29	.772	.187
	grade7	12	2.25	.622	.179
TAHO	grade6	17	1.71	.686	.166
	grade7	12	2.00	.953	.275
CAUIOFO	grade6	17	1.82	.809	.196
	grade7	12	1.83	.835	.241
SQ *	grade6	17	2.41	.795	.193
	grade7	12	1.67	.778	.225
EITO	grade6	17	2.06	.827	.201
	grade7	12	2.08	.793	.229
IQ	grade6	17	1.88	.697	.169
	grade7	12	2.17	.835	.241
HAPA	grade6	17	2.24	.562	.136
	grade7	12	1.92	.289	.083
SPAP	grade6	17	1.88	.697	.169
	grade7	12	1.75	.754	.218
DWBD	grade6	17	1.94	.748	.181
	grade7	12	1.67	.778	.225

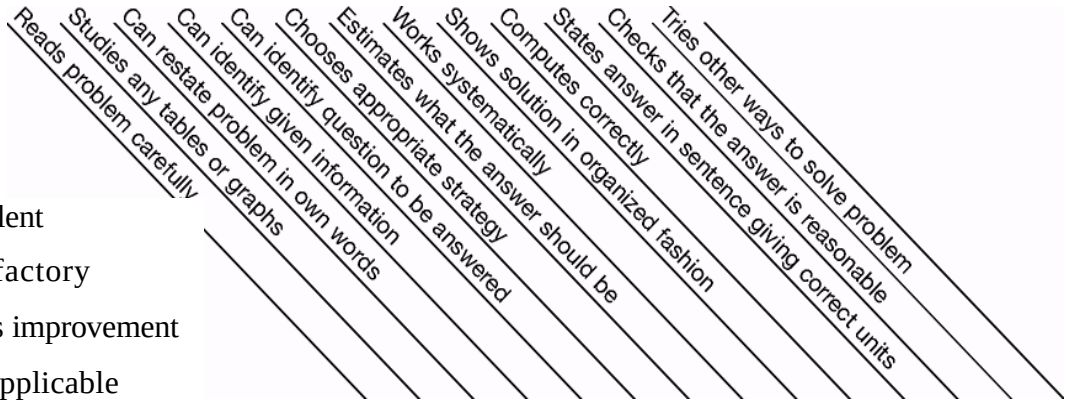
Table C.5.: Asian–Western: Overall summative student grades
(See Appendix F for the legend of initials)

	REGION	N	Mean	Std. Deviation	Std. Error Mean
PS *	asian	21	1.73	.437	.095
	western	22	2.31	.419	.089
CL	asian	21	1.96	.262	.057
	western	22	2.03	.375	.080
MW *	asian	21	1.62	.740	.161
	western	22	2.36	.727	.155
CW	asian	21	2.38	.740	.161
	western	22	2.23	.685	.146
HW	asian	21	2.33	.730	.159
	western	22	2.32	.646	.138
PID	asian	21	2.00	.949	.207
	western	22	2.32	.716	.153
QS	asian	21	2.19	.680	.148
	western	22	1.95	.653	.139
TS	asian	21	2.24	.700	.153
	western	22	2.32	.646	.138

Table C.6.: Grade 6–Grade 7: Overall summative student grades
(See Appendix F for the legend of initials)

	GRADE	N	Mean	Std. Deviation	Std. Error Mean
PS	grade6	17	2.00	.590	.143
	grade7	12	2.03	.475	.137
CL	grade6	17	2.00	.296	.072
	grade7	12	1.96	.468	.135
MW	grade6	17	1.94	.827	.201
	grade7	12	2.17	.835	.241
CW	grade6	17	2.12	.781	.189
	grade7	12	2.42	.669	.193
HW	grade6	17	2.29	.772	.187
	grade7	12	2.33	.651	.188
PID	grade6	17	2.00	.866	.210
	grade7	12	2.33	.888	.256
QS	grade6	17	2.12	.697	.169
	grade7	12	2.08	.515	.149
TS	grade6	17	2.12	.600	.146
	grade7	12	2.33	.651	.188

APPENDIX D: PROBLEM SOLVING TEACHER ASSESSMENT TOOL



3 if excellent

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1 if needs improvement

0 if not applicable

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APPENDIX E: COOPERATIVE LEARNING TEACHER ASSESSMENT TOOL

3 if excellent

2 if satisfactory

1 if needs improvement

0 if not applicable

	Performs assigned role	Stays on task	Demonstrates problem-solving ability	Works systematically	Works with others in the group	Tutors and helps others	Considers and uses ideas of others	Speaks quietly	Expresses ideas to others	Initiates questions	Has a positive attitude	Shows patience and perseverance	Disagrees without being disagreeable
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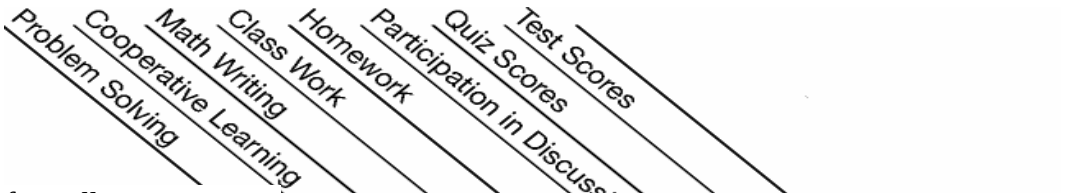
APPENDIX F: OVERALL TEACHER ASSESSMENT TOOL



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APPENDIX G: VALUES AND MATHEMATICS PROJECT INFORMATION

Background

The current research work on values in mathematics and science education has its immediate roots in an earlier project Values and Mathematics Project (VAMP) described in more detail below. It in turn derived from three fields of research carried out here and elsewhere on (a) mathematics teachers' theories, (b) teachers' decision-making in classrooms, and (c) mathematics education as cultural induction. In addition the science education background work was on teachers' and students' beliefs and misconceptions in science.

Project

Values in Mathematics and Science Education: Mapping the relationships between pedagogical practices and student outcomes.

The current project "Values in Mathematics and Science Education: Mapping the Relationships between Pedagogical Practices and Student Outcomes" builds on the previous work in three main ways.

1. It brings together the previous work on the two disciplines of mathematics education and science education.
2. It focuses on both teachers' and students' values, and on the relationships between them.
3. It adds the dimension of interventions to the previously analytic foci.

This project is funded by ARC Discovery Grant from 2002 to 2004. Total funding is $91,000. Mathematics and science in schools both involve the teaching of values. Some value outcomes are intended by the teachers and are explicitly taught, particularly in science, while other values are only implicitly present in classroom practices, as is typically the case with mathematics.

What is not yet known is what values students learn from different teachers and from their practices, and how these learned values impact on student engagement with these subjects. This project is exploring the relationships between the values embedded in the pedagogical practices of primary and secondary teachers of mathematics and science, and student values outcomes.

At the heart of this project is this theoretical description of the 6 key values associated with Western Mathematics and Science and their development. This theory developed from the values of Western Mathematics described in Bishop, A.J. (1988) Mathematical enculturation. Dordrecht : Kluwer, chapter 3.

1 Rationalism

Valuing rationalism means emphasising argument, reasoning, logical analysis and explanations. It concerns theory, and hypothetical and abstract situations, and thereby promotes universalist thinking.

This value is demonstrated by:

- teachers developing students' skills at argument and logical reasoning
- teaching about proof and proving
- encouraging discussion and debate
- students seeking explanations for experimental data
- contrasting alternative hypotheses

2 Empiricism

Valuing empiricism means emphasising objectifying, concretising, and applying ideas in mathematics and science. It favours analogical thinking, symbolising, and the presentation and use of data. It also promotes materialism and determinism.

This value is demonstrated by:

- teachers developing students' practical skills
- teaching about applications and using ideas
- students and teachers creating symbols, models, diagrams etc.
- students collecting experimental data
- testing ideas against data

3 Control

Valuing control means emphasising the power of mathematical and scientific knowledge through mastery of rules, facts, procedures and established criteria. It also promotes security in knowledge, and the ability to predict.

This value is demonstrated by:

- teachers developing students' skills at drills and routines

- teaching about mathematical and scientific accuracy
- students practising skills and procedures
- teachers demonstrating how mathematical and scientific ideas explain and predict events

4 Progress

Valuing progress means emphasising the ways that mathematical and scientific ideas grow and develop, through alternative theories, development of new methods and the questioning of existing ideas. It also promotes the values of individual liberty and creativity.

This value is demonstrated by:

- teachers developing students' creative imaginations
- teaching about the development of scientific and mathematical knowledge
- encouraging alternative explanations

5 Openness

Valuing openness means emphasising the democratisation of knowledge, through demonstrations, proofs and individual explanations. Verification of hypotheses, clear articulation and critical thinking are also significant, as is the transparency of procedures and assumptions.

This value is demonstrated by:

- teachers developing students' skills at articulating their ideas
- teaching the criteria of proving and verifying
- encouraging discussion and debate
- promoting freedom of expression
- contrasting students' and teachers' views
- the replicability of experiments

6 Mystery

Valuing mystery means emphasising the wonder, fascination, and mystique of scientific and mathematical ideas. It promotes thinking about the origins and nature of knowledge and of the creative process, as well as the abstractness and dehumanised nature of scientific and mathematical knowledge.

This value is demonstrated by:

- teachers developing students' imagination
- teaching about the dehumanising nature of objective knowledge
- stimulating wonder and awe with significant ideas
- encouraging students to read science fiction material
- students experiencing surprise over unexpected findings
- exploring mathematical puzzles

APPENDIX H: VALUES OF MATHEMATICAL CULTURE INTERVIEW QUESTIONS

Rationalism

- How do you feel during a classroom discussion about mathematics?
- Is it just enough to learn one working way of solving the problem? Why/why not?
- The solution or the answer? Which one is more important? Why?

Empricism - Objectism

- What do you think about our chapter projects?
- Compare using symbols/graphical represantations in Maths with using words to explain your solution?

Control

- What do you think about solving the same type of exercise more than once?
- How do you check the reasonableness of your answer to an exercise?

Progress

- Why do we learn the historical progress/pioneers of the topic?
- How did/could you use mathematics to create something?

Openness

- How do you feel about the your classmates objecting teacher's point of view or giving alternative ways of solutions?
- How do we decide in class, which method is to be used for a given problem?

Mystery

- Is maths man-made or God-given?
- What do you think about Maths and real life? Is it an abstract science?
- What do you think about popular mathematics books?

APPENDIX I.1: SPY GAME MATHEMATICIANS POSTERS

Code Name

SIR ISAAC NEWTON

Recent Photograph

Isaac Newton was the greatest English mathematician of his generation. He laid the foundation for differential and integral calculus. His work on optics and gravitation make him one of the greatest scientists the world has known.

REAL NAME

QV. PYGIRS

Code Name

ULUGH BEG (aka. ULUĞ BEY)

RECENT PHOTOGRAPH

Ulugh Beg was the grandson of the conqueror Tamerlane and was a Turkish mathematician and astronomer. He founded an important centre for study at Samarkand staffed with the best scientists of the time. He did important early work on trigonometry.

REAL NAME

QV. WIRGL

Code Name

PASCAL

Recent Photograph

Blaise PASCAL was a very influencial French mathematician and philosopher who contributed to many areas of mathematics. He worked on conic sections and projective geometry and in correspondence with Fermat he laid the foundations for the theory of probability.

REAL NAME

Qw.
GSRGLEVH

Code Name

ARYABHATA

RECENT PHOTOGRAPH

Aryabhata wrote the *Aryabhatiya* which is a small astronomical treatise giving a summary of Hindu mathematics up to that 6th Century. It covers arithmetic, algebra, plane trigonometry and spherical trigonometry as well as continued fractions, quadratic equations, sums of power series and a table of sines.

REAL NAME

QW. ZEVQE

APPENDIX I.2.: SPY GAME MISSION 1

Difficulty index: Ranks Offered for all houses. 4 to 1.

Dear Agents,

You will find the posters of our top agents all around the school.

Your mission, should you choose to accept it, is to decipher their under cover names before the enemy. You should hurry, we cannot let the enemy learn their identities. The lives of our top agents are at your capable hands.

CONFIDENTIAL

Agents **PASCAL, NEWTON, ULUGH BEG, and ARYABHATA** will be your contacts for the coming missions.

Good Luck,

Sench, Mr. Sench - HQ

APPENDIX I.3.: SPY GAME MISSION 2

TOP SECRET

Mission Code Name: Unlucky Triangle

Difficulty index: Ranks Offered for all houses. 8, 6, 4 2.

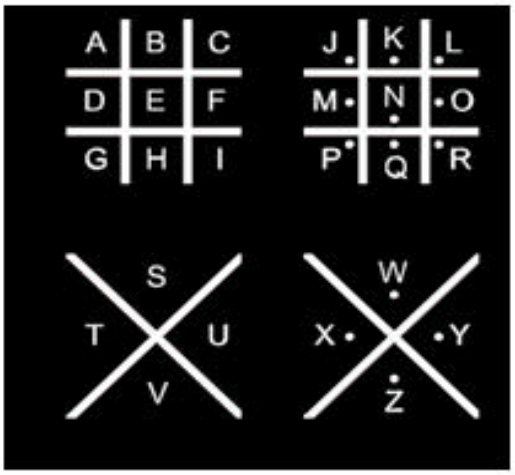
Dear Agents,

Your mission, should you choose to accept it, is to decipher the text below. Ciphertext will lead you to your next contact.

CONFIDENTIAL

Ciphertext

Ps: Use the Pig Pen Ciphering system below.



Good Luck,

Sench, Mr. Sench - HQ

APPENDIX I.4.: SPY GAME MISSION 3

TOP SECRET

Mission Code Name: Rare, Medium or Well-done?

Difficulty index: Ranks Offered for all houses. 8, 6, 4, 2.

Dear Agents,

Your mission, should you choose to accept it, is to decipher the text at the paper given to you. Our agents Newton, Ulugh Beg and I at the HQ have the necessary equipments. You should decide which stick is the right one.

CONFIDENTIAL

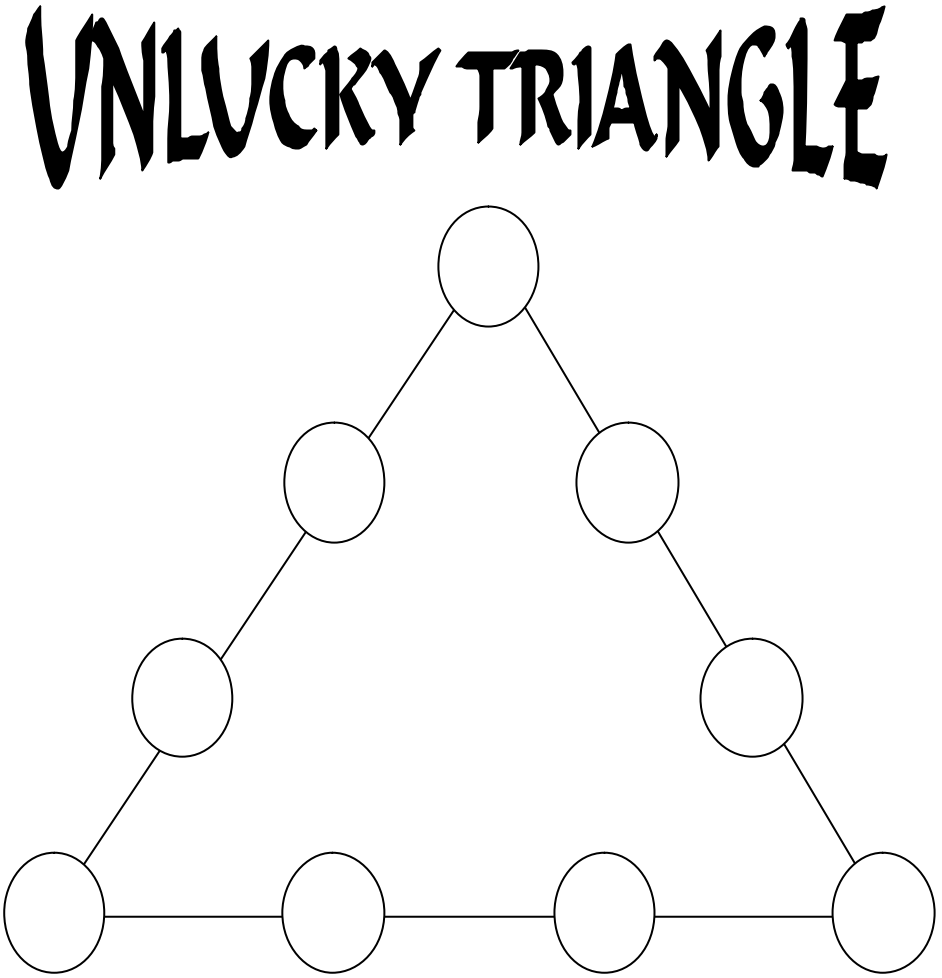
Ps: Rock and Roll, baby...

Good Luck,

Sench, Mr. Sench - H.Q.

APPENDIX I.5.: UNLUCKY TRIANGLE

Number List
0
1
2
3
4
5
6
7
8



Put the numbers 0 through 8 in the nine circles on the triangle

The rules:

- Each side of the triangle must add up to unlucky 13
- Use each digit only once

APPENDIX J: SPY GAME CLASSROOM DISCUSSION/ FOCUS GROUP INTERVIEW QUESTIONS

1. How did you find the Spy Game activities?
2. What did you like most?
3. How did it feel to work in a group? Would you prefer working on your own?
4. What was your role in the group? Who decided that role?
5. Did you know any of the characters in the game before?
6. What do you think about aryabhata/ulugh beg/newton/pascal?
7. Do you know any other mathematicians from your country/culture?
8. Do you think our cultural upbringing effect the way we give our decisions?
9. Do you think the cultural background of Aryabhata has an effect on his work? Would he reach the same conclusions if he would live in Europe? Or newton in india?
10. What do you think about the unlucky triangle?
11. What do you think about people assigning special meanings to numbers? Does 13 have an unlucky meaning in your culture? Did it have an effect on your decision about the problem?
12. What other numbers you think have special powers?
13. The two cryptology methods we learnt on Friday were "Caesars" and "pigpen ciphering method"; both founded by people in Europe?. Do you think was it easier for students coming from Europe to solve these problems?
14. How about mathematics? Were the mathematicians of Europe better than the mathematicians lived in other parts of the world?

APPENDIX K: FOCUS GROUPS GENERAL INTERVIEW QUESTIONS

1. Describe the mathematics system/class in your home country
2. Describe your attitude toward and beliefs about mathematics before leaving your home country.
3. How have these attitudes and beliefs been changed by your experiences since leaving, if they have changed at all?
4. Compare your attitudes, beliefs, and performance in mathematics to members of your home country. What is similar and/or different?
5. What impact, if any, does each individual student have on the class? Do you have any specific examples? If so, explain.
6. Compare your attitudes, beliefs, and performance in mathematics to other members of the class. What is similar and/or different?
7. Describe how meaning is negotiated in the classroom. How do we decide which method or approach, or form to use for a given exercise or answer?
8. What is Mr. Sench's role in the process? Can you give any specific examples?
9. If you are one of the newer members of the class explain what it was like to enter this math class.Give specific examples of things that happened.
10. If you are one of the older members of the class explain what it was like when new people entered the math class. Give specific examples of things that happened.

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