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Cover Page Footnote

The authors appreciate the comments of Dr Füsun Akarsu, Monterey Institute of International Studies at Middlebury College.

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Synopsis

We explore the factors that influence the relationship between mathematics and culture in the international school context. First, we share some thoughts about international schools in general and the international mathematics curriculum implemented at the middle grades level at our school in particular. Second, we present some interesting snapshots from our culturally-diverse mathematics classrooms.

Keywords: *international schools; mathematical enculturation; middle years programme*

In 2014, the *Journal of Humanistic Mathematics* republished an interesting and controversial paper by Murad Jurdak on how culture, religion, and language may interact with mathematics and its education [8]. Whether or not one agrees with Jurdak's theses, it is clear that there are various factors that influence the relationship between mathematics and culture. In this article we explore some of these in the context of an international school.

First, we share some thoughts about international schools in general (§1) and the international mathematics curriculum implemented at the middle grades level at our school in particular (§2). Second, we present some interesting snapshots from our culturally-diverse mathematics classrooms (§3). We wrap up the paper with a brief discussion of our experiences (§4).

1. An overview of international schools

International schools have always been atypical gathering spots for individuals. An early example was the Ottoman *Enderun*, which was established during the sixteenth century in Constantinople—the city where East meets West. Enderun selected students from different ethnic backgrounds and provided them with free education. Students at Enderun received a liberal education while they learned how to live and learn together. Their common ideal was to build peace among various communities in the multinational empire [4]. While Enderun was dissolved with the rise of nationalism before the Balkan Wars, *Ecolint*—the first non-selective private international school in the Western world—was founded in 1924. Influenced by the philosophy of the League of Nations after World War I, Ecolint admitted students from all nationalities and encouraged mutual co-operation [11]. Following the destruction brought on by World War II, another meritocratic school, the *United World Colleges* (UWC), began to recruit students on an even larger global scale. The UWC's mission was to create an international intellectual force for promoting peaceful coexistence [12]. In this manner, international schools have always claimed to promote peace among nations based on an idealist philosophy, regardless of their differences in student recruitment or the curriculum they implement.

Today, there are many international schools worldwide, representing the ideal of coexistence among nations. These schools have been founded on the historical ambition to impart education that can transcend borders to teach tomorrow's adults how to live together peacefully [10]. Many educators associated with these schools believe that the future depends on effective peaceful interactions among people from different backgrounds and cultures [9]. However, this interaction may require further effort for transformation into coexistence. In fact, one may need to exert more effort than expected to understand a different culture from one's own, since some aspects of every culture are situated on the visible part of the iceberg [5, 6], such as its laws, rules, language, and symbols, while others, such as values, are hidden underneath [1]. In the age of globalization, international schools serve as a milieu for the coexistence ideal: They provide us with interesting stories in which opportunities for mutual understanding and cooperation are told. Students from different cultural backgrounds learn how to live and learn together at these schools.

2. The international school

The international school we introduce in this paper is a *Middle Years Programme* school which is located in a major metropolitan city in Turkey. Over 30 nationalities are represented in the school's student population, and 16 nationalities in the staff population. All the students hold non-Turkish passports and are of high socio-economic status, economically privileged, and culturally aware. In this sense, our school is a typical international school with a diverse student and teacher body. Almost all students in this school speak two or more languages. Some of our students are educated in the national school systems of their native countries before coming to our school, while others has recently started their international education experience at this school.

An international curriculum.

Our school implements the International Baccaluarate Organisation's *Middle Years Programme* (MYP), which aims to help students from 6^{th} to 10^{th} grades develop intellectual, personal, emotional, and social skills to live, learn, and work in a rapidly globalizing world. MYP allows teachers to be flexible in the way that we can organize our coursework. However, all adaptations of the MYP by individual schools should foster a common understanding of the fundamental concepts and meet some benchmarks. In mathematics, these benchmarks include numbers, algebra, geometry and trigonometry, statistics and probability, and discrete mathematics. In addition, mathematics teachers should embed three fundamental concepts in their teaching: holistic learning (integration of mathematics with other disciplines), intercultural awareness (how cultural forces lead to developments in mathematics), and communication (how to effectively use the language of mathematics) [7]. Thus, mathematics in the MYP reflects the culture of its practitioners and can be used to understand the people with whom we share the planet [2]. In other words, mathematics in our school aims to provide opportunities to create healthy connections among our students from different cultures.

Who are our students?

In this paper, we introduce six of our students and their experiences in learning mathematics. Their pseudonyms are *Diya*, *Charlie*, *Sara*, *Nico*, *Nur* and *Akira*.

Diya is the daughter of the information technology teacher of our school. She is a newcomer to grade seven, and is originally from India. In addition to being fluent in six different languages, she learned to speak in Turkish quite rapidly. Her work in mathematics is rich in content but never well presented.

Charlie is a silent member of the sixth-grade class. Although he is half-Turkish and half-English, he identifies himself as English. *Charlie* was born in the UK, but has always been educated at international schools. He is going to leave at the end of the year to attend a boarding school in the UK.

Sara is an Italian girl in grade seven; she was born in the United States, where she lived for three years. After spending seven years in Italy, she and her family shifted to Turkey because of her father's work. Since *Sara* is usually very silent, she is not the most active participant in class discussions. Although she is capable of achieving great success in mathematics, in her mother's words, "*Sara* is too modest, and so shy. She has to learn to be more ambitious, more assertive".

Nico, a sixth grader from Switzerland, is a very smart boy with a warm personality. He has excellent general mathematical knowledge and is always willing to help his peers and share his ideas with the rest of the class during discussions. His test results have been outstanding and he is particularly good at understanding new topics with ease.

Nur is a seventh grader from Malaysia who had lived in Hong Kong, Malaysia, and Thailand before moving to Turkey four years ago. This is her last year in Turkey, and she is very sad about returning to Malaysia.

Akira (a sixth grader from Japan) is one of the three students attending the English as a second language class instead of learning an additional foreign language. She has been residing in Turkey for three years and had not lived abroad before.

3. Some vignettes from our classrooms

Nature of mathematics.

Diya defined mathematics as an "exercise for the brain", while *Charlie* described it as "a rainbow with many colours" and regarded it as a way to refresh his mind. Some students believed that mathematics was utilized differently by different people in the past and at present. For example, according to *Sara*,

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

In line with *Sara*'s comments, *Nico* remarked,

> "*I can see other students use different approaches in mathematics. For example, Sunyoung poses brainteasers all the time. I think it is good to have so many different people in class, because I'll be more prepared when I live in another country.*"

Teachers and the teaching of mathematics.

Students defined the role of their teachers, using phrases such as "like a friend", "someone who understands what we feel" or adjectives like "funny", "relaxed", "understanding", "hyperactive", and "young". *Nico*, who had previously studied in an international school, said,

> "*I think teachers at international schools have more time than my teachers in Switzerland... Teachers are generally cool... [doing] a less stressful job... I think that makes them more understanding.*"

Nur described her teachers in her native Malaysia as strict but good mathematicians:

> "*My teachers there were very, very strict, and mathematics was very difficult. I was bored and felt sleepy. When I said that I didn't understand [something], the teacher merely repeated [his words]... My teacher [in Malaysia] was a great mathematician; he was always solving problems in the blink of an eye... I think you like to teach us mathematics, but you never solve questions—you always ask us to solve them... I am [returning] to Malaysia*

> *at the end of this term. I was just becoming good at maths. It is so hard in Malaysia that I fear I will fail.*"

Some students described mathematics in our school to be challenging. In fact, only one student described mathematics in his native country (France) as more difficult. All the students preferred doing real-life projects or recreational mathematics over solving algorithmic drills. However, problem solving was a particularly unpopular activity for some students. We observed that *Akira*, who had mentioned that the MYP mathematics needs to "focus more on the fundamentals", was confused during a problem-solving activity:

> **Akira***: "I don't understand this question."*
> **Teacher:** *"Did you identify what is given and what is being asked?"*
> **Akira:** *"I tried, but everything is mixed up."*
> **Teacher:** *"Is the problem about understanding the language?"*
> **Akira:** *"Yes, a bit. But I know all the words; just the question seems as if it is hidden."*

The students had varied perceptions of the teaching methods that they had experienced at different schools. *Nur* was helpful in delineating these challenges:

> "*My brain couldn't get used to the math they were teaching. Then I moved to another country, and the methods changed again. I get mixed up.*"

Studying mathematics.

Parents of some of our students played a significant role in students' studies. If these parents were not able or available to help, they hired tutors to help their child after school. However, some other parents did not get involved in students' daily work. For example, while *Charlie* did not mention asking for help, *Akira* was studying with her mother on a regular basis.

> **Akira:** *"I study every day with my mother; she explains to me the things I do not understand in class."*
> **Teacher:** *"If there is something you don't understand, why don't you ask your teacher?"*

Akira: *"I like to study with my mother, and I feel like I understand it in class. But when I go home, I'd realize that I didn't."*
Teacher: *"How does your mother help you?"*
Akira: *"We go over all the questions that you solved in class. Then she asks me similar questions, and I solve them."*
Teacher: *"Do you ever study alone?"*
Akira: *"Only to do my homework. After I finish that, I study with my mom some more, to revise the day."*
Teacher: *"Does she also help you during project work?"*
Akira: *"Yes, she searches the Internet with me or helps me in general."*

Charlie began his studies a couple of days before some tests.

Teacher: *"How do you prepare for tests?"*
Charlie: *"I read and solve the problems in my notebook; I know that you will ask similar problems."*
Teacher: *"What else do you do, or think you should do?"*
Charlie: *"I must start studying earlier, I think, but you know, usually there is other stuff too. Everyone gives so much work to do."*
Teacher: *"What would you have done if you had started earlier?"*
Charlie: *"I'd have studied from the book; there are plenty of exercises in the textbook."*

Using mathematics.

There were several small but obvious differences in how they used mathematics that we observed among our students that can be easily recognized by anyone who spends even a limited time in the mathematics classroom of an international school. The variety of mathematical notation systems used by the students was the most obvious. One of these differences was the long division notation, in which some students placed the dividend on the right of the divisor, in contrast to the generally accepted left-hand notation.

Another major difference concerned the measurement unit systems: the imperial system (*pounds* and *inches*) and the metric system (*kilograms* and *centimetres*).

Other issues came up due to the American textbooks we used. Many students found it difficult to tackle problems that included dimes or nickels.

Yet another difference pertained to whether the short form of mathematics should be "maths" or "math".

Students also experienced some differences outside the school during their stay in Turkey. For example, the percentage sign (%) is written before the numeral in Turkey.

4. What did we learn from our experiences?

We believe that the transient nature of the international school, particularly when class sizes were small, led to some of our challenges for creating a consistent mathematical culture within the classes. This dynamic, fast-changing, and diverse environment follows an accelerated cultural shift. This type of classroom, which accompanies a fast-changing culture, puts many students at several disadvantages. First, the culture of the class becomes extremely brittle and is easily affected even by small changes, resulting in confusion and discomfort among the students and for the teachers. Second, different teachers' different interpretations of teaching may limit the students' ability to achieve mathematical enculturation. The underlying philosophy of the unstructured and flexible MYP curriculum—in which the teachers are not restricted to follow a certain curriculum—is to enable teachers to differentiate their lessons according to the specific needs of their students. We are concerned that, as mentioned by some students, teachers at international schools generally preferred to design the curriculum, select textbooks, and plan their instruction, possibly based on their own values, beliefs, and norms. In this situation, success for students may mean adapting to the teacher's cultural understanding of the subject instead of creating their own enculturation in mathematics. This was a practical solution that some of students at our school initially developed in order to avoid confusion and discomfort.

We anticipate that some students may feel a strong dissonance between their home beliefs and the beliefs mandated at school, as well. Some of our students described an increase in this dissonance and discomfort as they moved from one country to another. *Nur*, for instance, admitted that she suffered and became confused each time she moved to a new country, while *Charlie* responded that it was always a smooth transition for him. A deeper look into their previous experiences revealed that *Nur* and *Charlie* had very different past experiences; *Charlie*'s enculturation at his former school in an another international school helped him overcome the difficulties, whereas *Nur* had suffered in her previous schools.

Some authors (see for instance [3]) suggest that the teacher's role should be limited to shaping the ideas of children based on certain criteria, which may still include designing a mathematical enculturation programme that is interpersonal, interactional, intentional, formal, and concerned not only with concepts, meanings, and processes but also with values. Given the efforts of MYP, and the support offered by several research studies in the form of rich, multiculturally designed instructional and curricular materials, the instruction at international schools should be truly culturally diverse and help students master mathematics as a mode of thinking rather than a compilation of rules or procedures [8]. Instead of imposing their own values, norms, and beliefs on students for the sake of maintaining their own comfort level, teachers should act as mathematical enculturators to help students resolve their difficulties during this challenging process.

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