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# Intergenerational Analysis of Mathematical Cultural Tool Appropriation in Transnational Families

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*Sociocultural theory maintains that human learning is mediated by cultural tools and also highlights the relationships between agents and cultural tools, which are embedded in social and historical contexts. This paper investigates whether and how transnational families engage in the appropriation of a mathematical cultural tool, a finger multiplication strategy, while contending with the pressures to conform to the mainstream practices of their host country. This study is based on ethnographic interviews with transnational parents and children in Japan. This paper offers insights into the process of out-of-school mathematics learning across generations and how identities are tied with this process. Findings also suggest how broad systems of power impact out-of-school mathematics learning.*

## Background and Conceptual Framework

Global mobility of populations has contributed to a growth in the number of transnational students and parents in schools internationally. Thus, there is a need for research examining curriculum and pedagogy responsive to these individuals' needs. In this study, I will examine transnational students' and parents' mathematical learning by focusing on one particular type of mathematical cultural tool. The term, transnational, is used to refer to the state of individuals who live beyond and across national boundaries. It describes the state of participants in this study who were living beyond and across the borders of Japan and the Philippines.

One of the central tenets of sociocultural theory is that human learning is mediated by technical and psychological tools including languages and culturally specific computation strategies (Vygotsky,

1978). These tools are cultural; they are created, shared, and used in collective practices. Vygotsky (1978) maintains that the use of these cultural tools is developed as an interpsychological process between people first and later internalized into an intrapsychological process within a person. This idea of internalization was later elaborated by Wertsch (1998) with careful attention to a tension between learners as active agents and cultural tools. Wertsch distinguishes mastery, appropriation, and resistance of cultural tools. Mastery is described as knowing how to use cultural tools, whereas appropriation is defined as “making something one’s own.” Resistance is considered to occur when agents distance themselves from particular cultural tools or when they perform certain actions with cultural tools under the forced circumstance. For example, in the case of Estonians in Wertsch’s study, they mastered the official account of Estonia’s history learned in the school and exhibited their understandings in the forced situation such as exams. However, they resisted to appropriate the official historical account and took it as someone else’s history.

As seen in this example, mastery, appropriation and resistance of cultural tools are strongly connected with an agent’s identity development. Polman (2006) further elaborated on the aspect of identity development and maintains that agents are taking up certain cultural tools while simultaneously creating possibilities for what kind of person one can be in the future. This study thus describes appropriation of cultural tools in relation to identities. Identity in this study is described aligned with Holland, Skinner, Lachicotte Jr, and Cain’s (1998) account. First, identities are the social products and “imaginings of self in worlds of action” (Holland et al., 1998, p.5) which are developed in social practices. Second, identities are “psychohistorical formations that develop over a person’s lifetime, populating intimate terrain and motivating social life” (Holland et al., 1998, p.5). Holland et al.’s case studies illustrate how cultural tools can afford and also constrain agents’ possibilities of becoming. These conceptual frameworks led to my examination of transnational students’ and parents’ appropriation and resistance of a particular mathematical cultural tool in relation to identities they developed socially and projected for the future.

## Literature Review on Non-dominant Students' Mathematics Practice

This paper highlights a relationship between agents and a mathematical cultural tool with the focus of transnational families living in Japan. Previous studies on social practices involving mathematical tools help frame the current study. Overall, research in this area has highlighted non-dominant students' and communities' competence in collective practices that involve mathematical tools (Abreu & Cline, 2007; Gonzalez, Andrade, Civil, & Moll, 2001; Nasir & Hand, 2008; Saxe, 1988, 2012; Saxe & Esmonde, 2005; Taylor, 2009). These studies altogether foregrounded mathematical competence that has traditionally been neglected in the school contexts. For example, in the study of low-income children's candy selling practices in Brazil, Saxe (1988) revealed the mathematical understanding that these children constructed in order to achieve the goals linked to the practices in which they participated. Taylor's (2009) analysis of low-income children's purchasing practices in the United States demonstrated the influences of the macro system (such as concentration of poverty and taxation policies) on these children's mathematics learning. Nasir and Hand's (2008) comparison of students' participation in mathematics classrooms and basketball games demonstrates significance in attending to students' opportunities for taking up integral roles and for developing identities of competence in a particular practice. Examination of students' practices outside school has been offering significant insights to non-dominant students' mathematical understanding and identity development. The current study builds on these works and examines transnational families' practices living in Japan, which have been understudied.

In this paper, I focus on one cultural tool (i.e., a finger multiplication strategy), which was observed among Filipino families living in Japan. The details of the finger multiplication strategy will be explained in a subsequent section. Saxe's (2012) seminal work on Oksapmin people's 27-body-part counting system illuminates how the counting system has been reproduced and altered along with the shift in political, economical and educational macro systems in Papua New Guinea. While the longitudinal historical analyses are beyond the scope of this study, I examined how a particular finger multiplication

strategy was appropriated and (not) maintained among transnational parents and children. In examining appropriation of cultural tools, Polman (2006) called for further research on this topic across time and across locations. This case study will offer insights into the adaptation and rejection of cultural tools, along with these families' cross-national movement and their pressure to fit into the mainstream. In doing so, this paper addresses the following research questions: 1) Whether and how do Filipino parents in Japan appropriate and pass on the finger multiplication strategy to their children? How do their narrated identities relate to this process? 2) Whether and how do children of the parent participants appropriate the finger multiplication strategy? How do their narrated identities relate to this process?

## Methodology

The main data source for this paper was obtained through a set of semi-structured interviews with 12 women who self-identified as Filipino and lived in Japan as well as semi-structured interviews with 10 of their school-aged children. All the interviews were conducted between November 2012 and February 2013. Child participants were either born in Japan or in other countries. In the interview, I elicited their transnational experiences, their language and mathematics practices in and outside the school. Both parent and child interviews included computation problems and word problems and they were asked to explain their strategies. The computation problems were presented as similar to school quizzes (10-15 problems for each participant). Word problems included both textbook problems and original problems that reflected the context in which parents used mathematics in daily lives. The majority of the interviews were conducted once, for approximately 1.5 hours. Depending on the preference of each participant, I conducted the interviews in either English or Japanese and later translated all quotes into English. Based on the findings from the interview study, I facilitated a series of workshops and addressed topics such as exploring the application and extension of the finger multiplication strategy. For the purposes of this paper, I focus on the findings from the parent and child interviews.

## Analysis

This paper presents an intergenerational analysis of cultural tool appropriation among transnational families. In other words, I analyzed perspectives of both parents and children with respect to their use of a particular cultural tool, finger multiplication strategy. After descriptive coding, I wrote an analytic memo for common themes appeared across participants and generated themes for focused coding. The focused coding highlighted for this paper was on identity and mathematical cultural tools. In this paper, the analysis of identity was limited to the aspects that were narrated in relation to mathematics. Under each coding, I identified common themes that appeared in more than half of the participants' interviews. For the analysis of child participants' appropriation of finger multiplication strategy, I identified parents who indicated they had taught the strategy to their child and then focused my analysis on those three children. My analysis investigated whether they used the finger multiplication strategy solving a computation task and also how they described the use of the strategy in school.

## Findings

### Finger Multiplication Strategy

In this paper, I draw on the use of the finger multiplication strategy as a window to examine power and tensions that arise in the discourse of transnational families and their use of cultural tools. In the process of computing school mathematics problems, some parent participants and child participants used a multiplication strategy using their fingers. This strategy was observed among five of the participants when they were solving a single-digit multiplication of numbers between six and nine. For example, this strategy was used when participants were solving the problem,  $9 \times 9$ . Using two hands, the strategy was described as follows by participants (each hand represents one number): Five is represented by the closed hand and any number above five is represented by the number of fingered opened (e.g., nine is four fingers open) (Figure 1 is a participant's representation



Figure 1. A parent participant's finger multiplication strategy ( $9 \times 9$ )

of  $9 \times 9$ ). Then, participants counted the number of open fingers and multiply ten to the number (product A) (e.g., in the case of  $9 \times 9$ , participants computed  $8 \times 10$ ). Then, participants multiplied numbers of closed fingers in each hand (product B) (e.g., in the case of  $9 \times 9$ , participants computed  $1 \times 1$ ). The final multiplication product was calculated by adding the above products A and B.

Participants explained that they used this strategy mainly for completing computation problems quickly in the school. For example, Irene said, "when we were at school and then we were doing some tests - that needs to be quick." None of the participants reported other contexts where they would use this strategy in their everyday lives. Participants acquired this strategy from various places: from their family members, friends, and at school. Child participants acquired this strategy exclusively from their parents. Neither the parent nor the child participants could identify the historical origin of this strategy. Some parent participants stated that the strategy was wide spread in their communities in the Philippines.

## Parent Participants' Appropriation and Resistance of Cultural Tools and Identity

In the interview, parent participants associated their cultural tools including the above-introduced finger multiplication strategy with their perceived national identities. Specifically, they described their use of cultural tools as "Filipino ways" that would significantly

differ from the ways in which their children were learning at school in Japan. Parent participants stated that mathematics and English were the only subjects they could academically support their children. However, they also expressed difficulties with teaching children and attributed the difficulties to the perceived differences between Filipino ways and Japanese ways. Karen's narrative illustrates this point. When asked whether she would help children learn mathematics at home, Karen said, "We don't know really exactly what kinds, how you solve the mathematics. We don't understand your ways (...) Japanese schools, you have your own system." In this narrative, Karen's use of pronoun indicates how she set up a boundary between Japanese ways (e.g., your ways, your own system) and Filipino ways and she distanced herself from Japanese ways. In the interview, parent participants commonly described how the cultural boundary restricted them from communicating on school mathematics with their children.

Furthermore, in the interview, parent participants undervalued their cultural tools compared to the cultural tools their children were acquiring at Japanese schools. For example, in her interview, Janice repeatedly said Japanese mathematics teaching was higher as represented in the following quote: "Japan is at a high level...what to say, I think mathematics is also at higher level. Filipino children learn division at around Grade 5 and Grade 6 but Japanese children learn it at a higher level." This perceived hierarchy-influenced participants' recognized roles as parents. Parent participants associated their national identities with helplessness to participate in children's school education. They expressed this powerlessness in relation to their backgrounds that they recognized to be different from the mainstream in Japan. For example, Michelle said, "I'm Filipina and I can't offer anything as a parent because I'm a foreigner. So, I always tell my child, 'you don't have to be number one, two or three but you have to follow what everyone else is doing.'" This quote resonates with what other participants described regarding their identities. Parent participants adapted an assimilative discourse summarized as follows, where they hoped their children would exclusively master the mainstream cultural tools.

These parent participants' identities shaped family practices surrounding the finger multiplication. All the parent participants positioned this finger multiplication strategy or the use of finger as secondary to strategies taught at school in Japan. When the finger

multiplication strategy was taught at home, it was as a “secret” and parent participants emphasized that children should acquire the mainstream cultural tools taught at school. In her interview, Karen described a main function of this strategy as “only for an emergency purpose,” as using fingers would be considered to be illegitimate in Japanese schools. When teaching this strategy to their children, Karen said they also encouraged their children to memorize a multiplication table. These participants’ accounts are similar to Wertsch’s (1998) account of resistance to the extent that parents taught their children their cultural tool for emergency purposes while also teaching to perform the mainstream way at school. The parent participants’ story in this study is more assimilative in the sense that they positioned their cultural tools to be secondary and “secret tools” compared to mainstream mathematics practices.

Furthermore, parent participants connected the finger multiplication strategy with perceived children’s computation fluency and memorization skills. There was a parent participant who selectively taught the strategy to the child who were struggling with computation and memorization but not to the child who were doing well in mathematics. Regarding this point, Irene, Ryan’s mother, said, “I’m telling Ryan this because his memory is a little bit... slow. So, I told him, ‘you can use this one’ and he said, ‘mommy, I think this is harder – I can’t. I have to remember.’” As such, teaching or not teaching of informal knowledge was connected to how parents envisioned their children’s identities. In the following section, I describe how child participants appropriated or did not appropriate the finger multiplication strategy.

## **Child Participants’ Appropriation of Cultural Tool and Identity**

Parents of the following three child participants indicated they taught the finger multiplication strategy to their children. May was a Grade 6 girl who came from the Philippines to Japan when she was in Grade 4 and repeated Grade 3 in Japan due to her limited Japanese language proficiency. At the time of study, May’s parents were considering whether they should send her back to the Philippines for junior high school. Eric was a Grade 4 boy, who came from the Philippines to



Japan after finishing Grade 1. His parents described him as an excellent student in the Philippines but that he was academically behind in Japan, receiving extra support from his classroom teacher after school. Ryan was a Grade 4 boy, who was born and raised in Japan. Because neither of his parents were Japanese citizens, their residency had to be updated annually and thus the family was not guaranteed for permanent residency.

The Japanese mathematics curriculum covers multiplication of single digit numbers in Grade 2 and requires students to recite the entire multiplication table between one and nine, using a culturally specific recitation strategy called *kuku*. For May who came to Japan after Grade 3, she did not have a chance to learn the *kuku* strategy. Both Eric and Ryan indicated that they learned the *kuku* strategy at school. Ryan stated in the interview: “I was placed in the slowest group for computation in Grade 2 and was forced to practice *kuku* repeatedly.” Thus, multiplication learning at school was a locus for constructing students’ academic identities.

In order to analyze how child participants appropriated or did not appropriate the finger multiplication strategy, I first examined how child participants solved single and two digits multiplication problems. May and Eric both used the strategy for single digit multiplication problems of numbers between six and nine. They both explained that they learned the finger multiplication strategy from their parents. Ryan did not use finger multiplication strategy but used the *kuku* strategy. May was able to reach the correct answers for both single and two digits multiplication problems but Ryan and Eric both could reach the correct answers for single digit multiplication but could not reach the correct answers for two-digit multiplication.

How did child participant use the finger multiplication strategy in school, where the use of finger was not encouraged and acquisition of *kuku* strategy was expected? May and Eric both mentioned that they would not use the strategy openly at school. Eric said he never showed the strategy to school teachers. May also said she would not use this strategy during mathematics quizzes but would use computation strategies that the teacher showed. She provided an example of  $7 + 8$ . Outside the school, she said she would usually compute this addition problem by decomposing the number by 5 (as  $5+5+2+3$ ). But in the mathematics quizzes at school, she would follow the way the teacher taught without decomposing numbers. This example shows how both

Eric and May were aware of what is considered to be legitimate and correct at school and they would strategically hide computation strategies different from the ways in which they learned at school.

The following quote from May provides a further account on how she appropriated the finger multiplication strategy to maneuver a competitive school environment. When asked in the interview if she would like teachers to acknowledge her finger multiplication strategy, May said, “No, I don’t want to (show it to the teacher). Everyone else is very fast at computation. I shared this only with those who were slow (at computation).” And she further added, “Students who go to afterschool cram schools (*juku*) are very fast (at computation).” Attending private cram schools (*juku*) during after-school hours have been common among children in Japan and even among upper grade elementary school students for previewing and reviewing school subjects and also for preparing for entrance exams. The fee for a cram school ranges between 50 dollars to 200 dollars per month. As such, there can be a social class divide between those who can attend a cram school and those who cannot. May’s interview describes how she observes a gap in computation fluency. In facing this gap, May selectively shared the finger multiplication strategy only with students like herself, namely, those who were slower at computation and did not have access to a private cram school. By doing so, May tactically used the finger multiplication strategy to create a context where she could be a competent student in mathematics.

## Discussions and Implications

In sum, this paper explores the use of the finger multiplication strategy to demonstrate tensions that transnational families must contend with as they endeavor to assimilate into the dominant culture of their host country. Filipino parents hoped for their children to master the use of mainstream cultural tools and thus taught the finger multiplication strategy to be used as a secret tool. This decision was connected to the narrated hierarchy between their home country and their host country with regards to mathematics teaching. Parent participants felt distance from the mainstream, but hoped for their children to fit in this mainstream. Thus, they chose not to openly pass on their cultural tools. Child participants who appropriated the finger multiplication strategy

tactically used the tool to maneuver a competitive school environment and to position themselves as competent mathematics students. By employing the intergenerational analysis, this paper offers insights as to how a cultural tool is appropriated or (not) maintained across generations and how identities are strongly tied with this process.

This finding is particularly significant to the discussion on how to meaningfully bridge out-of-school resources and in-school learning. As opposed to the deficit views toward immigrant students and households, there has been studies on mathematics teaching, which highlights immigrant families' funds of knowledge embedded in cultural practices that they engage in (e.g., Gonzalez, et al., 2001). For example, the finger multiplication strategy highlighted by this study can be useful for challenging students' "fossilized" (Vygotsky, 1978) knowledge (with a recitation method of multiplication) and for diversifying students' ways of approaching multiplication.

This paper also describes how social power imbalances can influence the use and maintenance of cultural tools. Findings from this study adds to the discussion of "social valorization" (De Abreu & Cline, 2007) that highlights the processes in which different kinds of mathematics (e.g., Brazilian peasant mathematics and school mathematics) are valorized or devalorized with reference to social classification. This paper depicted the interplay between participants' identities and the appropriation and resistance of a cultural tool, which was undervalued by parents and in the school. Also, this paper highlights child participants' agency to create a context where this socially undervalued cultural tool can be meaningfully used. Further research will be beneficial to identify school curriculum and pedagogy which can contribute to challenging the stabilized social valorization and which can support and affirm diverse ways of knowing. Such curriculum and pedagogy will eventually lead to affirming students' and parents' identities, because cultural tools and identity can be closely intertwined, as demonstrated in this paper.

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