

Adult Learners' Reported Use of Mathematics in Their Current and Future Lives

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ACKNOWLEDGEMENTS

We would like to thank the following programs for helping us with this research project: Action, Inc., Blue Hills Adult Education, Bristol Community College, Community Learning Center, East Boston Harborside Community School, Haitian Multi-Service Center/Catholic Charities, Holyoke Opportunity Academy/Holyoke Public Schools, Jewish Vocational Services, Methuen Adult Learning Center, Middlesex Community College, and Quinsigamond Community College. At each of these adult education programs, teachers and directors helped us recruit students to participate in focus groups. We are especially grateful to these student participants who shared their responses with us eagerly and fully.



This report was developed with funding from the Adult and Continuing Learning Services (ACLS) unit of the Massachusetts Department of Elementary and Secondary Education.



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Introduction

In FY2021, the SABES Mathematics and Adult Numeracy Curriculum and Instruction Professional Development Center (Math PD Center) at TERC asked us to conduct a mini-research project on how adult learners use mathematics in their previous and current jobs and in their everyday lives. We also asked how they might use math for their future endeavors. The purpose of this exploratory study is to inform the professional development and curriculum and materials development provided by the SABES Mathematics and Adult Numeracy Curriculum and Instruction PD Center (hereafter referred to as the Math PD Center) to help teachers learn the best ways to support adults learning math.

Methodology

The researchers hoped to talk with 40 adult learners from a cross-section of Massachusetts adult education programs representing different regions and program types serving a range of adult learners. In all, we talked with 44 students from the following regions and program types:

TABLE 1: PROGRAM TYPES AND REGIONS

Program Type	Region					Total
	Boston	Northeast	Southeast	Central	West	
Community-based Organization	3	1				4
Local Education Authority		1	1		1	3
Community College		1	1	1		3
City	1					1
Total	4	3	2	1	1	11

Because of the current pandemic, discussions with the adult learners were conducted over Zoom. All discussions were in English; thus, participating learners had to have at least a low intermediate level of English language skills.

We planned to conduct eight hour-long focus groups of five learners each and thought that participants would be more comfortable talking in groups that included other students whom they knew. We recruited learners by contacting teachers and directors who had ongoing, strong relationships with the Math PD Center, thinking that these teachers and programs would be willing to help us recruit students even in the midst of the pandemic when their time and resources were more stressed than usual. In the end, the researchers facilitated a total of 11 focus groups, with two to seven adult learners each, generally from the same class and program, but not always. We also interviewed two students individually. These were students who were eager to participate but who were not able to schedule a time that worked in

common with others. All of the participating students volunteered to join the study. Each received a \$25 e-gift card to Amazon in appreciation of their participation. Groups were held between January 18 and March 16, 2021.

We asked students:

- what math they used in their current or prior jobs,
- what math they used in their everyday lives,
- what their future education and employment goals were,
- what math they thought these jobs would require, and
- whether they had ever considered starting a business and what math this business would entail.

A copy of the focus group interview protocol is included with the attachments. Depending on group size and on how talkative students were, each focus group took between 30 and 80 minutes. Each group was conducted by the two researchers working together. Discussions were informal, with students taking turns and with everyone participating. The researchers took notes and recorded each discussion in order to be able to re-listen to responses, as needed.

The Study Sample

To help us understand our findings, we collected some demographic information about the adult learners who participated in the focus groups and two individual interviews. The students' ages and mathematics levels were provided by their teachers and/or administrators after completion of the focus groups and interviews. The participants self-identified their countries of origin during the focus group discussions.

Forty-four adult learners from 11 programs located across Massachusetts participated in the study. The ages of the study participants ranged from under 25 years to over 60 years of age, with the majority clustered in the middle ranges. The study group included 34 women and 10 men. As shown in Table 2, the men in the study were somewhat younger than the women.

TABLE 2: AGES OF STUDY PARTICIPANTS

Age in years	Total Sample (n=44)	Number of Women (n=34)	Number of Men (n=10)
18-25	3	1	2
25-35	12	8	4
35-45	15	13	2
45-60	12	10	2
60+	2	2	0

Thirty of the study participants (approximately 2/3 of the sample) were immigrants to the US, while the others were US-born. There were both women and men in the immigrant and US-born groups, with relatively similar proportions of women and men represented in each group as shown in Table 3.

TABLE 3: IMMIGRANT VS. US-BORN PARTICIPANTS

	Number of Women	Number of Men
Immigrants (n=30)	24 (80%)	6 (20%)
US-born (n=14)	10 (71%)	4 (29%)

The 30 immigrant students came from 15 different countries from around the globe, with five people being the most from any one country. Given the small sample size and the number of countries of origin, we did not focus our analysis on cultural differences.

Since the study concerned adult learners' perceptions of their mathematics use in their past, present and future work lives as well as in their everyday activities, it seemed appropriate to gather data on their math levels, as reported by their teachers or program administrators. Table 4 shows those reported math levels. Note that 10 immigrant students did not have reported math levels because they were studying ESOL and were not taking math classes.

TABLE 4: MATH LEVELS OF STUDY PARTICIPANTS

	Beginning	Intermediate	Advanced	No Reported Math Level
Immigrants (n=30)	3	3	14	10
US-born (n=14)	2	5	7	

Overall, the math levels of those participating in this study are probably higher than would have been expected from a random sample of the adult learners who were invited to participate. Since the learners knew the topic of the discussions would be their use of math, we might assume that those who were confident and comfortable in their own math knowledge would be more willing to agree to participate than those with lesser math knowledge and/or anxiety about mathematics use. Indeed, with one or two exceptions, they did not talk about math anxiety or prior negative math experiences.

Following the focus group interactions, the researchers identified a likely race category for each participant. US-born participants were categorized based on their visual presentation and any relevant comments they may have made during the discussions. Immigrant participants were categorized based on their country of origin and native language. This categorization is only presented to demonstrate the diversity of the sample, and the data are not used in any further analysis.

TABLE 5: RACIAL BACKGROUND OF STUDY PARTICIPANTS

	White	Black	Latinx	Asian
Immigrants (n=30)	10	10	7	3
US-born (n=14)	9	1	4	0

Interestingly, some students (and not just English language learners) thought they were signing up for a math class and were disappointed when the purpose of the focus groups was clarified at the beginning of each session. These students, and even some others who were clear about the purpose of the focus groups, said they wanted more math instruction, and more “advanced” math instruction. By more “advanced” math instruction, students generally meant algebra and geometry but sometimes also data, statistics, and quantitative analysis.

Using Math in Current and Previous Jobs

We asked participants what jobs they currently or previously had and what math they used in these jobs. Almost all of the students were working or had worked in essential jobs, meaning work that can’t be done remotely. Some students mentioned several jobs.

- The most common area of employment was **health care** (n=14), with students working as nursing assistants, home health care providers, personal care assistants, direct care providers, hospital records manager, nursing home cook, dental assistant, operating room technician, and therapeutic support worker. Twelve of the students who worked or had worked in health care were women and 11 were immigrants.
- Other areas of employment included **grocery and other stores** (cashier, stocker, bagger, customer service representative, florist, gardening assistant, floors and walls associate, inventory) (n=13); **food service and hospitality** (waitress, cashier, cook, housekeeping); bookkeeping and accounting; teaching; and transportation (Uber driver). Of the students who worked in grocery and other stores, eight were women and five were men. Regarding country of origin, eight were US-born and five were immigrants.
- Other students had done factory work, cleaned homes and offices, staffed laundromats; one served as a youth worker; and one was the secretary for her husband’s construction company.
- Some students had held management positions: Walmart department manager, Burger King shift supervisor, hospital manager for parking and transportation, airport passenger service supervisor.
- In their home countries, in addition to having owned shops that sold food, clothing and supplies, individuals had been employed previously as teachers, tax and regular accountants, as an economist in education and law, a museum worker, a dentist, a scientist in a chemical lab, and a therapist.

As one student remarked, “Math every day, everywhere.” Not surprisingly, the most common employment-related math skills involved money -- managing cash, credit card payments, and

checks. The tasks mentioned included adding, subtracting, counting, tallying, multiplying, making change and organizing money by denominations. Additional processes mentioned included computing earnings per hour, making sure that hours and earnings match; figuring percent and percent off; counting mileage and expenses for reimbursements; determining sales and profit; figuring price and the cost of extras. Every learner talked about money in some way in relation to their work. (No one said “decimals”.) Many learners also talked about other forms of counting: doing inventory (figuring out how much of a product has been sold, is on hand, or needs to be ordered); counting students present and absent; adding up mileage; tracking calls, emails, records retrieved and provided; determining the number of airline passengers in and out; and determining profit and loss. In the context of working with money, some students remarked about using mental math and estimation for keeping track of pricing in case system updates of SKUs were inaccurate, or knowing prices in your mind in order to estimate and know if someone is being charged too much or too little.

Measurement was the next most common area of employment-related math skills – measurement of ingredients by cooks and of infant formula by a daycare volunteer; of medications and pain killers, of food portions and intake, of liquid inputs and outputs, and of height and weight by nursing assistants and home health aides; of carpets, blinds, and linear feet by building supply workers; of ingredients for dental filling compounds by the dental assistant; or of the pH for soil or solvents by the scientist.

Time and scheduling also figured prominently in student’s responses about the math they use at work. Examples included coordinating and scheduling appointments for themselves and for their employers, calculating hours and how long it takes to do certain tasks (e.g., clean each hotel room or floor) or travel somewhere, and figuring out the time for breaks and when it’s time to return to work.

A few students (those working as accountants or helping a spouse manage a business) talked about being skilled in using specific software such as Excel, QuickBooks, Quicken, and other accounting software.

We heard little about math involving data, statistics, graphing, or analysis. One exception to this pattern came from a student who had worked overseeing community projects with women’s organizations in her home country. She described determining baseline and then maintaining data for levels of participation in project activities and using graphing to display project results. Another student who worked as the manager for parking and transportation at a metropolitan hospital talked about maintaining and compiling data for about 500 cars per day. This same student, who now works in addition as an Uber driver, discussed analyzing which days and times are most profitable for driving.

The vast majority of students were comfortable with the math they use at work. They appeared to understand the math required to do their jobs. Exceptions to this high level of comfort were voiced by two students. One student, an immigrant, spoke about not knowing American coins when she worked as a restaurant cashier. This made her work difficult at first but became easier as she learned what she needed to know. A second student stated that she had been unable to do parts of several jobs all because of “not being able to do the math.” As a waitress,

she couldn't do the calculations for taxes and tips and she "was not supposed to ask the other waitresses for help." She said, "Math has always been an obstacle in my life. I couldn't deal with it."

Some students voiced the importance of attention to precision. For example, the student who worked as the manager for parking and transportation said, "Every number had to match... This was not easy, especially when the numbers didn't match. One error could take two hours to fix." A second example was provided by the woman who worked as an airport passenger service supervisor. She stated that you "need a very accurate total of the number of people on the plane...sometimes a person bought two seats... [they] used a seat for a guitar or cello... reconciling the number of passengers and the number of seats" was important.

Using Math in Everyday Life

Participants were asked to identify and describe the math they use in everyday life. The math initially identified was usually: add, subtract, multiply and divide, and percent. Every person described a variety of mathematical tasks they encounter every single day. For example, one person said, "The number of shoes, the number of earrings, when to put gas in the car. Math is life. Paying bills, writing checks, counting the number of cigarettes left so I can spread them out. Putting money in and out of my savings account, stamps, mailing."

Overall, the most common use for math was "budgeting," necessitated by limited money available. Additional comments about math use centered around four contexts:

- shopping (primarily for food, but also for other items) and cooking;
- money management including using credit cards, bank accounts, and credit scores;
- particular issues for immigrants such as sending money home, Celsius/Fahrenheit conversion, and figuring out time zones; and
- helping children with school math.

Shopping and Cooking: Students described shopping practices that involved the use of mathematics, often employed to stay within a budget. These included comparing prices, preparing a shopping list beforehand and only buying what is on the list, buying products when they are on sale, and estimating the total cost before getting to the cash register.

Among the mathematical tasks and reasoning described were:

Having enough money when checking out at a store. Sometimes, it happens that you have to take some things out. I use the calculator on my phone to track how much money I'm spending. Before I had a phone, I did it in my head.

Percent. Is it a good deal? Do you take advantage of sales or do they take advantage of me? Do it in my head. Percent off—good deals. They trick you. You have to calculate it.

I compare prices while shopping. Use unit prices. I learned ratio and percent, I use the stickers, compare stores. Use proportion to compare prices for the same brand and quality. I can do it in my head. This is why estimation is very important in our life.

Participants often mentioned home cooking as a context in which they used math, primarily for measuring ingredients, but also when setting oven temperatures and timers. This context was the only one for which fractions were mentioned as necessary. One participant did comment that, being on a special diet, “I make everything from scratch. Homemade bread. Fractions. I get scared looking at them (in class). I do this every day. How come I can’t figure it out? Math is easier at home.”

Money Management, including Credit Cards and Banking: Many students mentioned managing their money beyond just budgeting. They sometimes used credit cards when their funds were not adequate to cover weekly expenses, and some mentioned credit scores. They noted that they paid attention to how much the interest rate is, how interest accumulates, and fees that may be charged. “Sometimes the money isn’t enough so I have to use a credit card. Then, the next week, I have to move money to cover the credit card debt.”

One person shared a strategy for maximizing savings on public transportation by buying passes when cost effective for different usage needs. “I take buses for transportation. Buying a pass for a week or a month based on the price.”

Mathematical Tasks of Particular Relevance to the Lives of Immigrants: Our final focus group was composed of four immigrant students who were in a Bridge to College program. They described a number of tasks that are particularly relevant to the immigrant community and require the use of mathematics. One task discussed involved the procedures for sending money to relatives back in their home countries. The participants knew the conversion rates between dollars and their home country currencies, but also noted that rates differ across different remittance apps and the agents’ fees differ as well. Thus, they constantly seek to find the best deal based on both the exchange rate and the fees.

Additionally, the participants reported needing to pay attention to time zones to make phone calls at appropriate times. As one person noted, “Calculating the differences in time between here and home. Before the difference was six hours, now it is five. Figuring out when to make calls.”

Temperature is also an issue. Participants were used to using Celsius in their home countries. Now, they say they are always doing the conversion to or from Fahrenheit.

Helping Children with School Math: Ten of the participants (all women) in different focus groups reported spending time with their children and grandchildren working with them on the math they are learning in school, working with them on math homework, or teaching their young children math in advance of entry into school. Six of the ten women were immigrants and the other four were US-born.

Of particular interest was not that they were helping their children, as parents typically do, but most explained that math was being taught with procedures that were different from how they themselves had learned. While this might be expected from immigrants who learned math in other countries, US-born parents also found changes from their own school days.

Three of the immigrant parents described their experiences:

Kids' math is very different. There are two ways to do math – the American way and the international way. I help the kids my way. The same result in the end.

I help my son with his math. Check his homework. He is in 7th grade and doing pre-Algebra. Reading math problems in English is challenging. I know how to do them but not how to explain them in English. The way to solve problems is different. I'm trying to understand his teacher's way.

Math with the kids includes addition and subtraction for my younger child and multiplication, geometry and fractions for the older child. I Googled his age and grade to see what topics they'd cover, what he should learn. Right now, he's learning long multiplication but I already taught him that. Multiplication tables. The strategy is different. The way I learned was one strategy; my son is learning lots of strategies including rectangles, and I'm learning, too, sometimes. Here, teachers make it easy.

The US-born parents also found school math was being taught differently from when they studied in school. They described their work with their children as:

I'm doing multiplication and division with my 9-year-old. Helping with homework. 4th grade. His math is totally different. I talked with the teacher to learn his way. I'm teaching the way I learned.

I'm helping my third-grade son to learn multiplication. I teach tricks like counting by 10s, counting on your fingers for something like 3×4 . Things are different; math teaching is different.

One parent observed:

Some teachers are still teaching the way they did before. This is okay as long as the students are learning. [But] some are using algebra in 3rd grade. With parentheses, you do what's inside first. Then, multiplication; then, addition. Your whole order of operations is different.

Thus, while the parents struggled to understand how their children were learning math in school, they still endeavored to support their children's learning by seeking to find out about the 'new' ways or by teaching their own learned strategies. None of the parents seemed to be challenging the schools' methods or unhappy with them.

Using Math for Future Goals

As students described their future goals, there were two distinct groups: 1) students who had a personal, short-term goal and who would decide what they wanted to do next once they had achieved that personal goal and 2) students who already had a career goal or general career direction.

For the first group, the students' primary goals were to improve their English (ELLs), complete the GED/HiSET (both US-born and ELLs), and/or be better able to help their children and grandchildren (both US-born and ELLs). As one learner said, she wanted to "complete something for myself, [but] I don't know where I will go from here...could be a therapist or a detective." Another student said she wants "to improve my English..." and "refresh my knowledge ... just in case in the future I want to do something else." She wants to know "how schools work here" to be able to help her 7-year-old daughter. Another learner said her "dream is to have a career one day." She started a family first because where she grew up, "School was not favoring girls. Girls stayed home, worked, married at 15 to 18." She will "want to do something to give back to the community." Another learner said he "came back to school because in this world you need education to do anything." He wants a high school diploma and then will think about what else he wants to do, but knows he wants to go further. He is "thinking about one step at a time." Another student "just need[s] to pass the math on the HiSET. I thought I was interested in the medical field but then I became a florist." She wants "time, freedom... I want to work where I get paid well for the work." Another student said she wants to "continue to learn English at a community college or college somewhere. I'm not sure what I want to do. I like photography, sewing, and garden planning. Right now, I don't have enough time to figure out what I want to do, but I will need math. Everywhere and everything, we need math."

In the second group, students who had more high-skilled jobs in their home countries (e.g., financial analyst/tax accountant, dentist, therapist) tended to have specific career goals, mainly to be recognized and continue as professionals in the US. They are aware of what they need to do to achieve these goals. The therapist, for example, was in the process of getting his credentials and education from Brazil evaluated in the US, and then planned to enter a PhD program in psychology. The Russian dentist was studying ESOL in order to pass the Test of English as a Foreign Language (TOEFL) and then enter a 2-year dentistry program that would allow her to work as a dentist here.

Not surprisingly, many students had health care-related career goals such as becoming RNs or LPNs, surgical technicians, phlebotomists, medical assistants, ultrasound or x-ray technicians, interpreters, pharmacy technicians, or nursing assistants. These students, especially those interested in nursing, often had general knowledge of what math they would need for their chosen careers (e.g., measuring vital signs and medications). Aside from health care, career goals included business (see the next section on starting a business) and business management, accounting, computers and IT, bioscience, horticulture, journalism and podcasting, corrections, employee rights law and paralegal, and teaching.

Did the students know what math their future career goals required? In some instances, yes, especially those students who mentioned that they were supported with regular career advising. In general, though, most of the students said they didn't know what math they would need, but they assumed they would need more of it, especially higher-level math. As one student who wants to become an accountant stated, "Yes, I will need math. Everything is accounting." A student who wants to become a medical assistant said, "I would need more

math, but I don't know what math." Another student, who wants to return to his home country and found a school, said he would "need to be oriented to what to study to achieve my dream."

Of course, there were exceptions to this general pattern. For example, the student who wants to manage the business side of her husband's contracting business knew that she would want to know how to do payroll and pay quarterly taxes, how to determine cost per square foot, how to break a job into phases and determine the cost for each phase, how to estimate the overall cost for a contracting bid, how to figure out quarterly profits, etc. The student who wants to become a horticulturist had already identified a specific program and his need to get an associate's degree, followed by a bachelor's and then a master's degree. He had "done a lot of research on the area and a lot of contemplation" and knew about tasks he would need to be able to do (e.g., calculate the pH of soil) and suggested he would want to take a business math course and also algebra working from "simple algebra to more complicated."

Interest in Starting a Business

When the participants were asked if they had ever thought about starting their own business, many said they were hoping to do that. Of the 44 participants, 29 (66%) indicated they were interested in doing this. It is notable that, across the sample, the future entrepreneurs included high percentages of both men and women as well as immigrants and US-born individuals.

TABLE 6: THOSE INTERESTED IN STARTING THEIR OWN BUSINESS BY GENDER

Total Sample (n=44)	Interested in starting a business
Women (n=34)	21 (62%)
Men (n=10)	8 (80%)

TABLE 7: THOSE INTERESTED IN STARTING THEIR OWN BUSINESS BY IMMIGRANT/US-BORN

Total Sample (n=44)	Interested in starting a business
Immigrants (n=30)	19 (63%)
US-born (n=14)	10 (71%)

Almost half of those who wanted to start their own businesses wanted to open a restaurant (or a food truck, for a few). It was clear that some had spent time thinking about the preparation necessary for opening and running such a business, including securing space, managing costs, financing the business, and ongoing analysis of customer preferences. Some of those interested in opening a restaurant had already worked in that industry, and so were realistic about the tasks and challenges involved. Two people acknowledged the challenges and preparation needed:

I plan to take business classes so no one can be ripping me off. Want to be able to do my own taxes and know the ins and outs of running a business. Need to know economics, taxes, food costs so not overcharging, but also need to make a profit.

A restaurant in America looks like a big undertaking. Need to mobilize large capital. Know all the requirements and regulations, figure out location, how to advertise... Would need an overall goal for the restaurant, to study the market, figure out what people like, what products to offer, how much to bake, how much to sell.

Other participants were interested in opening a variety of businesses, often related to their current or past jobs. Their plans included opening a laundromat, a beauty salon, a doggie daycare service, and a houseplant business. In addition, three people were considering buying and selling clothes as a business (probably online), having participated in such an endeavor before. Two people expected to join family-owned construction businesses, taking on a management role.

Still others are planning to build on their learning acquired in their workplaces, go on to gain the relevant credential, and then open their own professional office. In some cases, they already have a relevant credential from another country but now need to complete coursework or gain a certification here. People in this group are interested in opening a dental practice, a psychotherapy practice, an accounting or insurance agency, or a nursing practice.

During the discussions, it was apparent that most of those interested in opening a business of any sort recognized that they would need mathematical skills to manage money, monitor expenses, analyze customer data for marketing, and deal with regulations and taxes. Some did say they planned to access further learning in economics to prepare themselves.

Implications

This research has implications for ways that adult numeracy instruction can best meet the current and future needs of adult learners. These include raising teachers' awareness of their students' interests and situations as well as of instructional practices that facilitate learning and engagement. In addition, appropriate materials and resources should be created to meet these needs and professional development should be provided to support teachers' improved instruction.

What Teachers Should Know about Their Students

- Most students are using math in work and everyday contexts to solve problems and manage situations, although they may not be using school-based procedures.
- ELLs are interested in learning math as well as improving language skills.
- Most students have a reverence for algebra and think of it as entailing advanced skills, not as something that they currently use, but more as something they would need, in some way, for future jobs.

- In general, students think of school math as procedural rather than as conceptual and meaningful.
- Students find math to be easier at home than at school.

Classroom Practices That Should Be Encouraged and Supported

- Learn what individual students' career goals are.
- Give students choices of activities with different contexts related to their own goals and interests.
- Set aside time for learner-driven math activities.
- Connect algebra with real world goals and activities.
- Talk about "what is algebra and how is it used".
- Place more emphasis on data use and meaning.
- Create opportunities for parents and grandparents to talk about children's school math.

Topics for Materials Development/Identification

- Financial literacy (general, including budgeting, taxes, interest, different types of accounts, credit cards, etc.)
- Math for business (taxes, debt, payroll taxes, etc.)
- Math for entrepreneurship – starting a business (assessing the market, what math content do you need to know, etc.)
- Math for the healthcare context
- Algebra with real life applications, but also connecting to test demands
- Immigrant-specific math needs such as calculating the differences in time between the US and home countries, understanding and applying currency conversion rates and fees, and converting to and from Celsius and Fahrenheit

Professional Development

- Provide workshops and other PD to support teachers in situating algebra within contexts (e.g., algebra for healthcare, algebra for business)
- Provide workshops and other PD on understanding current K-12 math teaching (content of school math and how it's being taught) so that parents and grandparents can better assist their children and grandchildren with math learning
- Develop and provide a webinar or other PD opportunity that support students to become stronger leaders in their classroom and encourages teachers to better integrate student voices and experiences in their planning.