Students as Leaders in a Multi-Level Classroom

By Ayantu Abera, Eric Appleton, Gina Cortez, Mardgrina Leonce, and Khom Thapa

The authors are from the CUNY Adult Literacy Program, which operates on fourteen different campuses of City University of New York (CUNY) in the five boroughs of New York City. Ayantu Abera attends Borough of Manhattan Community College (BMCC). Gina Cortez attended and now works at Lehman College in the Bronx. Khom Thapa and Mardgrina Leonce attend New York City College of Technology in Brooklyn. They have all participated as class leaders in multiple online math classes together. Eric Appleton works as a professional developer and has been the lead teacher for a series of math problem solving groups over the last few years.

Introduction

We met each other while participating in a series of large, online, multi-level classes, starting in the summer of 2020. In this article, we describe the structure of our class and share the experiences of students who acted as leaders within the class.

Our math problem-solving groups were offered in the summer, and at times when other classes were not in session, in order to provide additional engagement for students across the CUNY Adult Literacy Program. These weekly, two-hour classes took place over Zoom using Google Classroom, Desmos Classroom, Desmos Graphing Calculator, and Mathigon Polypad as teaching tools. The classes were open to students from any of our campus programs, from all levels of adult basic education, including high-level ESOL. More than 100 students registered for the first class, with average daily attendance between 40 and 50 students.

We called the classes "math problem-solving groups" to indicate that the experience would be different from a regular high school equivalency math class. Because students were joining at all levels, some with a lot of math experience, some with not much, we decided that we couldn't start at the beginning of a topic and proceed sequentially through all the steps of learning. More advanced students would probably be bored and more beginning students would be lost.

Eric decided to organize the class around non-routine math tasks which would allow students at different levels to engage in different ways. When choosing problems, he tried to use the criteria Burns (2000) has described for mathematical problems: a situation that is perplexing for students, that involves something they are interested in solving, and where there is no obvious way to solve the problem. He was hoping

students would use a variety of solution strategies with the problems we posed.[1] A range of strategies, from concrete to abstract, would allow us to make connections and provide pathways for all students to discover solutions and explain their thinking.

When Eric saw how many students were registered for the class, he started to panic and asked himself how he would lead a class with so many students, especially if he wanted to avoid lecturing and have students work together. He decided to ask for help from staff in the campus adult learning centers to lead discussions as leaders in breakout rooms in Zoom. These first class leaders were math teachers, reading/writing teachers, and ESOL teachers, along with a few counselors and administrative staff members.

This is the description of the class leader role that Eric sent with an invitation to class leaders. We wanted students to have support as they struggled with the math and as they talked with each other, but we didn't want class leaders to *teach*, i.e. explain step-by-step how to solve problems. Instead, we wanted class leaders to ask questions and get people talking to each other. We really wanted students to work together and figure out the math on their own.

> Leaders do the following:
>
> - Share screen so everyone can see the problem
> - Help students listen to each other
> - Take notes on strategies
> - Find a volunteer to present the group's work
>
> Class leaders DON'T have to explain the math. Instead of explaining the math yourself, ask students what questions they have and ask other students to explain their ideas. Please share your ideas as well, but don't feel that you have to teach the math.
>
> *-From an email to class leaders.*

In the fall of 2021, Eric needed help with a Friday afternoon class and only a couple teachers were available, so he reached out to former students who had been active and enthusiastic in previous classes, students who were conscientious in their work and supportive of other students. These prospective class leaders weren't necessarily the most confident in math. The main criteria was whether they might be able to talk with other students and encourage active participation. Since then, in three different class cycles, these student class leaders have been just as successful as class leaders who were teachers, counselors, or staff members.

[1] For examples of problems that might meet this criteria for your students, see the Math Memos section of CollectEdNY.org.

How did you feel when you were asked to be a class leader?

Ayantu Abera

Ayantu: When I was asked to be a student class leader, it was interesting and surprising, because I didn't know that I could be a class leader, and I didn't expect that question from my teacher. It took me a while to respond back to him, saying, "Yes, I can try." I had a feeling that I wanted to learn a new skill, but also I was thinking, "I don't speak English well enough; how will people understand me?" I was so afraid to speak and say my thinking about math because I feel I don't have enough English; I don't know how to communicate well. Also, it was math, and I don't know much math. "How am I going to be a class leader?" Those kinds of thoughts were really controlling me when I started, but when we started the class, when the students started to share and we were in the breakout rooms, there was someone speaking who changed my perspective in the way I look at math and other stuff. I can learn—I can do better—I can improve. So, I learned a lot from this class just about being myself and trying to make an effort. And I learned a lot about how to communicate better and to express freely what I am thinking. It gave me great space. I thought being a leader was someone who speaks a lot, but day by day I improved and I became a better person and a class leader.
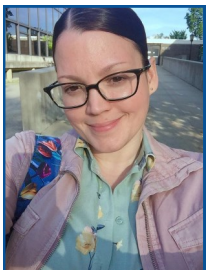
Gina Cortez

Gina: People have a thing with math. It's not my favorite subject, and I used to shy away from it. But when I started the adult education program [at Lehman College], I was looking around the space, and I noticed that, for once, I wasn't looking at myself a certain way. I was not looking at myself and saying, "I shouldn't be here. I'm not great at this math stuff. I'm the only person who shouldn't be here." I started looking at the students around me and saw people of all ages and different cultural backgrounds and the challenges they struggled with, and I said to myself, "All of these students are here for a reason, and all these students, without their realizing it have already motivated me to come back to class. They are just like me. Why I am putting myself down? This person is in the same community I come from. We are both here for a reason. We are both here struggling and trying to progress, and we have the opportunity to learn. Why shouldn't I take advantage of that?" I realized that I deserved to be there. I started feeling more comfortable, and I came back the next day.

When Eric asked me to be a class leader, I was surprised. I didn't know what to expect. What does being a class leader entail? But I thought to myself, "I'm just going to go for it and learn as I go. I don't know what I'm going to do, but let's jump into together, learn together, and see what it's about. "

Mardgrina: When I first saw the email from Eric, I didn't really want to take it into too much consideration. No, I don't think I would be able to do this. But then he hit me up again with a text message. Let me just try and see how it's going to be, because I was surprised. I was worried that I, myself, was learning. I couldn't teach someone because I need education. I feel like I'll be teaching somebody, so I was like, no, I don't think I'll be able to do this. I was hesitant to go for it. But when I went ahead and attended his class, it made me feel more comfortable. Seeing that we all wanted to work together towards a common goal made me feel more comfortable. I felt like I might have this! I was less nervous. We are all students, so we don't have to teach too much. It was an honor to be helping.

Mardgrina Leonce

Khom: When Eric asked me to be a class leader, I was surprised, happy, and nervous at the same time because when it comes to talking and explaining, I am not good in that area. But I realized that if I don't expose myself where I am weak at, I will never learn. In my personal opinion, what I fear is: What question might come up that we cannot answer? It might feel embarrassing if we feel that we don't know it. Now, I am more confident.

Khom Thapa

Outside of class times, the lead teacher and the class leaders met once a week over Zoom to talk about challenges and successes in the class. Sometimes, we reviewed the problem that would be presented that week. We talked about teaching questions, such as how to draw out reticent students or what to do if we didn't understand a student's explanation of their thinking. The student class leaders were an important part of these conversations, lending insight with their recent experiences as learners. They were great teachers in exactly the way we wanted teachers to be; they asked great questions, listened carefully to others, shared some of their thinking, and encouraged everyone to contribute to a shared understanding. In these class leader meetings, we also spent time learning how to use technology teaching tools. For example, we practiced taking notes and annotating visuals with Mathigon Polypad, a useful tool for teaching math.

> Class leaders since summer 2020:
> - 15 math teachers
> - 11 students
> - 4 administrative staff
> - 2 reading/writing teachers
> - 1 ESOL teacher
> - 1 counselor

Class Structure:

Our class structure is illustrated below with examples from a class in the winter of 2022. In parentheses, we show who is responsible for leading discussion at each stage of the class:

- Welcome/Warm-up
- Introduction of the problem
- Individual thinking time
- Small group work
- Large group share
- Closing

Warm-up (lead teacher)

In this class, we started with an activity called <u>Number of the Day</u> (Leonard, 2015). We decided to use different instructional routines to welcome students, encourage conversation, and try to make student thinking visible as soon as we started class (Adult Numeracy Network, 2023). In this routine, students are asked to come up with a way to make the number of the day. They can use the four operations, grouping, square roots, exponents, etc, but we don't tend to say all that. Usually, we just give an example and see if they can come up with other examples.

Eric presented the activity and asked students to write their answers in the chat.

> **The Number of the Day is 12.**
>
> Write your own equation that is equal to the number of the day.
>
> Example (2 + 2) x 3 = 12

Here are some responses from the group:

6 + 6 = 12	24/2 = 12	112 - 100 = 12
11 + 1 = 12	6 x 2 = 12	$\sqrt{144}$ = 12
2^4 - 4 = 12	2 * 8 - 4 = 12	(2 x 2 x 2 x 2) - 4 = 12
3 + 3 + 3 + 3 = 12	4 * 3 = 12	(2)(2)(3) = 12

One of the nice things about this activity is that students can engage at all levels. Some of the equations involve addition and subtraction. Some use grouping, exponents, and roots. All students can participate and often end up teaching each other when they explain their equations to the group. In later classes, the beginning of class was also used to review strategies and solutions to problems from previous classes.

Introduction of the Problem (lead teacher)

Each class included the presentation of a problem situation, usually without a specific question. During investigative discussion based on the problem situation, questions were generated by the group. This was followed by individual thinking time, small group discussion, and, finally, presentations of findings and new questions with the whole group. The structure of the math problem-solving group was based on a framework used in a monthly math circle, the [Community of Adult Math Instructors (CAMI)](#) (Appleton et al., 2017), where teachers and students come together to do math. Many of the class leaders have participated in CAMI.

Our main goals during the introduction of the problem were to promote curiosity, encourage close observation and questioning, and create space for students to share information about the mathematical situation, so that students were on a more equal playing field when we started to solve problems. Generally, we did not pose a specific question *yet,* because we wanted broader discussion and we didn't want students to be able to race ahead to an answer. Likewise, at this stage, there was little explanation provided and no instruction given on how to solve the problem that would be posed.

We focused on proportional reasoning during our 2022 winter class. In the first class, we looked at the following two images, answering the questions, ["What do you notice?" and "What do you wonder?"](#)

Buying Oranges

-*Photos taken by Eric at a fruit and vegetable stand in Brooklyn*

Some things students noticed:

- Left oranges look fresh. Some oranges on the right look spoiled.
- The oranges on the left are labeled. The oranges on the right are not labeled.
- The prices are different even though the oranges are all around the same size.
- The price on the left is 0.6.

Some of what students wondered:

- Why are they priced differently when they are the same thing?
- Which is the better bargain?
- Do the 5 for $3 oranges weigh more than the oranges that are 7 for $5?
- Are the oranges on the left cheaper or lower quality?

After the notice/wonder discussion, Eric posed a question to the group in the form of a sentence frame, and asked everyone to take a few minutes to write a response: *I would rather buy _____ because _____.*

Individual Thinking Time

We believe that it is important to let everyone have the space to struggle through problems individually. In our classes, we allowed time for individual thinking time and small group work before we share solution strategies. Individual thinking time helps students prepare for conversation and small group work helps them prepare to speak before the full group. In the math problem-solving groups, the amount of individual thinking time we provided depended on the problem. Some tasks required more thinking time before conversation. In this class, students were preparing themselves to share different ways of proving which oranges are a better deal.

Small Group Work (class leaders)

This is the part of the class when class leaders were called upon to engage students in breakout groups. Small group work often took the majority of our class time, depending on the problem we were working on that day. In our class, we eventually decided to let students choose which breakout group they wanted to be in. We experimented with naming the groups "Slow down," "Same speed," and "Speed up," so that students could choose the breakout group where they felt they would be most comfortable.

Class leaders were assigned to breakout groups in pairs to support students. Their role was to facilitate conversations surrounding the problem. The class leaders started discussion with the group: What do you notice about the situation? What questions do you have? For this particular problem: Which oranges do you think were a better deal? How do you know? Could you explain how you are thinking about it?

Eric Appleton

Eric: It is a challenging role to play. Class leaders had to listen carefully to students' explanations to try to understand their thinking, but they also had to listen to see if other students heard and understood the explanation. They needed to be able to capture the thinking in notes on the screen so that other students had support in understanding their peers. Class leaders needed to field questions from other students, including the question of whether this is the "right" way to solve the problem. We encouraged class leaders to refrain from saying whether an answer is right or wrong. It was more important to focus on the thinking which led to an answer: Who can explain Margaret's strategy? Who has questions about Margaret's strategy? Who has another way of approaching the problem?

Gina: Students are so used to hearing from teachers that they are wrong: "No, that's not the right answer." This is part of why students shut down and aren't open. We just say, "No, I know I'm not right; the teacher is going to say I'm not right." So, we hold on to everything that we want to express. In this group, we are allowed to discuss our opinion about something. We're not completely shut down. The response I like is: "Hmm. Can you tell me a bit about that? What makes you think that?" When we allow each other to open up and become more comfortable, we tune in differently and actually see things differently. We help each other learn something, whether it's small or big.

At the beginning of the semester, class leaders tended to share their screen and annotate. As time went by, other students started to take on screen sharing and annotation. As the semester progressed, we encouraged class leaders to slowly release responsibility for some of their tasks. We were looking for opportunities for other students to become leaders, as well.

Large Group Share (lead teacher, supported by class leaders)

At the end of the class, ideally, we had time for presentations from each group. Each class leader looked for a student volunteer to present their group's strategy or possible solution. Eric, as lead teacher, chose the order of the presentations. In making a decision about the order, he tended to start with concrete solutions that might use drawings or visual representations, then move towards tables and organized lists, and end with solutions that involved abstract strategies, such as algebraic methods. Another way to choose an order was based on how close the groups got to a solution. Sometimes, he chose to lead with a group that had an interesting mistake or surprising solution strategy, even if it wasn't quite successful. Presenting an incomplete solution was a useful way to encourage conversation. Solutions that involved standard procedures that you might see in a textbook were held for the end, since we didn't want students to think there was one right way to solve the problem.

Here are some solutions from our question about the prices of oranges. Can you see how you might justify a choice using each of these strategies?

Zuri's Method

5 for $3   7 for $5

1 orange = .60
5 oranges = $3
7 oranges= $4.20

1 orange = .71
5 oranges =$3.55
7 oranges = $5

$5 \times 0.6 = 3$

$7 \times 0.6 = 4.2$

$5 \times 0.71 = 3.55$

$7 \times 0.71 = 4.97$

Bell's Method

What if I spend $15? How many oranges will I get?

5 for $3: I get 25 oranges when I pay $15.
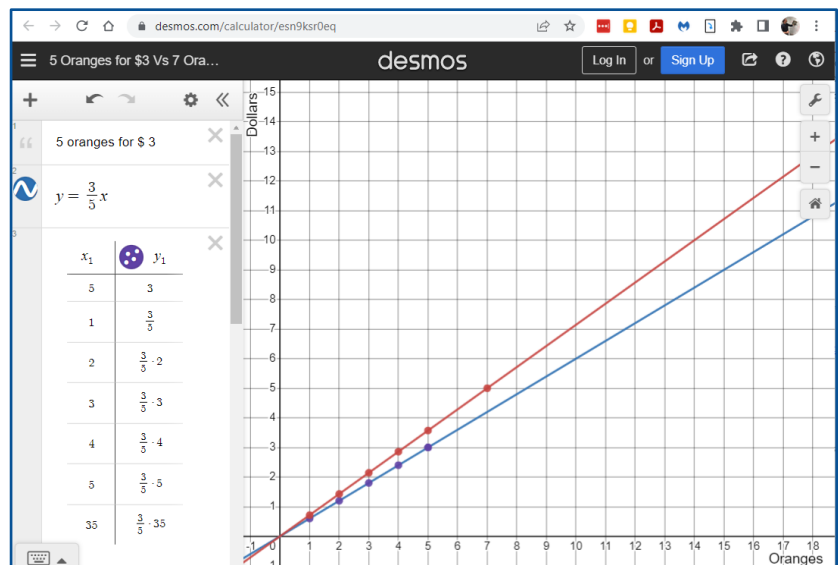
7 for $5: I get 21 oranges when I pay $15.

Sandra's Method

What if I buy 35 oranges?

$$\frac{3\,dollars}{5\,oranges} = \frac{21\,dollars}{35\,oranges}$$

$$\frac{5\,dollars}{7\,oranges} = \frac{25\,dollars}{35\,oranges}$$

Khom's Method

Closing (lead teacher)

When we had time, we led a quick closing at the end of the class in order to get feedback and encourage reflection on teaching and learning by asking students to respond to the following prompt:

Think about your experience in this session. Choose a number from 1 to 10.

One is terrible. Ten is amazing.

In our first class, we had 39 responses with an average of 7.6. We asked for a couple volunteers to explain their number. A few students shared:

- I had trouble with technology. I didn't have a great experience today, but it wasn't because of the class.

- I chose 5. It was a normal class.

- Everyone did great trying!!

- I was lost. That's why I gave it a 5.

As a follow-up to question about oranges, we asked students to look for advertisements and take photos to share with the class by submitting them in Google Classroom. Examples from this activity follow this article.

Experiences of Student Leaders
Challenges

As student leaders, we experienced challenges and gained skills. Gina and Khom share some of their challenges below.

> **Gina:** One of the challenges is getting people to participate in our groups, but that's because they haven't come out of their shell yet. Later, once they get to know us, they start coming out little by little and open up. You've got to give people time. But the other thing that was challenging for me was when students needed help with certain things, and I couldn't help them and so I would feel kind of disappointed, because I'm there to help and if someone is there asking me to help them and I don't know how to help them, I started feeling self-conscious and not confident enough. It's kind of frustrating. But then again, we don't all know everything so I said, "I don't know how to help you, but give me a moment, and I'll come back to you. I'll take a look at what I need to take a look at and maybe research some stuff, and we can arrange something and we can go over it again and figure it out together."

> **Khom:** I also had a little bit different kind of a challenge when I was a class leader: understanding different learning styles. Being an adult learner, most of us have come from different places and have a prior experience where a different place has a different style of teaching, so that brings different ways of learning.

And also explaining to students in a way that we understand and also that they, themselves, understand. That's also kind of challenging. At first, I had lots of questions: How should I talk? How should I lay out the board? What information should I share? How can I get other students to talk? Thankfully, Gina was my partner, and she had more experience. Mostly, she was leading, and sometimes I would jump in. One particular challenge for me is that I had a problem with math terminology because English is not my first language, so I had to work hard.

And participation was kind of tough. A lot of people like to be quiet and just listen. A lot of time, we ask questions: Why? How? Why do you say that? What do you think? We are pushing. We are trying. I hope people are learning something.

Gina: It can almost get a little too quiet at times where we don't know which way to go. We don't want to be pushy. Being a little bit pushy can have people hold back a little bit as well, so we have to let them be. It's fine if they don't want to participate at first. Sometimes, you have to give people space and time to ease themselves into the situation little by little, to get the feel of what we're doing, what exactly goes on in our group, how we work together, and what this is all about.

What the class leaders learned

Mardgrina: One of the benefits is developing a sense of responsibility. We have to get ourselves ready before the class so we could be prepared. We couldn't be coming to the class if we don't know and we're just trying to figure it out at the same time. So, when we get ourselves prepared mentally beforehand, we will be able to help you, and we will have patience. We have to give everyone a chance. Since *we* have a chance to get ready, we have to give everyone else a chance to understand the concept, because everyone has a different way to get to an answer. So, when you listen attentively, you have a better understanding as to where that student is going and where they are coming from. When they ask you a question, when you are listening attentively, you will be able to answer it and not answer the wrong question so you won't have more questions to answer. This is because you were listening attentively. When you listen, it's not just your method, it's not your way alone that's the right way to an answer. You have to be open-minded to different opinions. There is the longer way, there is the shorter way, there is the trickier way, because math is a big mountain, with different obstacles, so you have to jump, slide, whichever way you choose to get to that one answer.

Lastly, we gained technology skills. We learned how to use Desmos, Polypad, sharing screens, annotating on screens, Google Classroom, and all kinds of technical stuff we didn't know prior to the class. We also gained a lot of confidence!

Ayantu: As we talk about being class leaders, all of us mention a sense of responsibility. I hear from other class leaders, and thinking about my own experience, I think we learn to say no to distractions and to make time for us and for other students.

I remember when we first started and I said, "I don't think I can make it." I said this because I don't know math and I don't know how to help other students. And that is one thing I learned. Being a class leader is not being a teacher or knowing everything to explain to everyone, but trying to help where you can or where it is needed.

Khom: For me, it's a lot of learning being a student leader and a student at the same time: communication skills, being confident, and how to be patient. A lot of the time, it's hard to understand what other people are saying.

Gina: Having support from other students is just as important as having support from teachers and the program itself, because we encourage each other. We can say, "Don't worry about it. It's okay. We're all in this trying to better ourselves." I'm trying to build myself, but at the same time I want others to build with me. I don't want to just build myself and leave my peers and my community behind. I want other people to succeed in whatever they're doing.

Student-led math study group

Ayantu: After being in Eric's class, we decided to create our own math study group, with his support and the support of each other. We created this group—not to teach—but to help each other. We also struggled with math, so that's why we came together.

We started in May 2022, and we met every Friday on Zoom. We have students from different CUNY campuses. Before we started the group, we came together to discuss what we are going to do and how we are going to do it. Together, we wrote an introduction and guidelines for the group. We made an introduction because we want other students to know who we are, and because we want them to know that we are students, not teachers. We made the guidelines so that we know what to expect and what to do. We are not just there on Zoom, but we are there to learn together. We want other students to be active in the group. We made the guidelines to help move our goals.

In this group, we use the tools that we have used in Eric's class. We are practicing our technology skills. For example, we use the Desmos Graphing Calculator when we study together. We also created a Google Form for registration of new students in the study group.

We share information with different schools. We go to different campuses so that other students can join us. We also have discussion through Whatsapp. We share problems, words of the day, or a number of the day. It's very interesting, because every day we find out something new. We learn different ways of seeing math.

We are a group of students who came together for our success and for the success of others. The reason I'm saying this is because some in our study group have recently passed the GED test and they didn't say that they won't come anymore because they passed the GED. They are still coming to share their skills to help other people. We hope that you have student leaders that will come together and share their experience and learn together.

Accomplishments of Student Leaders

Ayantu, Gina, Khom, and Mardgrina presented, along with Eric, in the student leadership strand at the 2023 COABE conference in Atlanta, Georgia. In the spring of 2023, Khom testified before the New York City Council for the Committee on Immigration. He has passed all GED texts except Reading, Language Arts. Mardgrina has passed the GED math and science tests. Ayantu passed the GED science test. Gina passed the GED math test in the spring of 2023 and received her high school diploma! She is now working at Lehman College as a part-time office assistant. Ayantu, Gina, Khom, and Mardgrina continue to be part of a student leadership group from different CUNY campuses.

> Watch excerpts of Eric's interviews with Ayantu, Gina, Khom, and Mardrina.
> You can also watch a recording of our presentation at the 2023 Coalition on Adult Basic Education (COABE) conference.

Contact Us

We would love to hear about other student leadership activities, especially related to learning math.

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For more information about the CUNY Adult Literacy Program: http://literacy.cuny.edu

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> **Editor's Note:** We encourage you to reflect on this article individually or, if possible, with a group of colleagues as part of a teacher's learning circle. Potential questions you might use to guide your thinking:
>
> - What resonated with you in the class leader descriptions of their interactions with other students?
> - What implications are there in these four student voices for your own teaching practices?
> - What is one "teacher move" described in this article that you plan to apply this semester?
>
> Please consider sharing your reactions to this article as well as student reflections should you apply any of the instructional strategies or student growth opportunities in your own practice. Contact Patricia Helmuth, Editor, with your stories: mathpractitioner@gmail.com.

Making Equivalent Ratios with Advertisements

The advertisements below were submitted by students. Complete each table using the prices in the picture next to it.

number of limes	2	1	3	5	
dollars	$1.00				$20.00

pounds of apples	1	2	4	8	
dollars	$1.25				$20.00

cans of tuna	4	1	5	3	
dollars	$5.00				$20.00

bags of popcorn	2	1	3	5	
dollars	$5.00				$20.00

Write your own sale price:

Complete the table by adding different quantities and prices.

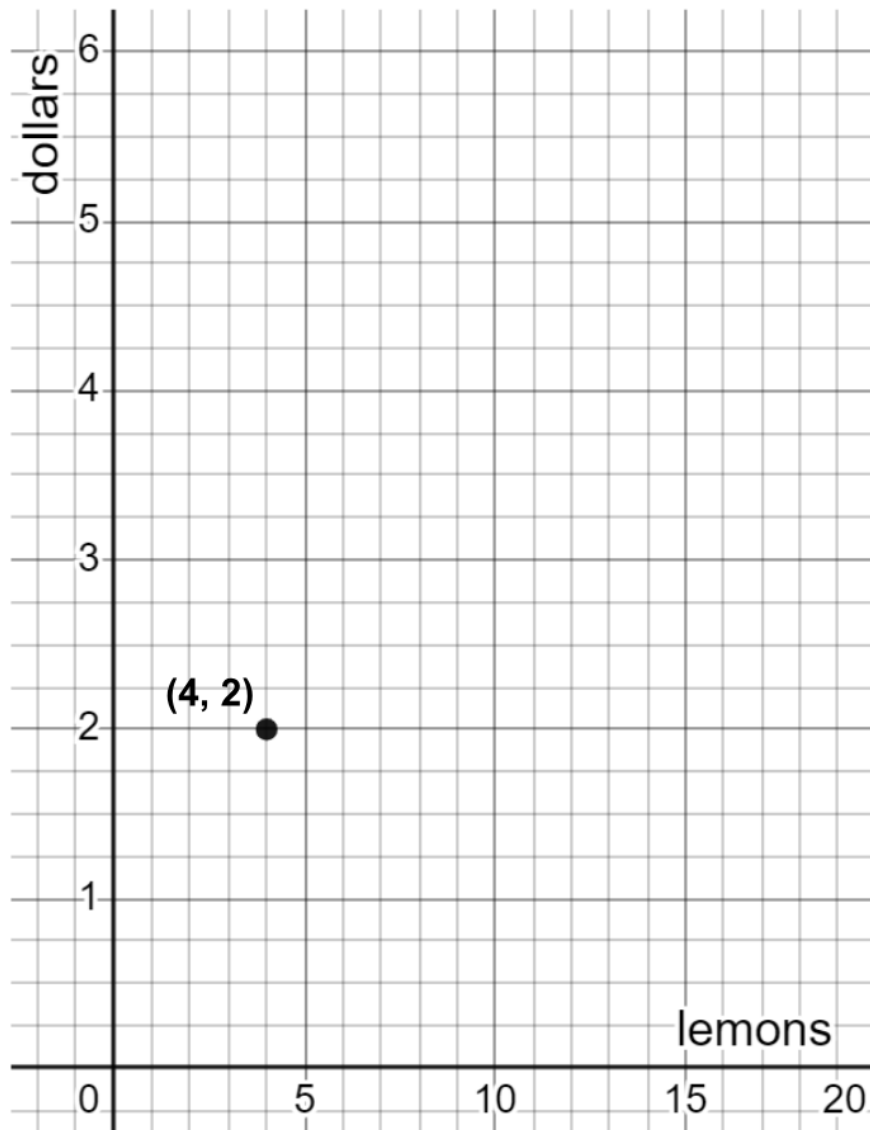| quantity					
dollars					

Vera found these lemons for sale:

Complete the function table and add points to the graph below using the price of lemons.

lemons	dollars
4	$2.00
2	
1	
	$2.50
10	
	$5.50

What do you notice when you look at the table and the graph?