Creating Independent Learners in Mathematics Class

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About the Author

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Introduction

Students in adult basic education (ABE) classes have a variety of purposes and motivations for continuing their education (Perry et al., 2025). These purposes and motivations range from the practical (skills to cope with daily life tasks), professional (skills to advance in career aspirations), and civics (skills to understand and participate in social life, e.g., understanding claims in the media), to the cultural (skills to participate in activities such as games, sports, leisure) (Gal et al., 2020). While students are learning the skills that support their advancement in relation to their own goals, ABE classrooms are also supporting students to develop mathematical habits of the mind with practices such as making sense of problems and persevering in solving them, and as well as constructing viable arguments and critiquing the reasoning of others (Pimentel, 2013). One cross-cutting skill that bolsters each of these purposes and motivations includes learning how to learn. ABE instructors want to cultivate the skills, dispositions, and attitudes in learners to be able to engage with a new resource to understand the ideas presented and then be able to apply them. Said another way, ABE instructors want to cultivate independent learners (Hammond, 2015).

This article is the second in a three-part series about mathematics discourse in ABE classrooms. In the first article from the Summer 2025 issue, we shared how signature routines, when integrated into curricular resources, can scaffold instructors' and students' participation in mathematics discourse. In this article, we share how one teacher, Kim

Mihalik, used discourse to improve upon her goal to create independent learners as part of the ANDE project..

About the ANDE Project

The ANDE Project is a digitally enhance mathematics curriculum that engages ABE students in rich, context-based mathematics tasks while supporting students' goals of obtaining their general education diploma. Each ANDE lesson is centered on a collaborative activity that requires instructors and students to engage in contextually rich and meaningful mathematics discourse. A second feature of the course materials are the Cultivating Inclusive, Resilient Communities of Learning (CIRCL) supports. CIRCL is a researched-based framework and set of instructor-led activities and practices for promoting socially, culturally, and emotionally-supportive learning environments, such as fostering students' sense of belonging (Matthews et al., 2021).

CIRCL supports are embedded within all Carnegie Math Pathways curriculum materials. Evidence from these classrooms has shown that consistent use of CIRCL practices improves students' confidence and sense of belonging while reducing their anxiety, which translates to greater student success and course persistence (Center for Community College Student Engagement, 2019). The ANDE project trialed and revised these resources for the adult education context. The CIRCL package is now available via open educational resources (OER) and can be modified for use across grade levels and subjects.

Dependent versus Independent Learners

In the book, *Culturally Responsive Teaching and the Brain*, Hammond (2015) argues that a primary goal of culturally responsive teaching is to accelerate students' learning by supporting them to become independent learners. Independent learners develop the capacities to think critically, process and engage with new information effectively, and monitor and direct their own learning. In mathematics class, independent learners take ownership of their learning by trying out their ideas on problems with a growth mindset (Sun, 2018). They develop strategies to monitor their thinking as they work through challenging tasks and engage in productive struggle (Warshauer, 2015). In contrast, dependent learners have not had the opportunities to develop the cognitive capacities for complex thinking. It is important to note that dependent learners are not intellectually deficient, they just haven't yet had "adequate support to facilitate their cognitive growth. Consequently, they are not able to activate their own neuroplasticity" (Hammond, 2015, p. 14). In mathematics classrooms, dependent learners might exhibit the qualities of learned helplessness (Yates, 2009) by not starting tasks, waiting for help when they are uncertain (e.g. avoiding productive struggle), and seeking constant affirmation as they work through problems. Table 1 summarizes attributes of dependent and independent learners.

Table 1: Dependent versus independent learners (from Hammond, 2015, p. 14)

Dependent learners	Independent learners
Is dependent on the teacher to carry most of the cognitive load of a task always Is unsure of how to tackle a new task Cannot complete a task without scaffolds Will sit passively and wait if stuck until teacher intervenes Doesn't retain information well or "doesn't get it"	Relies on the teacher to carry some of the cognitive load temporarily Utilizes strategies and processes for tackling a new task Regularly attempts new tasks without scaffolds Has cognitive strategies for getting unstuck Has learned how to retrieve information from long-term memory

Kim recognized that activities in the CIRLC resources (e.g., Normalizing productive struggle, Embracing growth, Stress Reappraisal) could cultivate the attributes of independent learners. She also recognized that her efforts to create a classroom environment where students participated in meaningful classroom discourse required students to start behaving like independent learners. She engaged in a cycle of inquiry to better understand how her facilitation of mathematics discourse could reinforce independent learning and foster independent learners. The following table shares Kim's analysis and reflections:

Table 2: Selected teacher discourse moves (from Herbel-Eisenmann et al., 2013)

Discourse Move	Description	Examples
Inviting student thinking	Inviting student thinking is a way to solicit students' various processes or strategies. This move can initiate a discussion, elicit multiple student perspectives, and encourage students to listen to each other's ideas. This move supports developing independent learners by providing opportunities for students to share their rough-draft thinking rather than passively waiting to be told how to approach a problem.	What are you thinking, [student]? Did anyone solve it a different way? Does anyone have a question for [student]?

Using wait time	Wait time provides students with time to process teacher questions and think about their responses. This move can support a classroom culture that values effort and thinking over speed. This move supports developing independent learners similar to the inviting move and also allows students to develop cognitive strategies to process new tasks or get "unstuck."	[Pause without as saying anything.] I want you to think about this individually, without saying anything to your group. Think about this for a few minutes, and write down any questions that come up.
Creating opportunities to engage with reasoning	Creating opportunities to engage with another's reasoning is about asking students to contemplate or use another person's idea. This move can allow students opportunities to identify similarities/differences among approaches; ask for clarification regarding an approach; and use, agree, and/or disagree with someone else's method. This move supports developing independent learners by allowing them to develop the skills to compare and evaluate others' reasoning.	How are [student's] and [student's] methods similar and how are they different? What questions do you have for [student]? Let's all try to use [student's] method on this next problem.

Classroom Vignettes

The ANDE lesson "Adding and Subtracting Decimals: Managing a Budget" (ANDE Lesson A5, see Figure 1) has a primary mathematical goal of promote students' fluency in adding and subtracting decimals (e.g., 7.NS.1b & 7.NS.1c). The main context for this lesson is budgeting and accounting for differences in income and expenses. Students are presented with a table that presents rows of estimated income (e.g., wages) and estimated expenses (e.g., rent) that are compared to the actual amounts spent. For each row, students are tasked with calculating the difference. Additionally, students are tasked with verifying their calculations by summing the estimates and actual amounts and then calculating the differences of those sums.

Figure 1: Selected problem from ANDE Lesson A5: "Adding and Subtracting Decimals: Managing a Budget"

Managing a Budget

A budget is a plan for your income and expenses over time. By making and using a monthly budget, you can see where you spend your money, who you owe money to, and how much you owe. A budget can help you save more and reach your financial goals.

The sample budget below has two parts: income and expenses. Income is money you earn, like wages. Expenses are things you spend money on, like rent and food. The sample budget has four columns: the category, the budget estimate, the actual amount, and the difference between the estimate and the actual amount.

Category	Estimated Amount	Actual Amount	Difference
Income:			
Wages	$911	$892.54	$18.46
Interest	$232	$196.11	
Income Subtotal			**$54.35**
Expenses:			
Taxes	$386	$317.67	
Rent	$298	$298	
Utilities	$99	$95.76	
Food	$160	$134.47	
Clothing	$66	$47.54	
Household	$55	$46.23	
Entertainment	$44	$40	
Misc./Other	$35	$30.22	
Expenses Subtotal			
Net Income = Income – Expenses			

Kim created the following vignette while preparing to teach the lesson. She prepared the transcript based on her recollection of teaching this lesson previously, and we used it together to reflect on how discourse typically unfolds in her classroom. We used the transcript to support thoughtful planning that would disrupt familiar patterns. As you read the vignette and transcript, consider the following question: how might these discourse patterns reinforce the attributes of dependent learners?

Vignette 1: Example of teacher-student discourse

Students are working in pairs and small groups to complete the activity. Kim is rotating between students and she sees a student sitting silently with the following problem in front of him: "How could you verify that the difference between the estimated income and the actual income is $54.35?" After waiting a few seconds to see if the student begins to write and work toward a response, Kim begins to interact with the student.

(1) Kim What do you think? How can you verify the difference here is $54.35?
(2) Student Subtract the $18.46?
(3) Kim What will that give us?
(4) Student $35.89
(5) Kim And what does that number mean or refer to?
(6) Student I don't know.
(7) Kim Ok. Where is the $18.46 and what does that mean?
(8) Student It's in the last column, and it's the difference I guess.
(9) Kim The difference of what?
(10) Student I'm not really sure.
(11) Kim Ok. Do you see where it says the estimated amount and the actual amount, and where it says wages?
(12) Student Yes
(13) Kim If we have an estimated amount, something we think we'll have for the month in income, and we have the actual amount that we got for income– are they the same number, or is there a difference between them?
(14) Student They are different. The estimated amount is $911 and the actual amount is $892.54.
(15) Kim How much of a difference is that?
(16) Student $18.46. I see now.
(17) Kim Ok. So, we still have another category to calculate. Do you see where it says interest and how we have the estimated amount and the actual amount?
(18) Student Yes, the difference between them is $35.89.
(19) Kim Ok, so we can put that number in the last column where it says difference. Now, can we just add up the differences and see if they equal $54.35?
(20) Student Yes, they do equal $54.35.
(21) Kim So, we just verified that the difference between the estimated income and the actual income is, in fact, $54.35.

In this vignette, the student wasn't sure what to do. Kim supposed that the student was puzzled by the meaning of $54.35. Kim began by rephrasing the problem (line 1) to orient the student to task. The student provided an unanticipated response so Kim responded by asking him to recontextualize (SMP7) the meaning of the number that could be calculated with $54.35 minus $18.46 (line 5). When the student was unsure about the meaning of the computation, Kim began to reorient the student to the problem by asking pointed questions about sections on the spreadsheet (lines 13, 17, 19). She asked leading questions that funneled the student to think about the problem by going through a set of procedures (Herbel-Eisenmann & Breyfogle, 2005). Overall, Kim led the student through the problem without many opportunities for the student's thinking to surface.

This vignette prompted Kim to reflect on how her interactions might be undermining her goals to develop independent learners. It brought up a tension in her teaching about supporting students who are unsure about how to approach a problem. On the one hand, it is important to allow students to productively struggle (Warshauer, 2015) by trying out a variety of methods so that they understand why some may and others may not work. On the other hand, class time is limited, and it is not always clear whether students will benefit from attempts that take them down an incorrect path.

After contemplating these tensions, Kim thought out how the resources in the ANDE course (e.g., CIRCL supports) and the skillful facilitation of mathematics discourse can contribute to cultivating independent learners. First, she consulted activities related to developing a growth mindset (Sun, 2018) which reinforced the notion that playing around with math, even if incorrect, and receiving supportive feedback can stimulate brain activity and growth (Hammond, 2015). This is in contrast to the student relying on the teacher to walk through the problem whenever there is uncertainty about how to proceed. When a student begins to rely on their own thinking (whether right or wrong) they are exhibiting traits of independent learners. This creates opportunities for students to self-assess their progress and learn how to ask for feedback at critical points in their learning. Secondly, Kim thought about the discourse moves that are pervasive in her teaching practice . She realized that the move of inviting student participation (Herbel-Eisenmann et al., year) is an opening move to allow students to share their initial ideas and that when she doesn't use sufficient wait time, she is contributing to students being dependent on her. Moreover, she started to recognize that creating opportunities for students to engage with each others' ideas removed her from doing the mathematics and builds independent learners. See Table 2 for a table of discourse moves that supported Kim in reflecting on her teaching.

After considering how meaningful mathematics discourse can be purposefully employed to cultivate independent learners, Kim recorded herself teaching to evaluate the extent to which her teaching moves were cultivating independent learners. The vignette and transcript below are based on a recording from Kim's class a few weeks after the semester started. As you read this vignette, consider the following question: how might the discourse moves utilized cultivate independent learners?

Vignette 2: Example of teacher-student discourse that supports independent learners

Students are working in pairs and small groups to complete the activity. Kim sees a student reading the problem, "How could you verify that the difference between the estimated income and the actual income is $54.35?" After waiting about 30 seconds, Kim reads the problem aloud again and pauses.

(22) Kim How can we verify that the difference between the estimated income and the actual income is $54.35?
(23) Student I think we add the two estimated amounts and the two actual amounts and subtract both of them…maybe?
(24) Kim Walk me through what you just said.
(25) Student Where it says wages and interest, we add those two together.
(26) Kim What do we get when we do that? Let's do one step at a time.
(27) Student Ok. We get $1143. And then we add $892.54 and $196.11, and we get $1088.65. I think we subtract those two next.
(28) Kim What do you get when you subtract these two?
(29) Student $54.35, and I got that because where it says interest and wages, it says income subtotal. Subtotal means those are added together. Then you subtract to get the difference because difference means we subtract.
(30) Kim Is there another way? Can we do this differently?
(31) Student Hmm. I'm not sure. I like the first way. But maybe if we add $892.54 to $911. I didn't try it yet, but just maybe.
(32) Kim What will happen if we do that? If we add those two together?
(33) Student We get $1803.54. And add the other two below. I'm not sure.
(34) Kim What will that get us?
(35) Student $428.11
(36) Kim And now what would you do?
(37) Student Subtract those, maybe? You get $1375.43, so no, that doesn't work.
(38) Kim Ok, so that doesn't verify the $54.35. So, we found a method that doesn't work. That's ok. You tried something. What are all the numbers we have to work with? What numbers do you see?
(39) Student I feel like there's another way to use the $18.46 and get an answer too.
(40) Kim Yea, we haven't used that yet. Do you have any thoughts of how we could use that? Why is that written there?
(41) Student It looks like for the wages they took the two numbers and subtracted them.
(42) Kim Ok, so you are saying they took $911, and they subtracted $892.54?
(43) Student Correct. Because difference means we subtract.
(44) Kim And so, what do you get when you do that subtraction?
(45) Student $18.46.
(46) Kim Where do we see $18.46 on the chart? Is it there?

(47) Student Yes, it's on the wages line on the right. If we took the two numbers from interest, and we also subtracted those, you'd get $35.89. I think now we need to take those two numbers that we have, 18.46 and 35.89, and add them together.
(48) Kim When you add those, what do we get?
(49) Student It should be $54.35, let me verify. Yes, you get $54.35!

In this vignette, much like the first, Kim noticed a student who was hesitant to answer the question. After waiting at least 30 seconds to ensure the student had time to think about what the problem was asking and coordinate the problem with the information provided in the table, Kim posed the same question (line 22), and the student provided a method. To more fully understand how the student was thinking about the problem and to allow the student to clarify their own thinking by "thinking aloud," Kim invited the student to elaborate on her method (lines 24, 26, 28). Kim then asked the student to consider an alternative method. The student provided an incorrect method, but Kim kept the student oriented to the problem while making sure they understood the values from the table (line 41). The student was then able to propose that the computation used for the wages can also be done for the interest and correctly computes the value of the difference (line 47). Overall, the student was encouraged to support their own line of reasoning which was verified by the calculations being equivalent. Such experiences, where students successfully work through problems that don't have an immediately apparent pathway, builds students' self-efficacy (Hammond, 2015; Horn, 2017).

Conclusion

In this article, we shared how Kim studied her mathematics discourse patterns with her students to support her goal of creating independent learners. Independent learners are willing to try out rough-draft thinking (Jansen et al., 2017) on new and/or unfamiliar problems and receive feedback to inform their learning. Kim realized that the discourse patterns between her and her students might be inadvertently cultivating dependent learners. We shared how Kim reflected on her teaching and purposefully used new teacher discourse moves (see Table 2) and CIRCL practices to support her students in becoming more independent learners. We hope the ideas in this article prompt you to reflect on the discourse patterns in your classroom and to consider the ways in which you can support your students to become independent learners.

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