

Marvelous Mathematician Fall 2019

CORE ACADEMIC QUARTERLY



Marvelous Mathematician

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Notes: Part of Lesson Planning

Note taking is an important skill in many classroom settings. However, to take meaningful notes students need training and a clear purpose for taking notes. In math classes, worked examples, vocabulary, conjectures, data, observations, diagrams, and clear articulations of important math concepts and procedures are important opportunities for taking notes. Such notes increase retention and provide resources for review, revision and application of learnings. Boch and Piolat (2005) point out the following:

Note-takers . . . make stronger connections between the information being received and that already stored in their long-term memory. . . . Furthermore, a later review of the notes, whether or not it is associated with a re-organization of the information, reinforces the integration of the knowledge and its storage in the long-term memory. (p. 105)

A Personal Story - The Conundrum

Both before and during my time as a CORE Math Consultant I have been a

facilitator for [AVID](#) (20 years). My content area of focus is Mathematics, so most of the participants I work with are math teachers and/or instructional leaders. At each training AVID conducts I ask the participants these same two questions:

“How many of you were taught a formal notetaking process during your K-12 years (as a student)?”

“How many of you still have your notes from university in a box somewhere in your house, basement, garage, attic?”

I have fun with the questions by predicting how many participants will answer “yes” to each question. On one sticky note, I write my prediction to the first question and hand it to a random participant saying, “This is how many will answer ‘yes’ to my first question.” I do the same for the second question, handing a second sticky note to a different participant. Then I ask the two questions whole group and count hands. I am usually very close!

In 20 years of AVID Math trainings I have facilitated about 6,600 participants. Approximately 20% of teachers, including instructional coaches, say they were taught how to take notes K-12 and approximately 70% say they still have their notes from university stored away in their homes somewhere.

It follows that most teachers are asked to teach the skill of note taking without ever having been taught the skill themselves. It is not surprising then that students struggle to become organized, successful notetakers when most teachers also struggle to be organized, successful note takers. As Boch and Piolat (2005) lament, “Very few students are taught even basic ‘note taking’ skills.”

Purpose for Notes

There are many formats that can be used for note taking, such as, Cornell Notes, two or three-column notes, journals, interactive notebooks, mind maps, concept maps, and more recently Focused Note-Taking with AVID. Good note takers take notes for a purpose. Notes are a place to gather information, and/or track learning that will be useful as a study tool, or as a reference guide for specific outcomes. Notes are an important resource for reviewing key information over time. Imagine grocery shopping for someone else. How many grocery items can the average person remember without forgetting the eggs? The amount of information we can hold in working memory is very limited. As shown on the chart below, adults are

likely to only retain about seven items in working memory over a short period of time. Even just a trip to the grocery store often requires notes.

Limits of Working Memory

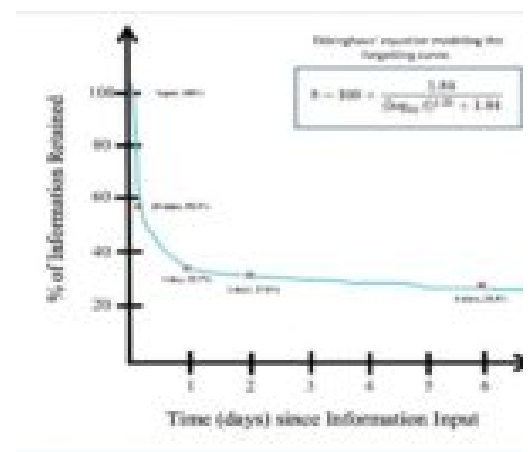
Age (years)	Average Capacity Range (Chunks of Information)	Average Time Limit for Retention
Younger than 5	2 ± 1	Unknown
From 5 to 14	5 ± 2	5 to 10 minutes
Older than 14	7 ± 2	10 to 20 minutes

David A. Sousa, *How the Brain Learns Mathematics*, 2008

Rabinovich and Bick (2009) explained the science behind the brain’s short-term memory recall ability of seven items.

As a sentence or a string of numbers gets longer, it becomes exponentially harder for the excited cluster to suppress the others from firing, resulting in pathways that are weak or barely there. Recalling seven items requires about 15 times the suppression needed to recall three. Ten items require inhibitory powers that are 50 times stronger, and 20 or more items would require suppression hundreds of times stronger still. That is normally not biologically feasible. (p. 2018101)

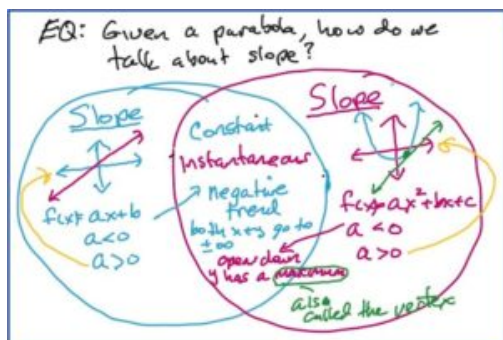
Dr. Hermann Ebbinghaus (1913), a German psychologist, researched and published a Forgetting Curve graph, that predicts the retention rate of information learned over time without revisiting the information. Thinking about classroom instruction, one day after a lesson, the teacher can expect the students to have retained approximately 33.7% of the information taught if the students are not taught how to revise, edit, connect, or study their notes.



It is part of the job of educators to support students in capturing, organizing and connecting important content information. Understanding some of the science

behind the brain's ability to buffer information in short-term and subsequently into long-term memory storage enforces the argument for teaching note taking as a "no brainer."

Important questions for teachers to ask themselves during planning time are, "What are students going to be asked to do at the end of this lesson? What are students going to do with today's information in the future?" Then, "What notes format best supports this goal?"



Suppose students are asked to write about similarities and differences between linear and quadratic functions on an end-of-unit assessment in Algebra 1. The teacher might select a Venn Diagram approach for her students in preparation for the assessment.

A Venn Diagram would help the learners to clearly differentiate between what the two function types have in common and how they differ. The teacher could also add a section on key vocabulary and some sentence starters.

Another teacher might choose a three column notes format where students could dedicate one column to the linear function traits they and the second column to quadratic function traits that are similar, then the third column could be a place to share key differences.

Linear	Parabola	New stuff
X-intercepts <i>one, same, all</i> Slope $f(x) = ax + \dots$ $a < 0$ $a > 0$	X-intercepts <i>none or +∞ or -∞</i> Come in pair Slope $f(x) = ax^2 + \dots$ $a < 0$ $a > 0$	• Solutions, zero, root • Imaginary roots • instantaneous (at a point) • degree of 2 • The sign of a determines which direction the parabola opens \Rightarrow up or down min max

It is Not Always Direct Instruction

Classroom instruction is not always delivered via direct instruction. Although note taking is commonly associated with direct instruction, this is not the only instructional routine in which note taking is possible and important.

With a math problem-solving or inquiry-based lesson, students should make notes of their personal work and conclusions from the investigative task. Students also need clear explicit notes on the summary for the activity or lesson. The summary is typically derived from whole class and teacher directed discussion. Students may also benefit from a follow-up worked example modeled for all learners to show how to apply the key mathematical idea from the activity.

Students are often required to read math word problems and in other classes documents for information to apply later. Skills like marking the text are important for identifying key information to focus on or review later. Teachers play a key role in helping students identify the purpose for the reading and in teaching students how to organize the information in their notes.

Many curricula offer consumable books for the learner. Students can mark the books or documents and reflect on learnings, identify key points or points of confusion, or insert key questions as they work towards an application of the knowledge.

Online resources, such as, Desmos, Khan Academy, credit recovery programs and YouTube are a part of many students' K-12 math journeys. Students should keep journals with notes and reflections even while sitting at the computer working through online lessons.

Watching videos with an educational end in mind is another activity students regularly encounter in school. Videos should be paused at key places to allow students time to process and note their learnings.

Whether information and learning experiences are delivered through direct instruction, inquiry-based activities, consumable books, online learning or watching a video, note taking is an important means for processing and cataloguing information.

We Do Not Always Use Our Notes Right Away

Many times, the learner is on a journey to the next assessment. This journey can last an hour, a day, a week, or a few weeks. The next math quiz or test may not be until the end of the week or the end of the month. Between the time of the lesson and the assessment is a lot of opportunity for forgetting learned concepts and skills. Factor into this the number of different topic areas all students are studying each day (math, literacy, science, social studies), both in elementary and secondary school, and the opportunity for mixing up or losing information multiplies. Our brains are designed to forget. Chawla (2018) shares an explanation from Oliver Hardt.

“Without forgetting, we would have no memory at all,” said Oliver Hardt, who studies memory and forgetting at McGill University in Montreal. If we remembered everything, he said, we would be completely inefficient because our brains would always be swamped with superfluous memories.

Ironically, this give us hope! We know our brains will remember some content and through good note taking we can help ourselves regain memory of other content, especially since it can be attached to that which we do recall.

A large part of AVID’s Focused Note-Taking process is teaching the learners how to revisit their notes in a sense-making way. By writing summaries and reflections, the learner will reinforce the learning. Working with other students and other information sources, the learner has the opportunity to revise his or her notes and make important connections to prior understanding. This work to make sense of the notes helps in information retention. The final phase in any note taking process is using the information for the intended purpose.

Recommendations for Getting Started

Below are five recommendations for initiating or improving note taking in classrooms:

- Consider the current note taking method used in the classroom.
- Look at classroom assessments to see how the current note taking system helps or hinders students as they prepare for the assessment.
- Consider modifications and involve students in the process.

- To ensure students have more processing time with what they are learning, build in opportunities for them to edit/revise their notes with a partner during class.
- If you do not have your own note-taking system, adopt one and give it a try. Become a purposeful notetaker yourself.

Conclusion

Note taking plays an important role in helping students retain learning. While taking notes, students process information, and the notes provide a resource for future study and review. It is important for students to be explicitly taught how to take notes. Almost all learning situations are opportunities for students to record important information and time should be provided for students to take notes. It is vital that the notes serve a purpose for students. Teachers must plan how and when notes will be used and make the use of notes part of the learning process for students.

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