

Microlearning and memory

How learning in Bytes
helps enhance cognition



rumie

Microlearning, in a nutshell

WHAT'S THE BUZZ ON MICROLEARNING?

The term “microlearning” may be new to some, but nearly everyone has participated in some form of brief instruction.

Short videos on YouTube teach everything from how to fix a zipper to how to play the classical guitar. Language apps tutor travellers in the fundamentals of Portuguese. WikiHow, a website that publishes thousands of “how to” articles on everything, from “How to Avoid Overreacting” to “How to Photograph the Moon,” reaches over 125 million people a month. On TikTok, while dancers demo hip-hop moves, doctors share intriguing medical facts.

Microlearning exists in nearly every field. The format itself is nothing new. As Karl M. Kapp and Robyn A. Defelice point out in *Microlearning: Short and Sweet*, the use of microlearning has “simply grown with the advent of mobile.”¹⁴ Mobile technology enables learners to more readily access and implement short, personalized lessons anywhere at any time.

While dozens of definitions of microlearning exist, Kapp and Defelice provide the most inclusive. According to the authors, microlearning encompasses: “instructional

¹ Karl M. Kapp and Robyn A. Defelice. *Microlearning: Short and Sweet*. (Association for Talent Development, 2019), 18.

unit[s] that provide[s] short engagement in an activity intentionally designed to elicit a specific outcome from the participant.”¹⁵

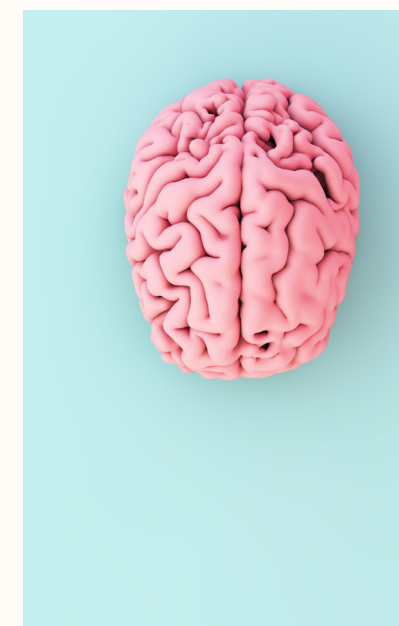
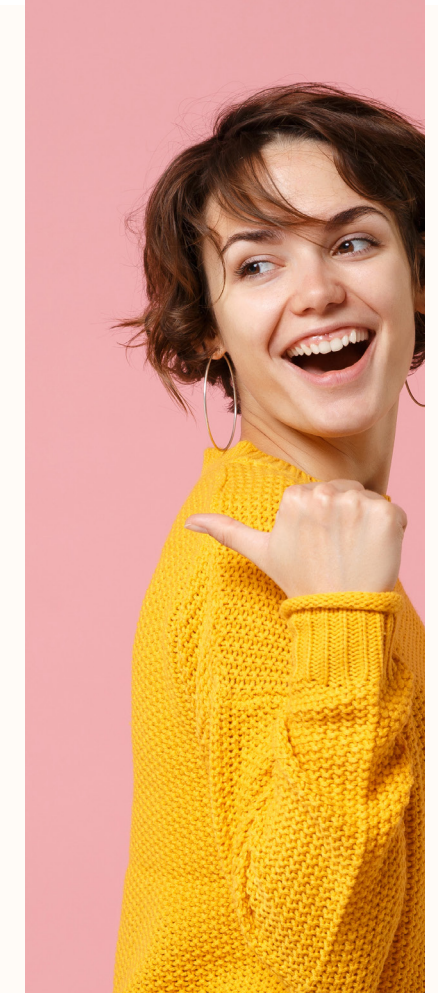
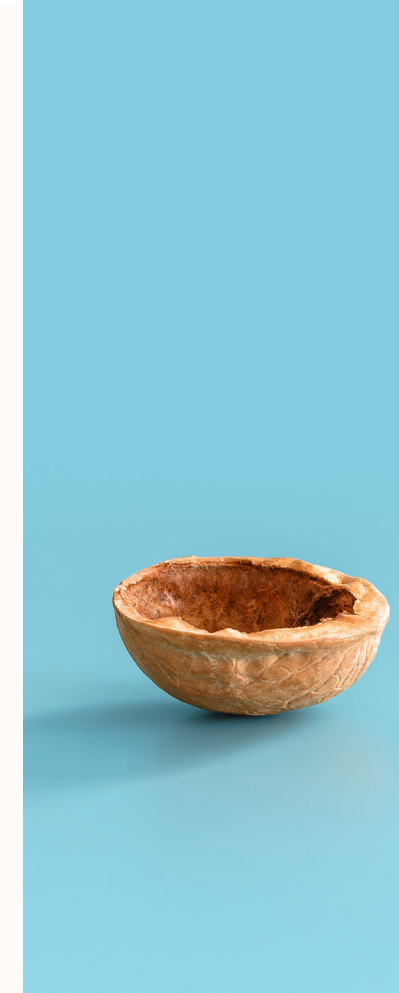
The best forms of microlearning provide short bursts of results-oriented learning, and they make those quick interactions memorable and meaningful. Successful microlearning delights rather than discourages.

Despite its diminutiveness, microlearning can play a sizable role in an individual’s path of learning or in the larger learning ecosystem of a classroom, institution, or organization. A growing body of research suggests that microlearning outweighs some of the alternatives when it comes to cognitive performance. For instance, when participants in a 2017 study were given “smaller slices [of] content,” they retained information and performed better.¹⁶ Studies have also demonstrated that microlearning improves learners’ motivation and engagement.¹⁷

² Kapp and Defelice. *Microlearning*

³ Luminița Giurgiu. “Microlearning an Evolving Elearning Trend.” *Scientific Bulletin*, 22, no. 1 (2017): 18–23. <https://doi.org/10.1515/bs-ft-2017-0003>.

⁴ Isa Jahnke, Yen-Mei Lee, Minh Pham, Hao He, and Linda Austin. “Unpacking the Inherent Design Principles of Mobile Microlearning.” *Technology, Knowledge and Learning*, 25, no. 3, (2019): 585–619.



DESPITE ITS DIMINUTIVENESS, MICROLEARNING CAN PLAY A SIZABLE ROLE IN AN INDIVIDUAL’S PATH OF LEARNING OR IN THE LARGER LEARNING ECOSYSTEM OF A CLASSROOM, INSTITUTION, OR ORGANIZATION.



Design and delivery

SINCE THE CONTENT OF MICROLEARNING IS BYTE-SIZED AND CHUNKED, IT EASILY MIGRATES FROM PLATFORM TO PLATFORM. INSTRUCTORS CAN DISTRIBUTE MICROLEARNING LESSONS ACROSS THE SOCIAL CHANNELS WHERE THEIR LEARNERS MOST ENGAGE.

Nuggets of microlearning play more than one role. They might be implemented as part of an onboarding program in a corporation or a learning strategy in a K-12 classroom. They lead, inspire, complement, and reinforce learning.

Since the content of microlearning is byte-sized and chunked, it easily migrates from platform to platform. Instructors can distribute microlearning lessons across social channels where their learners most engage. Microlearning bites function as conversation prompts for online seminars. When housed in the school's existing learning management system (LMS), they act as resources to "flip the classroom." Instructors also employ nuggets of microlearning to help their students review critical course content or prime them for what's coming up in the next semester. Teachers can also encourage learners to consolidate their learning by guiding them in creating their own microlearning courses.

A range of design and delivery tools might make up a microlearning initiative. Video, visuals (memes, infographics, images, or visual presentations), podcasts, text messaging, interactive forums, or audio recordings all work in tandem to create interconnected nuggets of learning.¹⁸

A growing body of research attests to the applicability of bites of learning across multiple contexts and disciplines, from training dairy farmers to upskilling textile workers.¹⁹ The rise in popularity of microlearning may be a result of a growing trend towards lifelong learning.²⁰

¹⁸ Amanda Major and Tina Caladrino. "Beyond Chunking: Microlearning Secrets for Effective Online Design." *FDLA Journal*, 3, no. 13. (2018).

¹⁹ Anne Hesse, Pedro Ospina, Matthias Wieland, Francisco Leal Yepes, Bac Nguyen, and Wolfgang Heuwieser. "Short Communication: Microlearning Courses Are Effective at Increasing the Feelings of Confidence and Accuracy in the Work of Dairy Personnel." *Journal of Dairy Science*, 102, no. 10 (2019): 9505–11. doi.org/10.3168/jds.2018-15927. https://doi.org/10.3168/jds.2018-15927

²⁰ Omer Jomah, Amamer Khalil, Masoud, Xavier Patrick Kishore, and Sagaya Aurelia. "Microlearning: A Modernized Education System." *BRAIN, Broad Research in Artificial Intelligence and Neuroscience*, 7, no. 1 (2018): 103–110.

Merits of microlearning

Some of its most salient benefits include its capacity to:

- Strengthen knowledge retention and retrieval and improve mental acuity and flexibility.
- Reduce cognitive overwhelm and fatigue.
- Increase engagement and motivation.
- Adapt to the preferences and lifestyles of modern learners.
- Promote greater collaboration.
- Encourage self-determined learning through active (rather than passive) learning strategies.

Measurable, memorable

Before you dive into the focus of this paper—the positive effects of microlearning on memory and cognition—it will help to understand memory from a neuroscience perspective.





A primer on the neuroscience of memory

WHAT RECENT DISCOVERIES IN COGNITIVE PSYCHOLOGY AND NEUROSCIENCE TELL US ABOUT HOW THE BRAIN REMEMBERS.

AT THE HEART OF LEARNING LIES THE BRAIN'S ABILITY TO HANDLE THE SKILLS AND KNOWLEDGE IT RETAINS—AND TO DO SO FLEXIBLY AND CREATIVELY.

Rather than comprising a single faculty or event, the act of remembering involves a series of neurochemical responses and processes, which rely on billions of neurons and numerous linked neural pathways.

Unlike a computer's hard drive, which saves, stores, and retrieves files composed of binary states (while keeping those files mostly in place and intact), when the brain forms, holds, and retrieves a memory, it performs an ongoing act of creative construction, deconstruction, and reconstruction.

Any act of remembering depends on the shape, pattern, and allocation of neurons in different clusters within the brain.¹⁴ And those shapes, patterns, and allocations change throughout a person's lifetime—a phenomenon commonly called “neuroplasticity.”

Memory also takes place across interconnected regions of the brain. For example, short-term memory relies heavily on the prefrontal cortex. But when a short-term

¹⁴ Mrigank S. Shail. “Using Micro-Learning on Mobile Applications to Increase Knowledge Retention and Work Performance: A Review of Literature.” *Cureus*, 11, no. 8. (2019).

memory moves into long-term memory, a whole system of neurons across several lobes and cortices of the brain gets involved.¹⁵

Further, neuroscientists tend to divide memory into four distinct categories or stages: **Sensory memory, short-term memory, working memory, and long-term memory.**

¹⁵ Larry R. Squire. “Memory Systems of the Brain: A Brief History and Current Perspective.” *Neurobiology of Learning and Memory*, 82, no. 3 (2004): 171–77. doi.org/10.1016/j.nlm.2004.06.005.

Sensory memory

The scent of lilacs, the sound of footfall on the floor above. Both are instances of sensory memory. Since sensory information is ongoing and abundant, there's rarely any need for the brain to hang onto one sensory memory for longer than a few seconds. The scent of a lilac bush often fades once a person has walked away from it.

But if those lilacs or footsteps add meaning to an individual's life—if that person has a reason to remember them, and especially if they trigger strong emotions—then the individual's sensory memories may transform into long-term memories. For example, if the footsteps turn out to belong to an intruder, an individual's brain will have good reason to remember how the steps sounded. Co-existing with that memory will be an explicit memory of feeling fear. Thanks to the firing and wiring of neurons, the next time an intruder breaks in, that individual will recognize the signs of danger.

Short-term memory

Short-term memory refers to the process by which the brain holds onto new information for a limited period of time.

For example, if a woman orders a bouquet of flowers over the phone, she might look up the number of the florist and remember the digits just long enough to dial them. The specific neural pathways dedicated to recalling those seven to ten digits, however, don't usually stick around for more than 30 seconds.

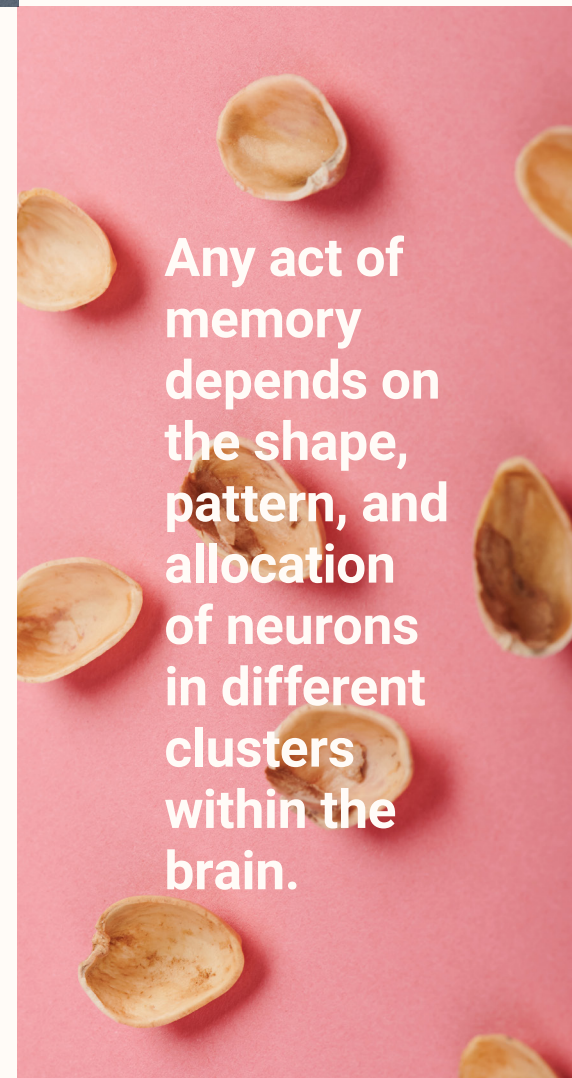
If the woman orders flowers from that florist daily, she'll commit the phone number to long-term memory. She'll form stronger synapses between the neurons in that memory cluster.

Working memory

Take it a step further and imagine the woman ordering those flowers happens to be a mathematician. Either by chance or by habit, she turns the florist's digits into an equation. She decides to “work with” the numbers in a way that exercises her working memory.

Along the same line, a baker who follows a recipe for chocolate cake not only works the eggs, flour, and cocoa with his hands; he plays with those ingredients in his working memory.

If the baker repeatedly works with the same recipe, he'll store the memory of it indefinitely. The neurons that fire whenever the baker bakes that cake will wire in a way that he never forgets a step.



Any act of memory depends on the shape, pattern, and allocation of neurons in different clusters within the brain.

Long-term memory

Neuroscientists tend to divide long-term memory into subcategories: implicit, such as procedural memories, and explicit, such as episodic and semantic memories.

Implicit memories include procedural memories—or those memories that you act upon without explicitly thinking about them. Whenever you drive a car or ride a bike, you're exercising your implicit, procedural memory.

Explicit memory, on the other hand, refers to the memories you bring into conscious awareness. Explicit memory may be personal or impersonal, episodic or semantic. A memory is episodic when it involves something you've directly experienced: the pronunciation of your

aunt's maiden name, a date with a new friend you had in the park last May, a birthday you once celebrated in a garden.

Semantic memory, alternatively, is usually impersonal. It might include the names of the monarchs of the Kingdom of Thailand or the symbols of the elements in the periodic table. (If you've met the King of Thailand, however, your memory of him will be episodic rather than semantic).

Through a process of reintroduction and recall, short-term and working memory might turn into long-term memory. Rehearsal or retrieval can change, upgrade, or reinforce a memory.

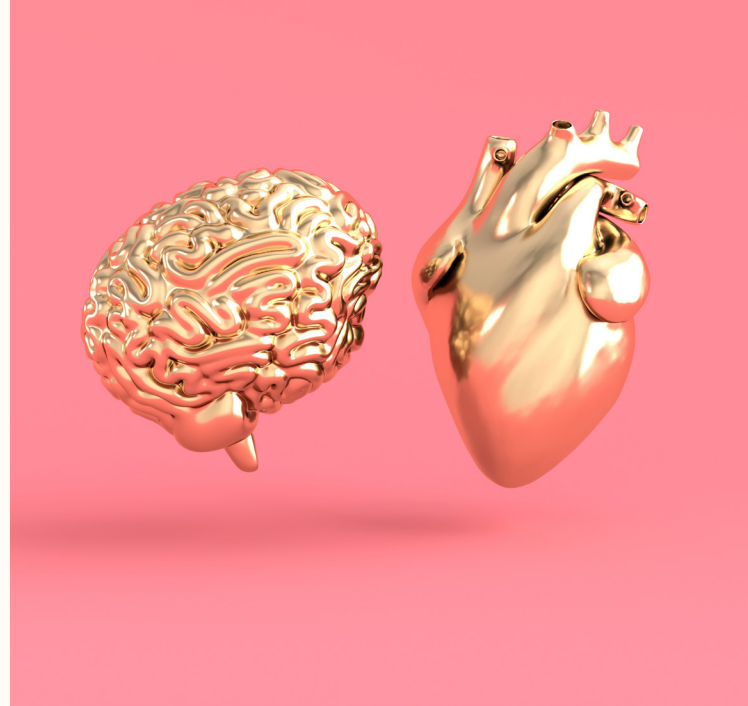


Micro-learning debunks the myths of memory

Folk wisdom tells us that committing knowledge to memory requires unrelenting discipline and repetition. Teachers reinforce that notion whenever they direct learners to sit at a dedicated study space and focus intently on a single subject for hours on end.

The belief that deep learning requires head-down, nose-to-the-grindstone repetition is deeply embedded in our culture.

Aspects of that approach might work at some stage of a learning journey. However, recent discoveries in learning science prove that relentless focus often backfires. It leads to inflexibility—and if carried out non-stop, it causes burnout.



Distributed learning or spacing out

Another common myth about memory is the belief that the human brain has limits to its storage capacity.

Imagine it were possible to count all the grains of sand on all the beaches and deserts of the world. The tally of grains would not come close to the number of bytes of information available in the long-term memory of the human brain.

The problem that most people have with memory rests not in their brain's storage capacity. Memory problems tend to lie in the systems—the elevators, escalators, and envoys—that carry memories in and out of storage. The term “use it or lose it” applies somewhat

here. If the brain commits something to memory, that information stays in memory. But if the mind rarely retrieves that stored information, it will be difficult to find it. It will feel as if the memory of an event, piece of knowledge, or skill is lost.

The trick to successfully retaining skills and knowledge, however, lies not in taking in *more* information. Instead, it requires handling *fewer* pieces at once. When those few pieces of learning settle, they add to the foundation of long-term memory, which supports further learning. Learning in small bytes improves the dexterity and capacity of working memory, ultimately adding to a nimbler, vaster system of connected neural networks.

Variety, both in location and content, lead to greater cognitive flexibility.

Microlearning helps to tread the trails that make deep learning possible.

Part of the beauty of microlearning lies in how it lightens the load on cognition. A lighter cognitive load leads to a simpler, easier learning journey. Designers of microlearning respect that working memory can only juggle so much: They never throw the learner too many balls. When learning is manageable, the content is more fun to bounce around in working memory and easier to store in long-term memory.

Learning in light and easy steps is sometimes referred to as distributed, or spaced, learning. As Benedict Carey writes in *How We Learn: The Surprising Truth About When, Where, and Why It Happens*. (Macmillan, 2018).¹⁴

¹⁴ Benedict Carey. *How We Learn: The Surprising Truth About When, Where, and Why It Happens*. (Macmillan, 2018).



Hidden benefits of distraction

If a student tends to spend hours playing video games in the days leading up to an exam, her habit may not help her academic performance—unless, of course, the games have been designed to help her prepare for exams!

Still, in the right circumstance, there's an upside to distraction. When learners experiences a mental block to the flow of ideas, consciously pursuing a distraction may be what their brain needs to move beyond the impasse.

A few minutes (or hours) of a game play might engage neural pathways and networks that enable a learner to see an old problem in a new way. Interruptions can help the mind to move beyond its own biases.

For example, if a writer's cat paws at her keyboard while she types, she might be inspired to take her story in a more playful direction. Periods of incubation—or lengths of time when the brain isn't focusing on the specific problem hand but is instead mind-wandering, daydreaming, or performing another pleasurable activity—often promote deeper, more personalized learning.

Further, activities that take the brain away from the task at hand might contribute to spontaneous "aha" moments of intuitive insight. This phenomenon is explored extensively by Srinii Pillay, M.D.,

in his 2017 book, *Tinker, Doodle, Dabble, Try*.¹⁴

Contrary to common advice, learning also needn't take place in a single location. Nor does it require focusing on a specific set of skills *ad infinitum*. Variety, both in location and content, lead to greater cognitive flexibility.

Variation and experimentation prime the brain to work with new information nimbly and spontaneously. They force the brain to internalize general rules that span across diverse contexts and situations—not to mention across disciplines.¹⁵

Interleaving, a term from cognitive science, means mixing related but distinct material during study.

Studies from Doug Rohrer et. al. have demonstrated that interleaving can improve comprehension in everything from math and chemistry to basketball and piano. Jumping around from practising scales to sonatas to sambas, for example, increases mental agility. It prepares the brain to meet the unexpected.¹⁶

¹⁴ Srinii S. Pillay, *Tinker Dabble Doodle Try: Unlock the Power of the Unfocused Mind*. (New York: Ballantine Books, 2017).

¹⁵ Carey. *How We Learn*.

¹⁶ Rohrer, Doug, Robert F. Dedrick, and Sandra Stershic. "Interleaved Practice Improves Mathematics Learning." *Journal of Educational Psychology* 107, no. 3 (2015): 900–908. <https://doi.org/10.1037/edu0000001>.



Flexible and self-directed learning

Accessing the relatively small, condensed, and focused bites of microlearning is easy. With a mobile device, microlearning travels flexibly across contexts, locations, and situations. It naturally introduces the practice of interleaving.

Typically learner-centric, microlearning encourages learners to choose when, where, and what they want to learn. Learners practise greater self-agency, so they naturally take ownership of their learning. In *Self-determined Learning: Heutagogy in Action*, Stewart Hase and Chris Kenyon demonstrate that microlearning develops "self-efficacy and confidence" through the small wins it advocates.¹⁴

Further, when a learner follows their own chosen path, they also engage in their metacognitive skills more. A awareness of their own thought processes in turn leads to greater self-awareness—another invaluable competency

¹⁴ Stewart Hase and Chris Kenyon. *Self-Determined Learning: Heutagogy in Action*. (Bloomsbury Academic: 2015)

for the 21st century.

Unlike many forms of learning, microlearning tends to embrace, rather than censure, interruptions and distractions. It communicates in easy-to-understand, simple language. Since lessons arrive in chunks, they're also easier to chew and digest. Microlearning never requires the learner to block off lengthy study sessions removed from all interference. The learner can gain valuable knowledge and skills between bus stops and when waiting in line at the market. Microlearning travels with them wherever they go.

Further, microlearning extends beyond any one moment, device, or lesson. Since most microlearning leads to practical action in the world, it encourages the learner to develop a habit of translating the lessons practically into day-to-day life. That reinforces the vital links that the brain needs to keep learning, to keep growing.



An evolving ecosystem of accessible learning



Are you an educator? Or just someone who loves to inspire learning?

Here are a few ways to bring Bytes into the classroom.



Rumie's mission has always been to improve the quality of life globally through learning. To do that, our team of researchers, engineers, educators, designers, community organizers, volunteers, economists, and subject matter specialists aim to deliver microlearning that meets learners where they are.

Rumie hosts hundreds of free and accessible microlearning courses, or "Bytes," optimized for mobile and modern learning.

But Rumie is more than a library. Rumie is a community. A living centre of knowledge. A movement towards a more equitable and informed world. We are a registered charity that aims to put meaningful and manageable learning material into the hands of those who need it most. Our ever-evolving platform makes learning as easy and as fun as social media. We invite learners to scroll with purpose.

With libraries dedicated to climate action, mental health, innovation, relationships, and financial and

digital literacy, Rumie covers the content that's most in-need and in-demand.

Our platform also focuses on essential life skills and career competencies, which work in tandem to build self-awareness, self-confidence, and self-sufficiency in each learner. Bytes guide learners in how to adapt mindfully to the changes happening in the modern world. Further, Rumie's "Learning to Learn" library nudges participants to adopt valuable skills in metacognition, so they can learn to love learning for life.

By keeping up to date with the best practices in microlearning, Rumie strives to stay relevant and real. As a start-up, we respond to any shifts in society when they happen—not months down the line. With our thriving community on Discord, we engage learners in discussions that help them to stay awake to what matters, to figure out their next steps, and to land that job, that internship, that scholarship—or whatever their goals might be.

- Discussion prompts
- Bytes to "flip the classroom"
- Microlearning challenges
- Self-directed time to "scroll with purpose"
- Participate in a "create your own Byte" learning session



What learners are saying:

“ Rumie is a fantastic server for job-searching information. The constructive feedback given on my resume was rock solid, and the tips for the job search are fantastic. The website is also a fantastic place for quick, easy-to-learn information and makes understanding certain material extremely easy. I have recommended Rumie to several of my friends and they have all been happy with what they have found on the server. ”

“ I’m going to binge these [Bytes], probably. This is exactly the resource I’ve been looking for! ”

Get in Touch:



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