#### Paper PD06

# From Overload to Insight: Personal Knowledge Management for Clinical Data Scientists in the Age of Generative Al

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## **ABSTRACT**

As knowledge workers in a regulated and rapidly evolving industry, clinical data scientists at all career levels are expected to learn fast, think clearly, and deliver reliably—often under pressure. This session introduces a modern approach to Personal Knowledge Management (PKM), combining classic systems like *Zettelkasten* and *Building a Second Brain* with the support of generative Al. Using practical examples, this paper explores how Al-powered search, summarization, and reasoning tools can augment daily tasks and support continuous learning. Scenarios from clinical programming show how these tools enhance insight generation, reduce cognitive load, and improve reproducibility—while maintaining data privacy and compliance. Beyond personal productivity, we explore how PKM practices can scale within teams—through shared knowledge bases, internal corporate knowledge sharing tools, and Al-assisted coaching models that promote collective learning. Participants will gain a lightweight framework to evaluate PKM effectiveness and leave with actionable ideas to support both individual growth and collaborative excellence.

## INFORMATION IS NOT INSIGHT: THE CASE FOR PKM

Imagine waking up every morning to a tidal wave: unread emails, Teams notifications, group meetings, new papers on RWD usage in clinical trials, regulatory updates, new CDISC standards, training sessions, and the occasional "urgent" ping about a CHMP publication.

Welcome to modern work.

We live in a golden age of information access—but that access has a hidden tax: **cognitive overload**. We are constantly exposed to information yet struggle to retain or reuse it. Ironically, the more we learn, the more we forget. Our brains weren't designed for this.

Psychologists have long shown that humans forget most of what they learn soon after encountering it. <a href="Hermann Ebbinghaus">Hermann Ebbinghaus</a>'s forgetting curve estimates that within an hour of learning new information people forget up to 50 % of it; within 24 hours they may forget 70 %, and by the end of a week they often retain only 25 %. The so-called Google effect (digital amnesia) describes our tendency to forget information that is easily available through search engines. Unless we manage the information stream, our brains will naturally discard it.

In an age of endless learning, only what you manage becomes knowledge.

As knowledge workers in a regulated, high-stakes environment, we need a new approach. Not just to stay afloat—but to *think clearly* and *deliver reliably*.

# Enter Personal Knowledge Management (PKM).

PKM is the art and science of capturing, organizing, and retrieving information so that we can generate insight when it matters most. It's not a new idea—just newly urgent. PKM is a way to manage the vast amount of information, we as knowledge workers encounter on a daily basis and which enables us to take responsibility for our learning and productivity.

This paper explores how clinical data scientists can build their own "second brain" using digital notetaking apps and how generative Al can become a powerful co-pilot in that journey.

Yet, while PKM is often described as the art of capturing and organizing information, my deeper aspiration is self-cultivation. English lacks a truly adequate word for this concept; that is why I persist in using "Knowledge" throughout this discussion. In German, the richer term *Bildung* captures the idea: it represents what remains after everything learned is forgotten—a cultivation of self that endures beyond facts and frameworks. *Bildung* weaves transferable learning with moral and emotional maturity, uniting the qualities of a collaborative team player with the autonomy of

an independent thinker. Ultimately, it is a harmonization of mind, heart, and identity. For clarity and ease, however, I will refer to *Knowledge* in the remainder of this paper, with *Bildung* as its guiding spirit.

#### BUILDING A SECOND BRAIN: FROM CARD BOXES TO C.O.D.E.

Wouldn't it be great if we had a second brain—one that never forgot what we learned, always knew where to find things, and helped us make sense of complexity?

Turns out, that's not science fiction.

Back in the 20th century, German sociologist <u>Niklas Luhmann</u> created the <u>Zettelkasten</u>—a physical card box system for capturing ideas as atomic notes and linking them into a growing web of thought. With this method, he published over **70 books and 400 articles**, earning him the nickname "the productivity machine." He even won the Hegel Prize.

Fast forward to today, and author <u>Tiago Forte</u> brought this idea into the digital age with <u>Building a Second Brain</u> (BASB). Today, we no longer need to rely on physical card boxes; instead,

digital notetaking apps – apps such as Evernote, Obsidian, Notion to name a few - empower us to build our own second brains, and Forte provides powerful strategies to help us make the most of these tools.

Forte's method, known as **C.O.D.E.**, outlines four stages of knowledge management:

- Capture Save what resonates.
- Organize Make it findable.
- Distill Extract the essence.
- Express Share to sharpen your thinking.

Let's take an example. For instance, imagine reading a book and jotting down key highlights along with your personal reflections as you go—this is the Capture stage in action. Next, you organize these notes in your notetaking system, making sure to label and categorize them so they're easy to retrieve later. As you distill the essence of your highlights and repeat this process for every book you read, you begin to see patterns and connections across different works, sparking new ideas. By diving deeper into these emerging concepts, you might eventually synthesize your insights into a PHUSE presentation or another creative project, expressing your newly formed knowledge and contributing back to your community.

While Forte focuses on digital notetaking, many practitioners—including myself—blend digital and analog approaches. The medium matters less than the **mindset**: You're not just taking notes. You're creating a personal knowledge graph for sustainable personal growth.

For these classical methods, it's vital to remember that these techniques are not merely about amassing facts or building a digital archive. Drawing on the concept of *Bildung*—the cultivation of the self through a lifelong process of learning and transformation—the true purpose of linking notes, distilling insights, and organizing our knowledge is to shape the way we think. By connecting ideas and extracting their essence, we are not just constructing a database, but nurturing our judgment, deepening our understanding, and igniting our imagination. In this way, a second brain becomes a catalyst for personal growth, creative synthesis, and wiser decision-making.

# **ACCELERATING KNOWLEDGE CREATION WITH GENERATIVE AI**

Let's zoom in on the knowledge creation flow.

At its core, **knowledge = meaning**. It emerges when we connect disparate pieces of information, extract patterns, and apply them in context. The above-mentioned example illustrates how new ideas can emerge when reading books. Let's generalize this now with deconstructing the entire knowledge creation process.

The true value of a second brain isn't storage.
It is synthesis.

The process typically looks like this:

- Research → Seek out information (intentionally or accidently)
- 2. **Capture** → Save what's relevant and what resonates
- 3. **Expand**  $\rightarrow$  Make connections, add your perspective
- 4. **Express** → Turn it into something useful

**Note**: This process describes how one creates knowledge intentionally by researching on a specific topic. The same process applies though with information you may find accidentally, maybe by just browsing through the internet or social media. Apps like *Readwise Reader* – an all-in-one



reading app, that centralizes articles, PDFs, videos, newsletter and more - are great to save information for later processing.

Until recently, this workflow required substantial time: searching the web, reading books, attending conferences, or slogging through regulatory guidance. Today, with the rise of generative AI, we can accelerate this dramatically—without sacrificing depth.

Here's how I use three tools together, inspired by workflows from Christoph Magnussen and others:

- **Perplexity AI** (<u>www.perplexitiy.ai</u>) Perplexity.ai is an AI-powered search engine that instantly answers questions by searching the web in real time, summarizing information from authoritative sources, and providing responses with clear citations for easy fact-checking. It can be used similar to the Google search engine, but offers way more features. It functions as an intelligent research assistant, delivering concise, conversational answers and enabling users to verify and explore the original sources. I use Perplexity for *real-time research*: up-to-date answers grounded in reliable sources, such as academic publications. I download the sources found by Perplexity for the next step.
- **NotebookLM** (<a href="https://notebooklm.google.com">https://notebooklm.google.com</a>) NotebookLM is an Al-powered research and note-taking tool developed by Google that analyzes user-uploaded content—such as documents, PDFs, videos, and web pages—to generate summaries, organize information, and provide answers with contextual insights. It streamlines research and learning workflows by offering features like interactive Q&A, flashcards, custom reports, and podcast-style audio overviews directly from the user's own materials. I use NotebookLM for capturing and comparing insights: I upload source PDFs, webpages or videos found by Perplexity Al and let it generate summaries, themes, and mind maps. In NotebookLM I work with these sources: ask targeted questions, find patterns, and so on. NotebookLM also has a auto-generated podcast and video features, which helps to get quick insights on the run. I use the output generated by NotebookLM to set the context for the next step.
- ChatGPT (www.chatgpt.com) ChatGPT is an advanced conversational AI assistant developed by OpenAI, capable of answering questions, solving problems, generating and editing content, analyzing documents and images, and supporting natural dialogue across many languages and formats. It integrates with various tools to perform tasks such as deep research, code writing, data analysis, and voice-based interaction, adapting its responses to context and user preferences. I use ChatGPT for expanding and expressing: use a reasoning model such as o3 to simulate discussions, draft content, or generate new connections. I use the context created in the previous step for effective prompting ChatGPT and grow beyond what I already researched.

Theoretically, all the above-mentioned tools could be used to support either research, capture, expand and express step. At the time of writing this paper (October 2025), the above-mentioned tools are specialized in these respective areas where I use them.

Let's again take a look at an example. Over the past years, I've read many books about agile teams and organizational strategies—such as Team of Teams, Humanocracy, and The Ride of a Lifetime. To deepen my understanding, I could use Perplexity.ai to explore additional resources, uncovering articles on the Spotify Model, McKinsey's Helix organizations, or insightful videos on how Netflix structures its teams. The next step would be to upload these sources, along with my book highlights, into NotebookLM, where I can ask focused questions tailored to my current objective—like defining a new strategy for statistical programming at Bayer. The insights and context generated in NotebookLM then become the foundation for the final step: using ChatGPT to synthesize the information and express new ideas, transforming my research into actionable knowledge.

It is important to keep in mind that Al helps us skip the shallow parts of learning (summarizing, extracting) and focus on the deep parts (judging, connecting, creating). But it works best when paired with an intentional PKM process.

While AI models are unparalleled in their ability to store and retrieve staggering volumes of information, it's vital to recognize that they fundamentally lack *Bildung*—the cultivation of wisdom, character, and deep understanding as mentioned before. Strip away the vast reservoirs of training data, and what remains is emptiness; there is no internal growth, no true synthesis of meaning. This is precisely why human involvement remains indispensable, regardless of how sophisticated these generative tools become. The technologies outlined above are not substitutes for genuine knowledge or *Bildung*, but rather powerful enablers, designed to support and enrich the human journey of learning and self-cultivation. I cannot stress enough: the goal is not to outsource our intellectual development to machines, but to use these tools to deepen, not diminish, our own *Bildung*.

## NOTES THAT WORK: THE ART OF NOTETAKING

Regardless, if you use a traditional learning process or utilize AI to accelerate these steps, PKM is essential to sustain your knowledge. If PKM is the engine, then notetaking is the fuel. But not all notes are created equal. Let's clarify what notes are (and aren't):

X Not transcripts.

Short reminders or summaries that you can reuse in your PKM.

Pro Tips for Effective Notes:

- **Summarize, don't transcribe**: Focus on ideas, not sentences.
- One idea per note: Atomic notes are easier to reuse.
- Use your own words: It forces you to think.
- Structure as you go: Use bullet points, headings, indentation.
- Connect to other ideas: Ask "Where have I seen this before?"
- **Distill key takeaways**: Add 1–2 summary lines at the top.

The note is not the end. It's the beginning of thinking.

Try the Cornell method for structure or apply Zettelkasten principles for connection. Personally, I use Markdown syntax even in analog notes—it makes later digitization easier. I'll take a photo of a notebook page, run it through ChatGPT, and drop the output into Obsidian.

## CHOOSING THE DIGITAL NOTETAKING APP THAT FITS YOUR STYLE

As mentioned earlier, digital notetaking apps are great tools to build your second brain. In a nutshell, a digital notetaking app helps us to create, organize and manage notes electronically on various devices. They often come with features like search, real-time collaboration, and multimedia integration. There are well over 100 digital notetaking apps available on the market in 2025, with dozens of well-known options and many more specialized or niche apps. With this, finding a tool, which works perfectly for you, is like finding a needle in a haystack. So how can you find an app effectively? Selecting a note-taking app should match how your brain works. Tiago Forte defines four note-taking archetypes—each with their own strengths:

- The Librarian has a practical, project-orientated relationship with information. Librarians collect material from diverse sources, curate it and store it in consistent categories. Apps such as **Evernote** and **OneNote** excel at collecting and retrieving information from multiple devices.
- The Gardener thinks in a bottom-up way, cultivating many ideas like seedlings in a garden. Gardeners enjoy wandering through their notes, making spontaneous connections and harvesting ideas when they mature. Free-form tools like **Obsidian** and **Roam Research** support this exploratory mindset.
- The Architect prefers a clear hierarchy and a carefully designed system with a clear hiearchy. Architects excel at creating overarching frameworks and making executive decisions about folder structures and metadata. They might choose apps like **Notion** or **Craft**.
- The Student focuses on acquiring knowledge for a specific purpose (studying for an exam, learning a new language or starting a job). Students value ease of use and minimal complexity; simple apps like Apple Notes or Goodnotes suffice.

Archetype	Description	Best Digital Apps
Gardener	Likes to explore ideas and grow knowledge organically	Obsidian, Roam
Architect	Builds clear systems and categories	Notion, Craft
Librarian	Curates project oriented info across many sources	Evernote, OneNote
Student	Gathers for specific learning goals	Apple Notes, Goodnotes

Table 1 – Note-taking archetypes

I'm a blend of Architect and Gardener. That's why I use **Obsidian** for flexible structure and **Readwise** as an additional tool to import my Kindle highlights into Obsidian.

#### **GETTING STARTED WITH PKM**

Once you have chosen a note-taking tool that suits your needs, the next important step is to set it up in a way that aligns with your personal workflow and goals. If your archetype leans toward Architect or Librarian, you might find it helpful to design a detailed file and folder structure from the outset. This could involve creating specific folders for each project, area of responsibility, resource, or archive, allowing for easy retrieval and organization of information. On the other hand, if you identify more with the Gardener archetype, you may prefer to begin capturing notes freely and organically, letting your structure evolve naturally as your collection grows and as connections between notes become clearer.

Regardless of your preferred approach, it's valuable to spend a few moments reflecting on what you want to accomplish with your personal knowledge management system. Are you aiming for quick information retrieval, deep research, creative synthesis, or something else? Ultimately, a flexible yet practical framework that can be adapted to most workflows, providing structure without unnecessary rigidity, usually works best for me in the long run. A system, which checks these boxes, is Thiago Forte's PARA system and makes the process of notetaking both efficient and enjoyable.

Forte's <u>PARA system</u>—Projects, Areas, Resources, Archive—is a solid starting point for organizing notes. I personally use this system to store my notes and related work documents. From my point of view, this system provides a fit-for-purpose structure, which allows for utmost flexibility. There are many other systems (eg. "Getting Things Done" by David Allen) though for storing information.

Whatever app and system you choose for notetaking, the goal is this: can you find what you saved, when you need it?

Let's again take a look at an example how you can get started on PKM. For example, when I come across information that I want to preserve—like book highlights, insightful videos, or articles—I typically save these in the Resources area within my Obsidian notetaking app. If the content is directly relevant to my role as a Head of Statistical Programming, such as process documentation or team strategies, I store it in the Areas folder. When I embark on a new initiative, such as developing a new strategy or organizational structure, I create a dedicated folder in the Projects section, then browse through both Areas and Resources to link pertinent notes and references. After the project concludes with a presentation or a position paper, I move the entire project folder into the Archive, ensuring my knowledge base remains organized and accessible for future reference.

In summary, drawing upon a robust suite of tools—including notetaking apps, centralized all-in-one readers and Al tools—alongside established frameworks such as the PARA system, provides a dynamic and highly effective approach to personal knowledge management. By customizing these platforms to suit individual working styles—whether through meticulously structured folders or a more organic, freeform note-taking process—users can seamlessly capture, organize, and synthesize their insights and resources. The integration of Al-powered tools further enhances the ability to summarize, connect ideas, and generate new knowledge, resulting in a system that not only streamlines information retrieval but also encourages continuous learning and creative exploration.

This holistic workflow empowers users to transform scattered bits of information into a coherent knowledge base, accessible at any time for reflection, project work, or creative endeavors. The flexibility of such systems ensures they remain adaptable as goals and interests evolve, allowing for easy incorporation of new tools or techniques. Furthermore, the synergy between manual curation and Al-driven assistance bridges the gap between passive information storage and active knowledge creation, enabling deeper insights, cross-domain connections, and more impactful outputs—be it in research, content creation, or daily problem-solving. Ultimately, investing in a thoughtfully designed personal knowledge management system not only elevates productivity but also cultivates a sense of mastery and ownership over one's intellectual journey.

# MY PERSONAL PKM FLOW (WITH AI IN THE LOOP)

In previous sections I shared some of my personal preferences on my preferred AI tools to support my knowledge creation and my preferred app for notetaking. Over the years, I've tried various processes to connect the various applications and the sources, which trigger my notetaking. The following workflow turned out to fit best in my own routines and daily work. I follow this process whenever a piece of information triggers a thought and I have the impression that this piece of information might be valuable in the future.

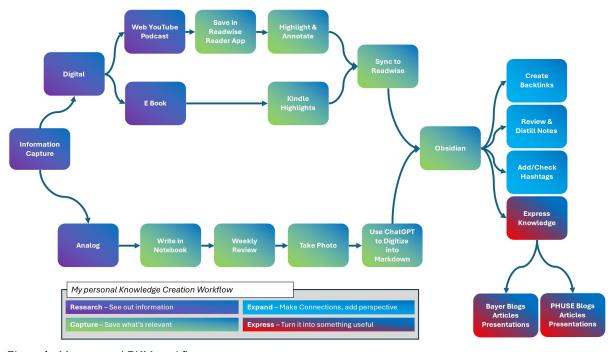


Figure 1- My personal PKM workflow

Let me share how I use this in practice:

- Reading: Kindle → Readwise → Obsidian

  Some time ago, I switched from reading printed books to read e-books on Kindle. The advantage of reading on a Kindle is the great feature of highlighting. My Kindle Highlights are synced with the app Readwise. Readwise is a great app to keep your highlights in mind. You can get into a routine of daily reviews, where random highlights pop up. In addition to that Readwise syncs to Obsidian.
- Summarizing: I feed highlights from Obsidian to ChatGPT or NotebookLM and ask these tools to summarize, extract insights, create tags. It is really powerful if you read books on similar topics and use these tools to identify the common themes or build up on each other.
- **Connecting**: I explore Obsidian's graph view on a regular basis to spot themes and build new ideas. I also use tools, such as NoteebookLM or ChatGPT to connect completely different topics and create new knowledge out of that.

And it's not just for content creation. I also use my Obsidian based PKM, NotebookLM and ChatGPT to:

- Reflect on blind spots
- Simulate peer review of my content creation
- Prepare for stakeholder meetings
- and more ...

With this flow, PKM + Al becomes a mirror. It shows you what you know—and what you don't.

## **CLINICAL PKM: USE CASES FOR DATA SCIENTISTS**

Let's bring it back to our world: Clinical Data Science. Over the course of our career growth, we are often transitioning from one role to others. We might have started as junior statistical programmers and moved to a Pharma company fresh from university. We then become more mature and take over the lead analyst role of an entire product or therapeutic area. And eventually, we might end up in a leadership role and lead an entire function of Clinical Data Scientist. Just imagine, how helpful a PKM set up in your first days and maintained over the years could be! Knowledge builds up on each other and you have it available just one click away.

Let's look at the different personas to see what types of knowledge could help at which career step:

#### JUNIOR PROGRAMMER - EVERYTHING IS NEW!

In the beginning, everything is new. Make as much notes as possible about the process landscape, the technology used, but also the therapeutic areas and types of work you are exposed to. Especially a thorough understanding of mechanisms of action, competitors, biomarkers, and indication-specific endpoints differentiates in many cases a good programmer from a great programmer. If you understand the big picture, it will help your growth. Setup a PKM and keep it up to date while you learn.

## MATURE CLINICAL DATA SCIENTISTS - MANAGE PRODUCT KNOWLEDGE AND NETWORK

The more you grow in your career, the more projects and data challenges you will have seen. Keep your PKM up to date. Distill trial learnings, SAP nuances, CDISC quirks, and submission lessons. Over time you will be able to connect notes across studies. You have a place you can go back to and grow beyond. Another important point in building your career is building up your network. Why not create notes about this as well? What can you learn about your partners, peers and stakeholders? They grow in their career as well and keeping the learnings about their area of responsibility in mind, will make it easier for you to connect quickly.

#### **SEASONED LEADER - SUPPORTING LEADERSHIP DECISIONS**

Regardless, where you are in your career, you will need to make lots of decisions. Could you imagine you would have stored all your decisions, how and what on which facts you made a decision, how you mentally felt that day and what the outcome was a few months later? You could be able to identify patterns in your decision making and be less dependend on luck for a good outcome. Maintain decision journals in a PKM. Log context, options, and rationale. This reduces hindsight bias and improve judgment over time.

Over the duration of a career, you will also read a lot of articles or books about leadership principles, organizational structures, strategies and much more. Having quite an exhaustive library of notes from these sources was invaluable for me personally to lead the Bayer SPA organization through a recent re-organization. To shape the SPA strategy and structure, I connected ideas from leadership books like *Team of Teams, Ride of a Lifetime* and *Humanocracy* with our own framework such as the VACC model, the Dynamic Shared Ownership Marketplace, and a 3 Horizon Workshops. I combined all my notes on these topics with practical operating model needs – demand and supply flows, new role definitions, portfolio governance – and enriched them with external analogies like Procter & Gamble or Disney's brand strategy and our Data Caterer identity. By refining sometimes very old ideas through various hands-on workshops, we arrived at a strategy that is both visionary and pragmatic,

## **CONTINUOUS DAILY LEARNING**

It is never too late or too early to start a PKM system. Just start though. Start your journey with a small step and the goal to go smarter to bed as you woke up in the morning. Start small: At the end of each day, review or think what you learned. Add one note. Over time, this becomes a map of your expertise.

## **COMPLIANCE AND PRIVACY: PHARMA IS SPECIAL**

So far we have spoken about all the great advantages of PKM in combination with AI. There is one critical downside, which we should think about as well. As Clinical Data Scientists, we are working in a strongly regulated environment. In our regulated pharma work, we also have to ensure that our PKM is meeting our compliance requirements. The following points need to be considered:

# Never store patient-identifiable data in public Al tools.

This is a case of "better safe than sorry". So reach out to your Chief Data Officer or Head of Data Strategy (or similar) and share your plans in case you plan to store any data in your PKM.

#### Follow company data-handling SOPs.

In this case, data also means analysis results. Be aware that if you handle product specific information or

communication anywhere, you are accountable for that. Especially in litigation cases, the handling of product specific information can be quite tricky. The proper way how to process data and analytics are described in SOPs for a reason.

• For sensitive content, use on-prem or private AI environments.

Many companies have created their own AI environments, which allows also the handling of sensitive content. Make yourself aware of the limitations of these environments to understand what you can and what you can't do.

Document your sources—regulators love traceability.

This point is especially important if you utilize a PKM not just for yourself, but for a wider group. It should be transparent, where you gather certain knowledge especially if it is about relevant business processes. The single point of truth for all audits and inspections should be your company specific SOP landscape. Don't cite best practices from your PKM and especially if you are creating notes from SOPs, have the reference to the most up to date version stored with the note as well.

#### FROM PERSONAL TO COLLECTIVE KNOWLEDGE

PKM isn't just personal. It can be the foundation for **Corporate Knowledge Management (CKM)**.

To scale PKM into CKM in your company, consider the following:

- Knowledge is like love – the more you share it, the more it grows.
- S Design reusable templates for note structuring and review.
- Recognize **contributors**, not just consumers.
- Setup a **sustainable CKM system** like a PKM system. Ensure though to strictly differentiate between opinions and facts.

Al can help taking meeting minutes, index notes, summarize discussions, and creating links—but only if we *capture* our knowledge in the first place.

## **CONCLUSION: CURATE OR DROWN**

The forgetting curve shows how fast we lose what we learn. The Google effect shows how much we rely on external memory. Together, they form a warning:

# What's not managed is lost.

With a second brain—and a smart Al co-pilot—we can transform information into insight, and insight into impact. PKM is not a luxury for the curious; it's a necessity for the strategic, and it begins with a note. Yet, as we embrace these systems and strategies, it is worth remembering the classical ideal of *Bildung* — the lifelong journey of self-cultivation and personal transformation.

Personal Knowledge Management, especially when paired with intelligent tools, is not merely an end in itself. Its deeper promise lies in nurturing an ongoing dialogue with knowledge—one that invites us to question, connect, and grow, enabling us to participate in our own unfolding as more capable, thoughtful, and creative individuals. The true value of a second brain and an Al co-pilot is not simply to offload our thinking, but to illuminate new pathways for understanding and self-discovery.

In this broader perspective, AI and PKM systems become companions in an endless process of becoming. They help us orient ourselves amid the abundance of information, but the ultimate goal remains the lifelong cultivation of wisdom and character. The process of *Bildung*—continual growth and development—renders knowledge management truly meaningful, ensuring that what we learn continues to shape who we are and who we might become.

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