USING AI TO IMPLEMENT DISTRIBUTED PRACTICE ON LEARNING: A DISCUSSION ON THE PROMISES AND PERILS OF THIS APPROACH

Dr.R.Sivarajan, Assistant Professor, Department of Commerce – Business Process Services
NGM College, Pollachi – 642001

Abstract
This paper provides guidance to adopt AI to easily implement distributed practice of learning as a teaching strategy that academicians can integrate into their teaching. The outcome of the process of studying extends beyond learning to being educated. To achieve this, students need to retrieve information throughout their learning process. They should practice such retrieval of information not just once in a while, but multiple times during a particular period of study or during a course of study. Such distributed practice on learning of study material several times for a prolonged period, is highly essential to develop a reasonable level of robust and flexible knowledge. Distributed practice across a course will help the students to make connections between concepts by easily retrieving information. This practice of learning, supports students to recall factual information even when it is partially forgotten. Distributed practice on learning can motivate students to actively connect varied information from separate topics and ideas to have a better understanding and implement the same during novel situations. Including distributed practice in a classroom can be difficult due to factors such as resistance as it is time consuming. This paper discusses on the promises and perils of this approach and also provides guidelines for how AI can support distributed practice on learning.

Keywords : Artificial Intelligence, Learning, Practice, Classroom, Teaching, Approach, Outcome, Perils, Strategy, Technology

Introduction

In recent decades, the intersection of artificial intelligence (AI) and education has sparked profound transformations in the way knowledge is delivered, retained, and applied. Among the various cognitive strategies explored by educators and researchers to enhance learning outcomes, distributed practice—also known as spaced repetition—has consistently emerged as one of the most empirically validated methods for improving long-term memory retention. The integration of AI into educational systems offers unprecedented opportunities to automate, individualize, and optimize the scheduling of distributed practice. Yet, this promise is accompanied by ethical, technical, and practical challenges that merit careful consideration.

Distributed practice refers to the educational strategy of spreading learning sessions over time rather than cramming them into a single, intensive session. Decades of cognitive psychology research have consistently shown that this method leads to more robust retention, deeper understanding, and improved transfer of knowledge to novel contexts. Unlike massed practice, which may offer short-term performance gains, distributed practice capitalizes on the brain's encoding and retrieval mechanisms, making it a more effective long-term learning strategy. However, implementing this method effectively on a large scale, especially within diverse learning environments, presents significant logistical challenges. This is where AI steps in as a potentially transformative force.

AI-powered systems can monitor student performance, track progress over time, and dynamically adapt the review intervals and materials to each learner's pace, strengths, and weaknesses. Algorithms inspired by cognitive models, such as the Ebbinghaus forgetting curve and Bayesian knowledge tracing, enable AI systems to predict when a learner is most likely to forget a piece of information and to prompt review just before that happens. Such an approach not only automates but also personalizes the scheduling of distributed practice in a way that would be impossible for a human teacher to manage in traditional classroom settings, especially with large student cohorts.

Several AI-driven educational platforms already embody this promise. Tools such as Anki, Duolingo, SuperMemo, and Quizlet leverage spaced repetition algorithms to enhance vocabulary retention, language acquisition, and conceptual understanding across various domains. These systems typically

use user response data—such as how quickly and accurately a learner recalls an item—to recalibrate the interval before the next review. More advanced AI systems may incorporate additional inputs, including biometric data (e.g., eye tracking, heart rate), contextual information (e.g., time of day, device used), or even emotional states detected through facial recognition to further tailor learning schedules. The result is a highly personalized, data-driven learning experience aimed at maximizing efficiency and retention.

Despite these advancements, the deployment of AI for distributed practice is not without its perils. Ethical concerns surrounding data privacy, surveillance, and algorithmic bias loom large. AI systems necessarily collect and analyze vast amounts of personal data, raising questions about who owns this data, how it is stored, and what it is ultimately used for. In educational settings—often involving minors or vulnerable populations—the stakes are particularly high. The risk of misuse, whether through commercial exploitation or inadequate data protections, cannot be ignored.

Furthermore, the effectiveness of AI-implemented distributed practice depends heavily on the quality of the underlying algorithms and data. Poorly calibrated systems may reinforce incorrect information, produce ineffective spacing intervals, or fail to account for individual learning differences beyond what the algorithm can model. There is also the danger of over-reliance on automation, where educators and students alike come to trust the system implicitly, potentially sidelining critical pedagogical insights or contextual understanding that only human instructors can provide. Additionally, excessive dependence on digital tools may narrow the scope of learning, emphasizing memorization at the expense of creativity, collaboration, and higher-order thinking skills.

Another concern relates to equity and access. While AI-driven educational technologies promise democratization of learning, in practice, they may exacerbate existing disparities. Access to reliable internet, modern devices, and digital literacy skills is unevenly distributed across socioeconomic and geographic lines. Students in under-resourced environments may not benefit from AI-enhanced distributed practice to the same extent as their more privileged peers. Furthermore, cultural and linguistic biases embedded in AI models can marginalize non-dominant groups, creating learning experiences that are less relevant, less engaging, or even harmful.

From a pedagogical standpoint, the implementation of AI in distributed practice invites reflection on the broader goals of education. While improving memory and retention is undoubtedly valuable, education also encompasses critical thinking, problem-solving, social development, and ethical reasoning. If AI systems are optimized narrowly for recall, they may skew educational priorities in ways that are misaligned with holistic development. There is a risk that learning becomes instrumentalized—reduced to a series of efficiency metrics—rather than nurtured as a process of intellectual and personal growth.

Nonetheless, the potential benefits are significant if the pitfalls can be mitigated. AI can free educators from the mechanical aspects of lesson planning and scheduling, allowing them to focus on mentorship, motivation, and the human aspects of teaching that machines cannot replicate. Moreover, AI-driven distributed practice can facilitate continuous formative assessment, providing educators with actionable insights into student progress and enabling early interventions. In contexts where resources are limited, such systems could provide scalable solutions to enhance learning outcomes without requiring proportional increases in human labor.

To harness the promise while avoiding the perils, a multidisciplinary and collaborative approach is essential. Educators, technologists, cognitive scientists, ethicists, and policymakers must work together to design AI systems that are pedagogically sound, ethically responsible, and contextually appropriate. This includes embedding transparency and explainability into AI algorithms, ensuring that learners and educators can understand and challenge the system's recommendations. It also involves building robust data governance frameworks that protect privacy while enabling meaningful personalization. Finally, it requires a commitment to inclusive design that addresses the needs of diverse learners and seeks to close—not widen—educational inequities.

In sum, the application of AI to implement distributed practice in learning represents a powerful confluence of technology and cognitive science. Its promise lies in its potential to optimize one of the most effective learning strategies known to psychology, making it accessible, personalized, and

scalable. Yet its perils—ranging from privacy risks to pedagogical distortions—are equally real. Navigating this complex terrain demands not just technical innovation but also thoughtful, principled leadership that places the learner at the center of every decision. Only then can we realize the true potential of AI in education—not as a substitute for human intelligence, but as a tool to augment it in the service of deeper, more meaningful learning.

Significant Perspective

Nowadays everyone is familiar with Large Language Models (LLMs) like ChatGPT which is extensively adopted in the classrooms both by the teaching fraternity as well as the student community. This also helps besides it also hurts the learning processes. To explain it in better terms, the way in which it is utilised is all that needs attention. Academicians use it to handle their classes in a more effective manner such as to teach new lessons in a different manner that might develop interest in the students. The instructors will be able to manage time better thus reducing their workloads and engage in research-oriented tasks and lesson planning (Mollick & Mollick, 2022; Walton Family Foundation, 2023). Students productively adopt the LLMs to assist in their learning, but on the other side they also plagiarize their work.

There are numerous teaching methodologies that have been proven to be worth adopting, but they are hard to be practiced because of the extended time consumption. Such methods can be effectively used in the learning processes for students. With the help of AI, adoption of these methodsis more accessible.This paper provides guidance to adopt AI to easily implement distributed practice of learning as a teaching strategy that academicians can integrate into their teaching. The outcome of the process of studying extends beyond learning to being educated. To achieve this, students need to retrieve information throughout their learning process. They should practice such retrieval of information not just once in a while, but multiple times during a particular period of study or during a course of study. Such distributed practice on learning of study material several times for a prolonged period, is highly essential to develop a reasonable level of robust and flexible knowledge. Distributed practice across a course will help the students to make connections between concepts by easily retrieving information. This practice of learning, supports students to recall factual information even when it is partially forgotten.

Strategies using AI

The main strategies include: providing numerous examples to help students to understand difficult concepts; explaining analogies through various means so that students avoid confusion and misconceptions while understanding various concepts; utilizing low-stakes test to periodically help students to retrieve information and access their knowledge; to have an assessment gap analysis that supports academicians to understand the level of students' learning; distributed practice on learning to connect topics and concepts within and across courses.

A Caution

Although the Large Language Models can be widely used in generating the required study materials to help students in the learning process, it is also found to be critical.Expertise in the subject and teaching is highly required in the assessment of AI's output. Subsequently,
the output can be used within an appropriate classroom. AI can manipulate information and the teacher should assess if the output will be valuable for their class.

Using AI to Distributed Practice on Learning

It is mandatory for students to retrieve what they learn not only immediately, but this retrieval of information should happen multiple times within and across the course of study. Such distributed practice on learning is of high importance in the students to develop robust as well as flexible knowledge as they practice the study material for several days, several months and several times. This distributed practice on learning will help students in connecting between various concepts so that retrieval of information from acquired knowledge is quite easy. This practice also helps students in

many ways such as to recall facts and ideas that they have partially or completely forgotten. This also helps students in connecting different ideas and concepts and create a mental model of a particular concept. Thus, students get a deeper understanding of concepts and expand their abilities to apply the ideas to a novel situation. This is the actual essence of a student being educated, from studying-learning-being educated.

Distributed Practice on Learning in Classroom

Adopting distributed practice on learning in a classroom is always found to be difficult as it is always met with resistance. The usual course materials will not be suitable for such a practice. Customised study materials in a linear fashion are constructed without a direct connection between topics. Students mostly prefer to use such customised study materials for a massed practice rather than individual practice. Studies reveal that the connectedness across concepts being critical in developing deep knowledge besides the capacity to transfer skills, the transition that students attain in performing well is an added incentive to the students. It is an additional task for the teachers to customise study materials, use them periodically to assess the learning of students.

To include distributed practice on learning in a classroom, the teachers assess the following: What are the topics to be chosen? How to bridge in connections between topics? When should the distributed practice on learning be done? Introduction of new topics and supporting students to practice is time-consuming but the outcome is more effective in the students. To implement such a practice using AI, the teacher should know what concepts are to be remembered by the students. The best way to practice is to review that particular topic periodically again and again throughout a specific period. Teachers can direct the AI to draft a brief overview on the chosen topic and generate questions to test the students' knowledge and subsequently these questions can be shared to students as quizzes or assignments. As and when the students respond to the initial set of questions then the AI can be prompted with to increase the level of questions to a little more difficult level.Furthermore, the addition of other concepts can be prompted to the AI to weave together across courses. Thus, the AI can help in finding connections to explicitly enhance students' understanding and knowledge.

Evaluating AI's output to deploy distributed practice

The fact and consistency generated in the AI's output has to be scrutinized. The output obtained may have new connections and at times may not be crucial. It is also important to assess the output to ensure that it fits to that particular classroom due to complexity of the questions generated and the level of ability of the students. The relevance and the alignment of appropriate suggestion for the particular topic should be reviewed.

Distributed practice on learning can be implemented in numerous ways. Evident studies prove that students are able to practice topics in the form of quizzes, assignment to retrieve information from memory through acquired knowledge. Using the AI's output supports students to develop a habit of recalling previous knowledge and connect one topic with another topic so that it can be used in novel situations.

Coping strategies for Future perspective Possibilities

Technological Coping Strategies

Human-in-the-Loop Design : Future AI systems should be developed with humans in the loop, meaning educators and learners should retain control and decision-making authority. AI should augment rather than replace human judgment. Teachers can use AI-generated schedules or feedback as tools, but ultimately decide how to act on them.

Explainable AI (XAI) : Algorithms used for spaced repetition should be explainable and transparent. Learners and educators should be able to understand: Why a review is being scheduled at a particular time, How confidence intervals and mastery levels are determined,
and how content recommendations are generated. This fosters trust and allows informed user choices.

Modular and Open-Source Frameworks : To avoid vendor lock-in and promote adaptability, future AI systems should support modular architecture and, where possible, be open-source. This allows institutions to Customize algorithms for specific curricula, Ensure data portability across platforms, and engage community stakeholders in auditing and improving the tools.
Ethical and Governance Strategies
Data Privacy and Sovereignty : Clear data governance policies must be put in place that: Limit data collection to what is strictly necessary, Ensure anonymization where possible, Provide users with access to, and control over, their own data, and comply with regulations like GDPR, FERPA, or future equivalents globally. Data ownership should rest with the learner, not the platform.
Ethical Audits and Bias Testing - Regular third-party ethical audits should be mandated to evaluate: Algorithmic bias, Fairness across demographics, and potential unintended consequences. Institutions must be willing to pause or revise use when bias is detected.
Consent and Literacy : Learners (and their guardians, where appropriate) must give informed consent for data use. In parallel, AI literacy programs should be implemented so users understand what the technology does, what risks exist, and how they can engage with it safely and critically.

Pedagogical and Curriculum Strategies
Balanced Curriculum Integration: AI-assisted distributed practice should be one component within a balanced educational ecosystem. Curriculum must ensure : That retrieval practice is not overemphasized at the expense of critical thinking, collaboration, or creative inquiry,That students are exposed to metacognitive strategies, helping them become self-regulated learners who understand why and how to space their learning.
Continuous Feedback Loops : AI systems should integrate formative assessment, giving learners regular feedback not only on what they remember, but also how their learning is improving over time. Educators should receive dashboards to monitor both individual and cohort-level trends, using this to personalize instruction and intervene when necessary.
Learner Agency and Motivation : Future systems must include elements that promote learner motivation and agency, such asGoal setting, Gamified progress tracking, and reflective prompts that help learners engage with their learning process intentionally.
Equity and Access-Oriented Strategies - Offline and Low-Bandwidth Solutions to reduce the digital divide, AI-based learning tools should be able to Operate in offline mode or in low-bandwidth environments, Synchronize periodically rather than requiring constant connectivity, And be compatible with low-cost devices or mobile-first platforms.
Localized and Culturally Responsive AI : Systems should be localized in language, context, and pedagogy. Future AI systems must be trained on Local curriculum data, Inclusive datasets reflecting linguistic and cultural diversity, And adapted learning goals relevant to the learners' communities.
Public Investment in EdTech Infrastructure : Governments and global agencies should invest in equitable infrastructure that provides access to devices, connectivity, and AI-enhanced learning environments. Public education systems must avoid dependency on private vendors that may prioritize profit over equity.

Future-Ready Research and Innovation Strategies
Interdisciplinary R&D Collaboration and Future progress requires sustained collaboration across Cognitive psychology, Education, Computer science, Ethics, and sociology. This ensures AI implementations are evidence-informed, culturally sensitive, and pedagogically robust.
Longitudinal Impact Studies : We need long-term research that goes beyond short-term gains in memory or test scores. Evaluations should track: Holistic learner development, Engagement and well-being, And how AI use affects social dynamics, teacher roles, and lifelong learning attitudes.
Sandboxes for Safe Experimentation : Governments and institutions should establish educational innovation sandboxes—safe, controlled environments where AI tools can be tested with oversight and input from all stakeholders before broad deployment.

Conclusion: A Vision Forward

The integration of AI into distributed practice is not just a technical evolution—it is a cultural and philosophical shift in how we think about learning. To truly harness its potential, we must not treat AI as a magic bullet, but as a *catalyst* that amplifies sound pedagogical practices while remaining grounded in human-centered values. Using AI to implement strategies such as providing varied examples, numerous explanations, low-stakes test, assessment of knowledge gap and distributed practice on learning will help teachers to generate effective study materials and thus enhance student learning. Adoption of AI would help the teaching-learning processes in a more extensive and efficient manner. With a proper insight into AI, generating explanations, examples, practice tests and diagnostic questions becomes easy thus helping teachers to spend less time on preparing study materials and spend more time focusing on students. By combining technical excellence with ethical foresight, educational vision, and inclusive policy, we can shape a future where AI empowers every learner to succeed—regardless of background or ability—not merely to remember more, but to *understand better, think deeper, and grow as whole persons*.

References

Adesope, O. O., Trevisan, D. A., & Sundararajan, N. (2017). Rethinking the use of tests: A metaanalysis of practice testing. Review of Educational Research, 87(3), 659-701.

Angelo, T. A. & Cross, K. P. (1993). Classroom assessment techniques (2nd ed.). San Francisco, CA: Jossey-Bass.

Angelo, T. A., & Cross, K. P. (2012). Classroom assessment techniques.

Jossey Bass Wiley. Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from examples: Instructional principles from the worked examples research. Review of educational research, 70(2), 181- 214.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How people learn (Vol. 11). Washington, DC: National academy press.

Bransford, J., Derry, S., Berliner, D., Hammerness, K., & Beckett, K. L. (2005). Theories of learning and their roles in teaching. Preparing teachers for a changing world: What teachers should learn and be able to do, 40, 87.

Chi, M. T. (2006). Two approaches to the study of experts' characteristics. The Cambridge handbook of expertise and expert performance, 21-30.

Dehaene, S. (2021). How we learn: Why brains learn better than any machine... for now. Penguin. Ebersbach, M., & Nazari, K. B. (2020). Implementing distributed practice in statistics courses: Benefits for retention and transfer. Journal of Applied Research in Memory and Cognition, 9(4), 532-541.