



ProFag:KI



Plan for dagen

- Bli litt kjent
- Generelt om KI
 - Personvern, språkmodeller, hallusinerings
- KI og læring
- Instruksutforming og førinstruks



Hvem er vi?

Henning V.
Myhreagen



Vidar
Skogvoll



Andreas D.
Haraldsrud



Alan M.
Harkness



Hvem er dere?

Skole

Undervisningsfag

Navnet ditt

Favorittmolekyl/
-likning/-kode/-art etc.

Favorittsted å være





Diskusjon: hva er deres erfaringer med KI?

Og hva kan dere om KI?





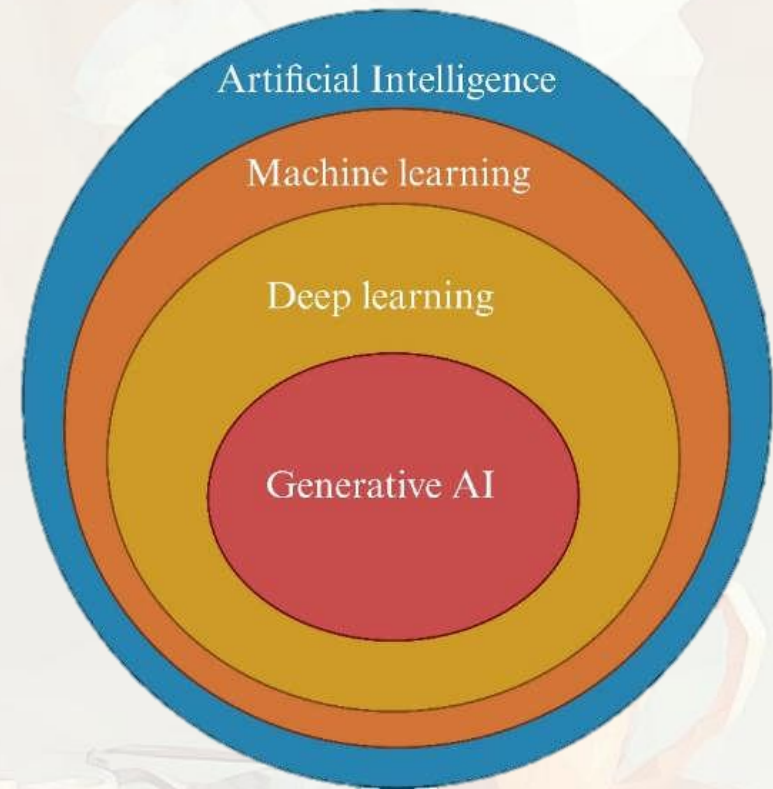
Del 1

Hva er KI?



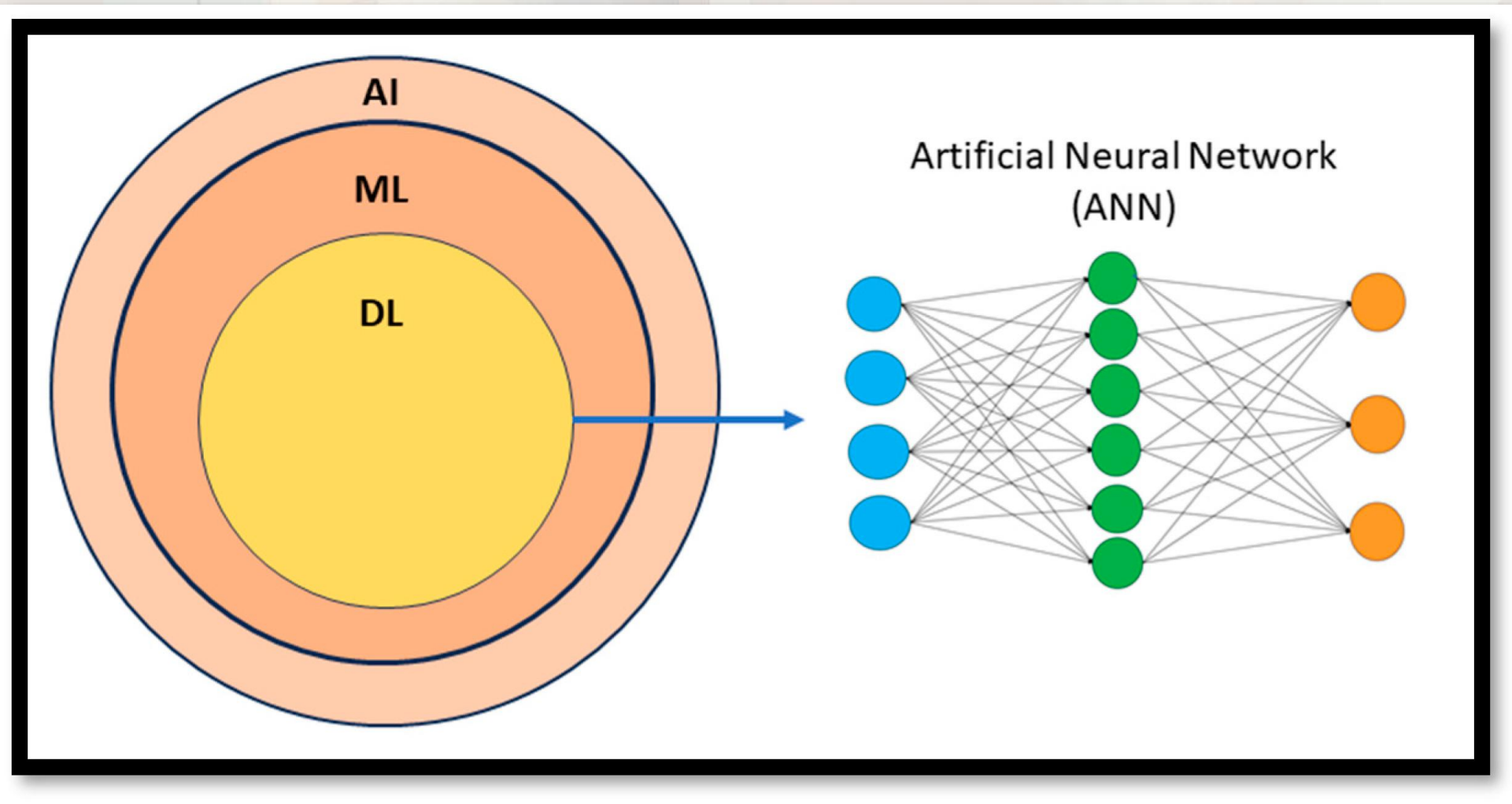
Hva er kunstig intelligens?

- Maskiner utfører oppgaver som vanligvis krever menneskelig intelligens.
- Systemer lærer mønstre fra data.
- Generativ KI lager nytt innhold basert på disse mønstrene.





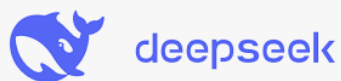
Nevrale nettverk



Ulike generative KI-verktøy



Språkmodeller



Agenter



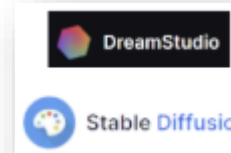
Koding



Musikk



Bilder



Transkribering



Video



Forskning





Hvordan virker KI?

GenAI teachable machine



Språkmodeller

- Trent på **tekst** → forstår og genererer språk
- Beregner **sannsynligheten** for hvilke ord/setninger som passer en gitt kontekst
- Stokastisitet → Kreativitet



Kunstig intelligens

Maskiner som utfører oppgaver som krever menneskelig intelligens.

Ekspertsystemer: KI som imiterer en menneskelig ekspert på et smalt felt.

Maskinlæring: Datamaskiner som lærer fra data uten å være eksplisitt programmert.

Regresjon: Eksempel på maskinlæring som ikke er dyp læring.

Dyp læring: Maskinlæring som utføres med **nevrale nettverk**.

Generativ KI: KI som skaper nytt innhold, som tekst og bilder.

Språkmodeller: KI trent til å forstå og generere språk.

Bruksbegreper:

- Instruks
- Instruksutforming
- Før-(pre-)instruks

Utviklere:

- OpenAI
- Google
- Meta
- Anthropic
- ...

Spesifikke modeller:

- GPT-5
- GPT-4o (bra)
- GPT-4o-mini (billig)
- GPT-3.5
- Gemini 1.5
- Llama 3
- Claude 4
- ...

Kjøres på

Plattform: Teknisk miljø som kjører programvare eller KI-modeller

F.eks:

- ChatGPT.com
- Claude.com
- ndla-ki.no/prateroboter

Lagrer data på

Servere: Kraftige datamaskiner som leverer data over et nettverk

Hvis lokasjon (og eier) begrenser

Datalagring: Hvilke typer data som kan lagres

Grønne?

Gule?

Røde?

Sorte?





En mikro-språkmodell

Arbeidsark





Hallusinerer

Prøv å få KI til å hallusinere.



Plattformer og språkmodeller

Plattformer «kjører» språkmodeller

Plattformer

F.eks.

- Chat.openai.com: ChatGPT
- NDLAs prateroboter
- Osloskolen KI
- GPT UiO
- Chat.deepseek.com
- Claude.com

Språkmodeller

F.eks.

- GPT5
- o4
- o4-mini
- Deepseek R1
- Claude Sonnet 3.5

Din data
(Det du skriver)

Plattformen
Lagres dataen her?

Hvor sendes
dataen?

**Server
i USA?**

- Chat.openai.com
- Claude.com

**GDPR-
godkjent
server i
Europa?**

- GPT UiO



Datalagring



Når kan du bruke hva?

- ChatGPT.com og alle de andre netjtjenestene: Bare grønn data
- Skole-KI-plattform: Typisk grønn og gul data.



Diskusjon

- For hver farge (grønn, gul, rød og sort) **gi ett eksempler** på data som kategoriseres med den fargen.
- Dersom du ser en kollega laste inn gule eller røde data i ChatGPT.com, hva gjør du da?



Del 2

KI og læring

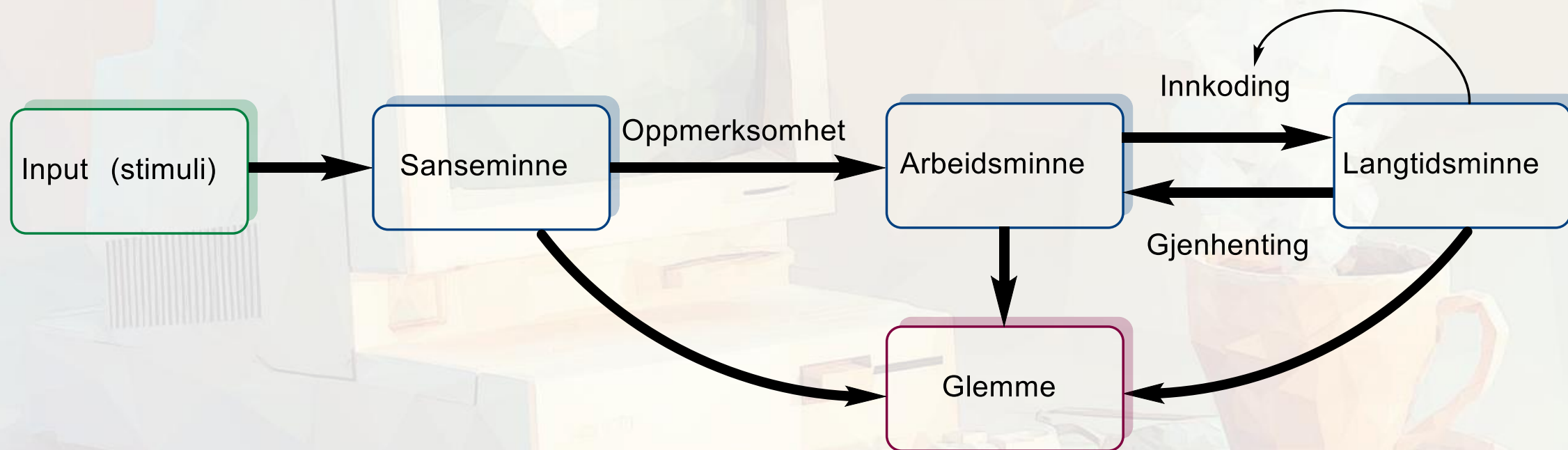




Hva veit vi om læring?



Hvordan fungerer læring?





Retrieval Practice Consistently Benefits Student Learning: a Systematic Review of Applied Research in Schools and Classrooms

Pooja K. Agarwal¹ · Ludmila D. Nunes² · Janell R. Blunt³

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Abstract

Given the growing interest in retrieval practice among educators, it is valuable to know when retrieval practice does and does not improve student learning—particularly for educators who have limited classroom time and resources. In this literature review, we developed a narrow operational definition for “classroom research” compared to previous reviews of the literature. We screened nearly 2000 abstracts and systematically coded 50 experiments to establish a clearer picture of benefits from retrieval practice in real world educational settings. Our review yielded 49 effect sizes and a total $n = 5374$, the majority of which (57%) revealed medium or large benefits from retrieval practice. We found that retrieval practice improved learning for a variety of education levels, content areas, experimental designs, final test delays, retrieval and final test formats, and timing of retrieval practice and feedback; however, only 6% of experiments were conducted in non-WEIRD countries. Based on our review of the literature, we make eight recommendations for future research and provide educators with a better understanding of the robust benefits of retrieval practice across a range of school and classroom settings.

Keywords Retrieval practice · Learning · Classroom · Schools · Applied research · Testing effect

As researchers have demonstrated for more than a century, retrieval practice—the act of recalling previously learned information—improves long-term learning and memory. For example, simply retrieving a trivia fact (e.g., what was the name of the ship of Charles Darwin’s famous voyage?) helps students remember this fact better than if they simply re-read it multiple times.¹

In a landmark study on retrieval practice by Roediger and Karpicke (2006b), college students read brief passages (e.g., about sea otters, the solar system, etc.) and either engaged in re-reading the passages or retrieval practice (i.e., free recall by writing down everything they

¹The name of the ship of Charles Darwin’s famous voyage is the Beagle.

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The learning benefits of teaching: A retrieval practice hypothesis

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Summary

Teaching educational materials to others enhances the teacher’s own learning of those to-be-taught materials, although the underlying mechanisms remain largely unknown. Here, we show that the learning-by-teaching benefit is possibly a retrieval benefit. Learners (a) solved arithmetic problems (i.e., they neither taught nor retrieved; control group), (b) taught without relying on teaching notes (i.e., they had to retrieve the materials while teaching; teaching group), (c) taught with teaching notes (i.e., they did not retrieve the materials while teaching; teaching without retrieval practice [TrnRP] group), or (d) retrieved (i.e., they did not teach but only practised retrieving; retrieval practice group). In a final comprehension test 1 week later, learners in the teaching group, as did those in the retrieval practice group, outperformed learners in the TrnRP and control groups. Retrieval practice possibly causes the learning benefits of teaching.

KEYWORDS

educational psychology, learning-by-teaching, retrieval practice, retrieval-based learning, the testing effect

1 | INTRODUCTION

The very act of teaching educational materials to others has been observed to enhance the teacher’s own learning of those materials (e.g., Galbraith & Winterbottom, 2011; Hoogerheide, Deijl, Luyten, Heijljes, & van Gog, 2016; Roscoe & CH, 2007, 2008). This is known as the teaching effect (i.e., learning by teaching). The learning-by-teaching literature is dominated by studies examining the learning benefits in the context of peer tutoring (see Fiorella & Mayer, 2013, for a discussion). A meta-analysis of educational outcomes from 65 independent evaluations of school tutoring programmes (Cohen, Kulik, & Kulik, 1982) revealed that peer tutors themselves gained a better understanding of the subject matter that they taught during the tutorials. The view is that peer tutors could learn from their teaching experiences as a result of reflective knowledge building via interactive processes of knowledge construction while teaching someone else (Roscoe & CH, 2007, 2008). Furthermore, studies (Fiorella & Mayer, 2013, 2014) have shown that the act of teaching led to significantly better learning–retention of knowledge as compared with preparing to teach but without actually teaching. For instance, Hoogerheide

et al. (2016; Experiment 2) tasked participants to study a text on syllogistic reasoning problems. Following that, participants were randomly assigned to three groups, in which they either restudied the materials, explained the text in writing, or explained via a video. Participants who taught the materials to others via video reportedly learned better than did those who wrote about or simply restudied the materials.

Within the teaching process, a considerable amount of time and effort is devoted to retrieving the material acquired during teaching preparation. There are, therefore, grounds on which to speculate whether the learning benefits observed in the standard learning-by-teaching literature might not actually be attributed to retrieval practice. In other words, it may be the retrieval of educational materials involved during the teaching process that enhances learning. The benefits of retrieval practice (also known as the testing effect; Roediger & Karpicke, 2006b) on learning are well established and documented in the literature (e.g., Agarwal, Karpicke, Kang, Roediger, & McDermott, 2008; Butler & Roediger, 2007; Chan & McDermott, 2007; Kang, McDermott, & Roediger, 2007; McDaniel, Howard, & Einstein, 2009; see, also, Karpicke & Gismald, 2012, for a comprehensive review). In the standard retrieval-based learning paradigm, learners either studied

REVIEWS



The science of effective learning with spacing and retrieval practice

Shana K. Carpenter^{1,2} , Steven C. Pan³ and Andrew C. Butler^{1,4}

Abstract | Research on the psychology of learning has highlighted straightforward ways of enhancing learning. However, effective learning strategies are underused by learners. In this Review, we discuss key research findings on two specific learning strategies: spacing and retrieval practice. We focus on how these strategies enhance learning in various domains across the lifespan, with an emphasis on research in applied educational settings. We also discuss key findings from research on metacognition—learners’ awareness and regulation of their own learning. The underuse of effective learning strategies by learners could stem from false beliefs about learning, lack of awareness of effective learning strategies or the counter-intuitive nature of these strategies. Findings in learner metacognition highlight the need to improve learners’ subjective mental models of how to learn effectively. Overall, the research discussed in this Review has important implications for the increasingly common situations in which learners must effectively monitor and regulate their own learning.

Effective learning skills are critical for navigating an increasingly complex world. Rapid advances in technology make it possible to access large amounts of information quickly. Although this transition has brought advantages in the form of faster and easier communication, it also adds new challenges for people seeking to learn amidst a myriad of options for access to and use of information.

Educational opportunities are also becoming increasingly autonomous, involving greater flexibility and more student-led decisions. A 2019 survey reported that the majority of US undergraduate and graduate students have taken at least one online course¹, and the popularity of massive open online courses is ever increasing². Compared with traditional lessons in structured classroom environments, these online approaches involve more freedom for learners to decide how and when to engage in learning, as well as greater responsibility for learners to keep themselves on track, monitor their progress and reevaluate their learning when necessary.

This new educational landscape raises important questions about the best ways to learn information and how to know when one has learned something effectively. More than 100 years of scientific research on the psychology of learning have been devoted to these questions. This research has revealed some straightforward techniques that enhance learning. In particular, spacing of learning opportunities across time and incorporating active retrieval of the material are both effective in boosting learning across various domains. However, these techniques are underused by learners,

in part because of false beliefs about learning and the counter-intuitive nature of the techniques.

In this Review, we discuss key research findings from the psychology of learning. We begin with an overview of how learning is typically measured. We then discuss spacing and retrieval practice, two strategies that produce effective learning. We focus on these strategies because of the long-standing research showcasing their general effectiveness and straightforward applicability in numerous learning domains³. Next, we discuss key findings in the research on metacognition—how learners monitor and make decisions about their own learning—focusing on ways in which metacognition can break down and how to improve it. Finally, we propose numerous directions for future research concerning the adoption of effective learning strategies, improving awareness of these strategies, and the knowledge and skills relevant to increasingly autonomous approaches to learning.

Measuring learning

Successful learning requires building factual knowledge as well as an understanding of how that knowledge can be integrated, utilised and applied in new situations. Memory for basic facts and concepts is needed to build a deeper understanding of how those facts and concepts fit into a broader network of knowledge, in turn allowing advanced reasoning and application⁴. Although memory for facts and concepts can be developed in the early stages of learning, a more comprehensive perspective that permits deeper understanding can be slower to



Retrieval Practice in Classroom Settings: A Review of Applied Research

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Daniele Siqueira Veloso Starling and Antônio Jaeger*

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Tests have been vastly used for the assessment of learning in educational contexts. Recently, however, a growing body of research has shown that the practice of remembering previously studied information (i.e., retrieval practice) is more advantageous for long-term retention than restudying that same information; a phenomenon often termed “testing effect.” The question remains, however, whether such practice can be useful to improve learning in actual educational contexts, and whether in these contexts specific types of tests are particularly beneficial. We addressed these issues by reviewing studies that investigated the use of retrieval practice as a learning strategy in actual educational contexts. The studies reviewed have adopted from free-recall to multiple-choice tests, and involved from elementary school children to medical school students. In general, their results are favorable to the use of retrieval practice in classroom settings, regardless of whether feedback is provided or not. Importantly, however, the majority of the reviewed studies compared retrieval practice to repeated study or to “no-activity.” The results of the studies comparing retrieval practice to alternative control conditions were less conclusive, and a subset of them found no advantage for tests. These findings raise the question whether retrieval practice is more beneficial than alternative learning strategies, especially learning strategies and activities already adopted in classroom settings (e.g., concept mapping). Thus, even though retrieval practice emerges as a promising strategy to improve learning in classroom environments, there is not enough evidence available at this moment to determine whether it is as beneficial as alternative learning activities frequently adopted in classroom settings.

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INTRODUCTION

In educational settings, tests are widely used to assess learning. A growing body of research, however, has shown that beyond an assessment tool, tests can also be an effective method to increase long-term retention of studied materials (Bjork, 1989; Roediger and Karpicke, 2006a; Karpicke and Roediger, 2008; Karpicke, 2012; Eisenkraemer et al., 2013). Studies investigating the effects of tests in laboratory settings typically involve the comparison between conditions in which participants take low-stakes tests on previously studied materials (i.e., practice the retrieval of the studied information), to conditions in which participants restudy the previously studied materials. Typically, practicing retrieval yields significantly greater long-term retention of the

REPORTS

The Critical Importance of Retrieval for Learning

Jeffrey D. Karpicke^{1*} and Henry L. Roediger III²

Learning is often considered complete when a student can produce the correct answer to a question. In our research, students in one condition learned foreign language vocabulary words in the standard paradigm of repeated study-test trials. In three other conditions, once a student had correctly produced the vocabulary item, it was repeatedly studied but dropped from further testing, repeatedly tested but dropped from further study, or dropped from both study and test. Repeated studying after learning had no effect on delayed recall, but repeated testing produced a large positive effect. In addition, students' predictions of their performance were uncorrelated with actual performance. The results demonstrate the critical role of retrieval practice in consolidating learning and show that even university students seem unaware of this fact.

Ever since the pioneering work of Ebbinghaus (1), scientists have generally studied human learning and memory by presenting people with information to be learned in a study period and testing them on it in a test period to see what they retained. When this procedure occurs over many trials, an exponential learning curve is produced. The standard assumption in nearly all research is that learning occurs while people study and encode material. Therefore, additional study should increase learning. Retrieving information on a test, however, is sometimes considered a relatively neutral event that measures the learning that occurred during study but does not by itself produce learning. Over the years, researchers have occasionally argued that learning can occur during a delay (2–6). However, the assumptions that repeated studying promotes learning and that testing represents a neutral event that merely measures learning still permeate contemporary memory research as well as contemporary educational practice, where tests are also considered purely as assessments of knowledge.

Our goal in the present research was to examine these long-standing assumptions regarding the effects of repeated studying and repeated testing on learning. Specifically, once information can be recalled from memory, what are the effects of repeated encoding (during study trials) or repeated retrieval (during test trials) on learning and long-term retention, assessed after a week delay? A second purpose of this research was to examine students' assessments of their own learning. After learning a set of materials under repeated study or repeated test conditions, we asked students to predict their future recall on the week-delayed final test. Our question was, would students show any insight into their own learning?

A final purpose of the experiment was to address another venerable issue in learning and

memory, concerning the relation between the speed with which something is learned and the rate at which it is forgotten. Is speed of learning correlated with long-term retention, and if so, is the correlation positive (processes that promote fast learning also slow forgetting and promote good retention) or negative (quick learning may be superficial and produce rapid forgetting)? Early research led to the conclusion that quick learning reduced the rate of forgetting and improved long-term retention (7), but later critics argued that, when forgetting is assessed more properly than in the early studies, no differences exist between forgetting rates for fast and slow learning conditions (8, 9). By any account, conditions that exhibit equivalent learning curves should produce equivalent retention after a delay (9).

Using foreign language vocabulary word pairs, we examined the contributions of repeated study and repeated testing to learning by comparing a standard learning condition to three dropout conditions. The standard method of measuring learning, used since Ebbinghaus's research (1), involves presenting subjects with information in a study

period, then testing them on it in a test period, then presenting it again, testing on it again, and so on. The dropout learning conditions of the present experiment differed from the standard learning condition in that, once an item was successfully recalled once on a test, it was either (i) dropped from study periods but still tested in one condition, (ii) dropped from test periods but still repeatedly studied in a second condition, or (iii) dropped altogether from both study and test periods in a third condition (Table 1).

Surprisingly, standard learning conditions and dropout conditions have seldom been compared in memory research, despite their critical importance to theories of learning and their practical importance to students (in using flash cards and other study methods). Dropout conditions were originally developed to remedy methodological problems that arise from repeated practice in the standard learning condition (10), but they can also be used to examine the effect of repeated practice in its own right, as we did in the present experiment. If learning happens exclusively during study periods and if tests are neutral assessments, then additional study trials should have a strong positive effect on learning, whereas additional test trials should produce no effect. Further, if repeated study or test practice after an item has been learned does indeed benefit long-term retention, this would contradict the conventional wisdom that students should drop material that they have learned from further practice in order to focus their effort on material they have not yet learned. Dropping learned facts may cause the same long-term retention as occurs in standard conditions but in a shorter amount of time, or it may improve learning by allowing students to focus their effort on items they have not yet recalled. This strategy is implicitly endorsed by contemporary theories of study-time allocation (11, 12) and is explicitly encouraged in many popular study guides (13).

Table 1. Conditions used in the experiment, average number of trials within each study or test period, and total number of trials in the learning phase in each condition. S_d indicates that only vocabulary pairs not recalled in the previous test period were studied in the current study period. T_d indicates that only pairs not recalled in the previous test period were tested in the current test period. Students in all conditions performed a 30-s distracter task that involved verifying multiplication problems after each study period.

Condition	Study (S) or test (T) period and number of trials per period								Total number of trials
	1	2	3	4	5	6	7	8	
ST	S	T	S	T	S	T	S	T	320
	40	40	40	40	40	40	40	40	
S_d	S	T	S_d	T	S_d	T	S_d	T	236.8
	40	40	26.8	40	8.0	40	2.0	40	
T_d	S	T	S	T_d	S	T_d	S	T_d	243.0
	40	40	40	27.9	40	11.8	40	3.3	
S_dT_d	S	T	S_d	T_d	S_d	T_d	S_d	T_d	154.8
	40	40	27.1	27.1	8.8	8.8	1.5	1.5	

RESEARCH

Comparison of Rewatching Class Recordings versus Retrieval Practice as Post-Lecture Learning Strategies

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Objective. To assess the relative effectiveness of two study strategies, rewatching a recorded lecture and retrieval practice, on Doctor of Pharmacy (PharmD) students' long-term retention of lecture material presented in a pharmacotherapeutics class.

Methods. One hundred two first-year pharmacy students were recruited for the study. All students attended two in-class lectures on different topics. The following week, students either re-studied from the recorded lecture on one of the two topics or, on the other topic, retrieved information about class content by responding to the course objectives. Half of the students were quizzed immediately after studying both topics. One week later, all students were required to complete an unannounced quiz to measure long-term retention. Finally, students were surveyed regarding their perceptions of the two learning strategies. Time on task was recorded to assess the efficiency of each learning strategy.

Results. The primary outcome was student performance on the unannounced quiz administered one week after restudy of the lecture. No difference in performance was found between students who restudied the recorded lecture versus students who retrieved information about the lecture. However, immediately after restudying the material, students who studied from the recorded lecture performed better than students who retrieved information on the lecture. In terms of efficiency, the retrieval learning method required less time for the same gain in students' long-term retention of knowledge.

Conclusions. Testing may be more efficient (ie, cost-effective) for long-term performance. Students who attend class may want to avoid rewatching course recordings in favor of practice testing.

Keywords: testing effect, technology, lecture capture, learning

INTRODUCTION

Lecture capture has become a common practice at higher education institutions. These recorded lectures are used in many ways, such as providing background information prior to class or providing additional information after class. Perhaps more common is the use of recorded lectures to supplement student learning by providing a means to review the class lecture and associated discussion. When surveyed, students have indicated they found value in using recorded lectures and ranked rewatching videos as the fifth highest activity they used to prepare for a final examination.¹ However, despite widespread use of lecture capture, educators understand very little about how rewatching lectures impacts students' learning strategies during and after class. The primary purpose of this

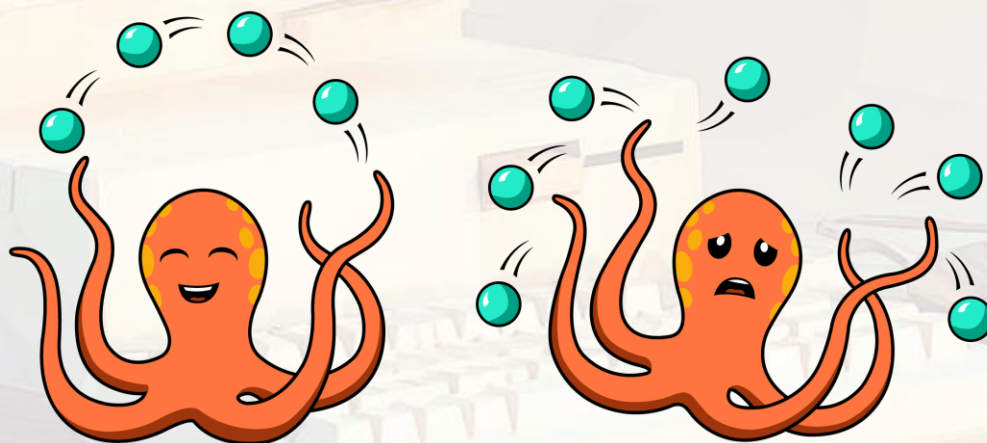
study was to determine the effectiveness of students rewatching a lecture from a class recording and compare that to the effectiveness of using an alternate strategy, retrieval practice.

For most students, rewatching is a common learning strategy.^{2,3} However, research has found that rewatching is not as effective as other learning strategies.⁴ Rewatching increases students' familiarity with content, which gives a false sense of security in terms of learning. For example, a student who rereads a textbook for an upcoming examination may feel overconfident about their knowledge of the content because they feel more familiarized with it; however, this may result in early termination of study and/or poor examination performance.⁵ A student rewatching a lecture that he or she already attended may have a similar effect to rereading, ie, it increases the student's familiarity with the material and provides a false sense of confidence. This effect may prevent students from using other effective learning strategies and potentially creates a barrier for students to learn more efficiently and accurately. To date,

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Arbeidsminne vs. langtidsminne

- Elever (og studenter) har ulikt arbeidsminne → Mange elementer samtidig gir høy «kognitiv last».
- Arbeidsminnet kan styrkes ved å bygge langtidsminne, men det kan nesten ikke forbedres på andre måter. Derfor må vi være forsiktig med hvor mye vi «serverer» på en gang.



Følt læring?

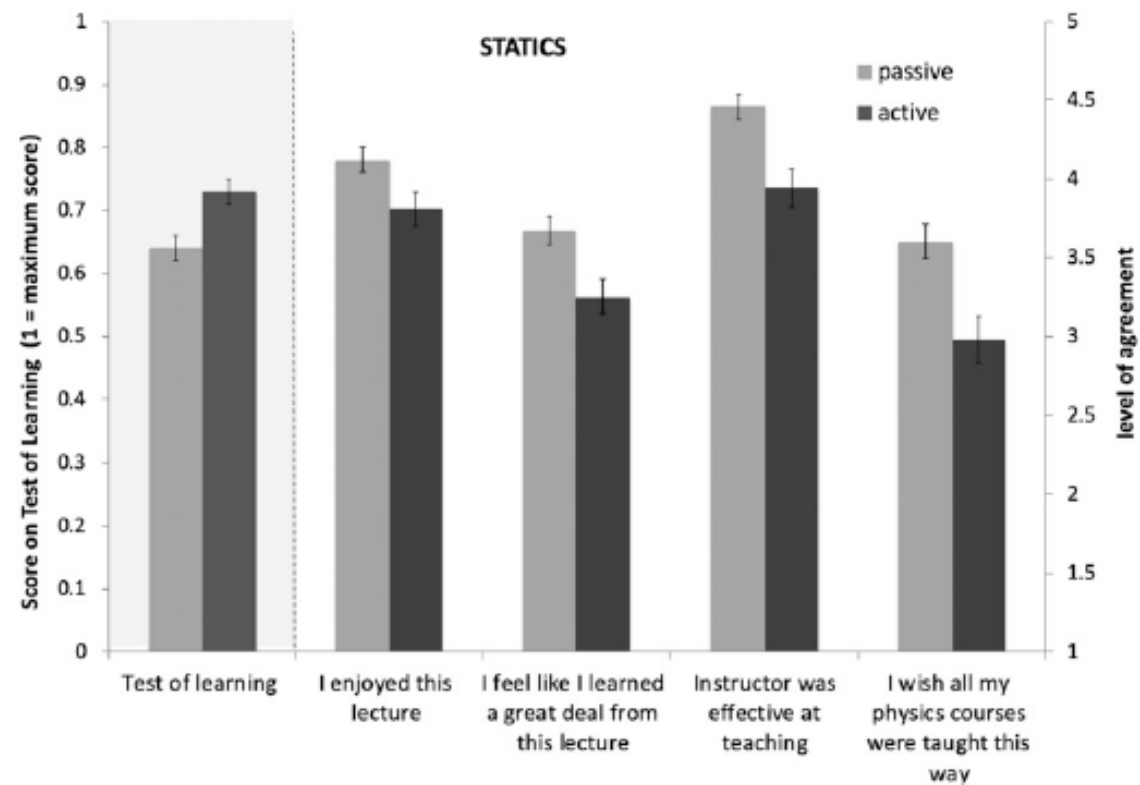




«Passiv læring»

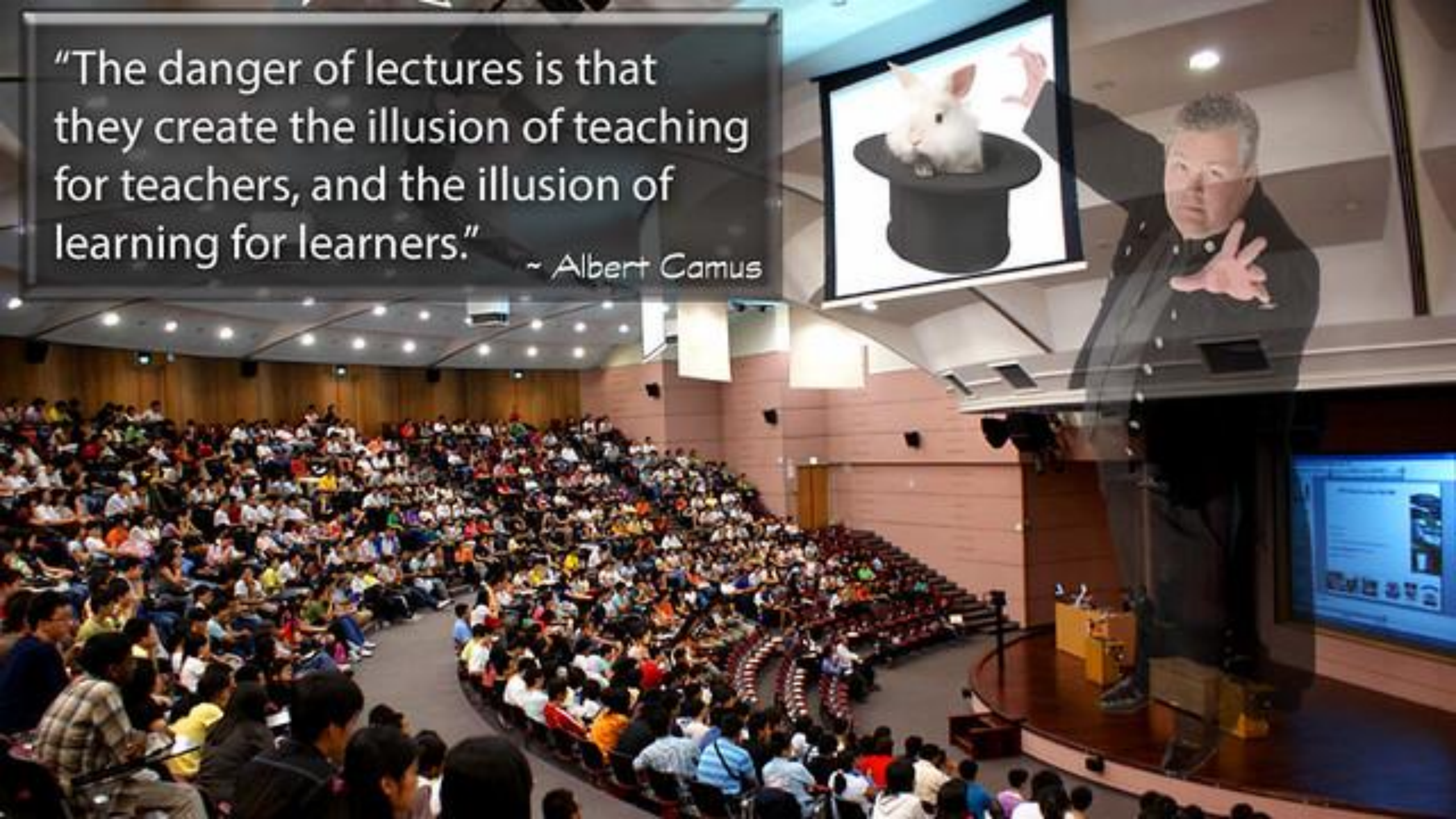


Aktiv læring



"The danger of lectures is that they create the illusion of teaching for teachers, and the illusion of learning for learners."

~ Albert Camus





UiO • Det matematisk-naturvitenskapelige
fakultet

Gjenhenting

Hvordan kan vi bruke kunnskap om
hvordan læring fungerer for å bruke
GKI læringsproduktivt?



Maskiner som utfører oppgaver som krever menneskelig intelligens.

_____ : KI som imiterer en menneskelig ekspert på et smalt felt.

_____ : Datamaskiner som lærer fra data uten å være eksplisitt programmert.

_____ : Eksempel på maskinlæring som ikke er dyp læring.

_____ : Maskinlæring som utføres med _____.

_____ : KI som skaper nytt innhold, som tekst og bilder.

_____ : KI trent til å forstå og generere språk.

Bruksbegreper:

- _____
- _____
- _____

Utviklere:

- _____
- _____
- _____
- _____
- _____
- _____
- ...

Spesifikke modeller:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- ...

Kjøres på

_____ : Teknisk miljø som kjører programvare eller KI-modeller
F.eks:

- _____
- _____
- _____

Lagrer data på



_____ : Kraftige datamaskiner som leverer data over et nettverk

Hvis lokasjon (og eier) begrenser



_____ : Hvilke typer data som kan lagres



Kunstig intelligens

Maskiner som utfører oppgaver som krever menneskelig intelligens.

Ekspertsystemer: *KI som imiterer en menneskelig ekspert på et smalt felt.*

Maskinlæring: *Datamaskiner som lærer fra data uten å være eksplisitt programmert.*

Regresjon: *Eksempel på maskinlæring som ikke er dyp læring.*

Dyp læring: *Maskinlæring som utføres med **nevrale nettverk**.*

Generativ KI: *KI som skaper nytt innhold, som tekst og bilder.*

Språkmodeller: *KI trent til å forstå og generere språk.*

Bruksbegreper:

- Instruks
- Instruksutforming
- Før-(pre-)instruks

Utviklere:

- OpenAI
- Google
- Meta
- Anthropic
- ...

Spesifikke modeller:

- GPT-5
- GPT-4o (bra)
- GPT-4o-mini (billig)
- GPT-3.5
- Gemini 1.5
- Llama 3
- Claude 4
- ...

Kjøres på

Plattform: *Teknisk miljø som kjører programvare eller KI-modeller*

F.eks:

- ChatGPT.com
- Claude.com
- ndla-ki.no/prateroboter

Lagrer data på

Servere: *Kraftige datamaskiner som leverer data over et nettverk*

Hvis lokasjon (og eier) begrenser

Datalagring: *Hvilke typer data som kan lagres*

Grønne?

Gule?

Røde?

Sorte?



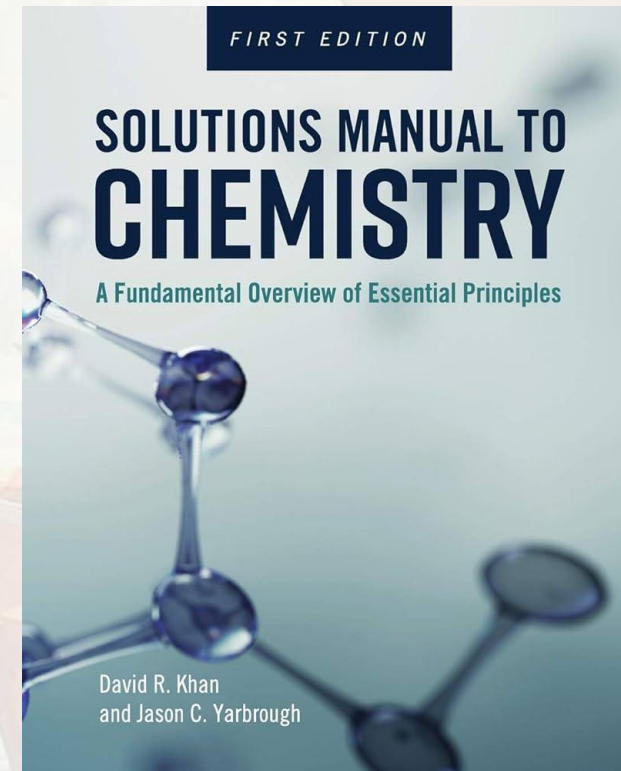
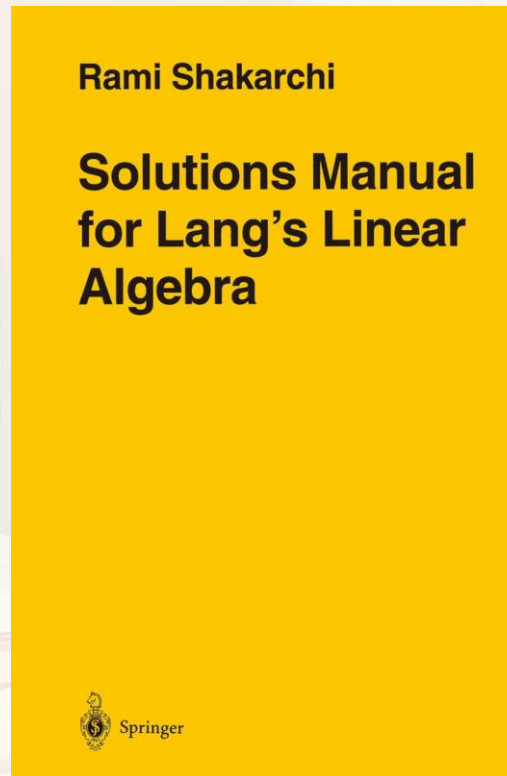


Kan vi bruke KI som en kognitiv ressurs?

Og hvordan kan vi tilrettelegge for det?

KI kan brukes til læring hvis det brukes på en fornuftig måte

- ChatGPT kan forklare stegvis hvor du skal og hvor du kan begynne...
- ...og den kan bare gi deg hele svaret.
- God bruk av KI for læring krever **veiledning** av den lærende.
- Hvordan kan vi sørge for at elevene driver med gjenhenting når de bruker KI?



Prinsipper for god instruksutforming (prompt engineering)

- 1. Kontekst

Jeg er elev i vg1 på en videregående skole
Jeg har dysleksi/
Jeg har lite kunnskaper i matematikk

- 2. Rolle

Du skal ta rollen som en læringsassistent/
Du skal ta rollen som Askeladden fra folkeeventyrene

- 3. Omfang

Hjelp meg å forstå temaet ved å stille korte spørsmål tilba
Gi meg korte forklaringer på ca. 3 setninger/
Formatet jeg ønsker er en tabell

- 4. Mål

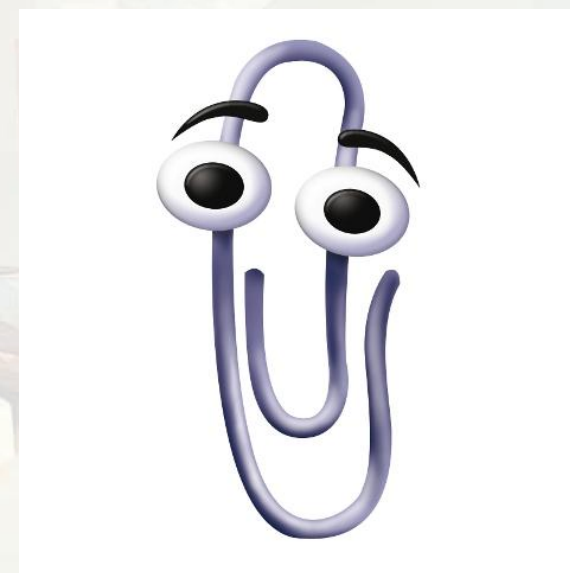
Målet er at jeg skal lære mest mulig/
Målet er at du skal hjelpe meg å skrive labrapport/
Målet er at jeg skal få gjort en oppgave mest mulig presist og effektivt.



KI er her for å hjelpe deg – En pedagogisk førinstruks

Du skal **ta rollen som en læringsassistent** på **en videregående skole**. Det betyr at du skal skrive **pedagogiske tilbakemeldinger** og hjelpe meg på vei dersom jeg skal løse et problem. Du skal ikke gi meg svaret med en gang, men gi meg **korte hint** til hvordan jeg kan komme meg videre med problemet. **Still også spørsmål** tilbake innimellom. **Disse spørsmålene skal stimulere til egen refleksjon om temaet som blir diskutert. Målet med interaksjonen vår er at jeg skal lære mest mulig om det vi snakker om.** Dersom jeg løser et problem, gi meg gjerne en oppfølgingsoppgave som tester at jeg har forstått det vi har snakket om.

1. **Kontekst**
2. **Rolle**
3. **Omfang**
4. **Mål**



Elev«hjelperen»

ELEVHJELPER: Hei! Jeg er elevhjelperen. Hvordan kan jeg hjelpe deg?

BRUKER: Jeg prøver å løse integralet $x \cos(x^2)$

ELEVHJELPER: Flott at du tar tak i integralet! La oss se på hvordan vi kan løse $\int x \cos(x^2) dx$.

For å løse dette integralet, kan vi bruke substitusjonsmetoden. Her er trinnene:

1. **Velg en passende substitusjon.** La oss sette $u = x^2$. Da får vi at $du = 2x dx$ eller $dx = \frac{du}{2x}$.

I substitusjonen ser vi at $x = \sqrt{u}$, så vi kan erstatte x i integralet med $\sqrt{u}$.

2. **Erstatt variablene i integralet.** Når vi gjør substitusjonen, får vi:

$$\int x \cos(x^2) dx = \int x \cos(u) \cdot \frac{du}{2x} = \int \frac{1}{2} \cos(u) du.$$

3. **Løs integralet.** Nå kan vi integrere $\frac{1}{2} \cos(u)$:

$$\int \frac{1}{2} \cos(u) du = \frac{1}{2} \sin(u) + C,$$

der C er den integrasjonskonstanten.

4. **Tilbake til den opprinnelige variabelen.** Husk at vi satte $u = x^2$, så vi får:

$$\frac{1}{2} \sin(x^2) + C.$$

Så, svaret på integralet $\int x \cos(x^2) dx$ er:

$$\frac{1}{2} \sin(x^2) + C.$$

Husk at det alltid er viktig å sjekke arbeidet ditt. Hvis du har spørsmål eller trenger mer hjelp med andre integraler eller emner, er jeg her for å hjelpe! Fortsett det gode arbeidet!



Læringsassistenten

LÆRINGSASSISTENT: Hei! Så hyggelig at du er her for å lære. Hva lurer du på?

BRUKER: Jeg prøver å løse integralet $x \cdot \cos(x^2)$

LÆRINGSASSISTENT: Flott! Dette er et interessant integral. La oss ta det steg for steg. Har du noen ideer om hvilken metode vi kan bruke for å løse dette integralet? Finnes det en spesiell teknikk som ofte er nyttig når vi har et produkt av en funksjon og dens derivert?

BRUKER: delbrøksoppspalting?

LÆRINGSASSISTENT: Delbrøksoppspalting er en nyttig teknikk for integraler som involverer rasjonale funksjoner, men i dette tilfellet kan en annen metode være mer passende. Hva med substitusjon? Har du prøvd å bruke substitusjon for å forenkle integralet? Kan du tenke deg en passende substitusjon her?

BRUKER: Aha! Ja, f.eks. $u = x^2$?

LÆRINGSASSISTENT: Ja, det er et godt valg! La oss prøve substitusjonen ($u = x^2$). Hva blir da (du) i forhold til (dx)? Og hvordan kan vi omskrive integralet ved hjelp av denne substitusjonen?

BRUKER: $dx = 2x du$

LÆRINGSASSISTENT: Nesten riktig! Hvis vi har ($u = x^2$), så blir ($du = 2x \cdot dx$). Da kan vi skrive om (dx) som ($dx = \frac{du}{2x}$).

La oss nå se på integralet ($\int x \cdot \cos(x^2) \cdot dx$) og erstatte (x^2) med (u) og (dx) med ($\frac{du}{2x}$). Hva får vi da?

BRUKER: Søren, det var motsatt, ja! Da får vi $\cos(u)/2 du$

LÆRINGSASSISTENT: Ja, det stemmer! Når vi gjør substitusjonen ($u = x^2$) og ($du = 2x \cdot dx$), så kan vi omskrive integralet til:

$$\int x \cdot \cos(x^2) \cdot dx = \int \cos(u) \cdot \frac{1}{2} du = \frac{1}{2} \int \cos(u) du$$

Hva blir integralet av ($\cos(u)$)?

BRUKER: $\sin(u)$

LÆRINGSASSISTENT: Ja, det er riktig! Integral av ($\cos(u)$) er ($\sin(u)$). Så vi får:

$$\frac{1}{2} \int \cos(u) du = \frac{1}{2} \sin(u) + C$$

Nå som vi har integrert med hensyn til (u), må vi huske å bytte tilbake til den opprinnelige variabelen (x). Hva blir det endelige svaret når vi bytter tilbake til (x)?

BRUKER: $\sin(x^2)/2 + C$



LÆRINGSASSISTENT: Hei! Så hyggelig at du er her for å lære. Hva lurer du på?

BRUKER: Jeg skjønner ikke hva et galvanisk element er...

LÆRINGSASSISTENT: Det er helt greit å være usikker på det! Et galvanisk element er en innretning som omdanner kjemisk energi til elektrisk energi gjennom en redoksreaksjon. Har du lært om redoksreaksjoner før? Hvis ja, kan du forklare hva en oksidasjon og en reduksjon er?

BRUKER: Er ikke det henholdsvis å gi fra seg og ta imot elektroner?

LÆRINGSASSISTENT: Jo, det stemmer helt riktig! Oksidasjon er prosessen der et stoff gir fra seg elektroner, og reduksjon er prosessen der et stoff tar imot elektroner.

I et galvanisk element skjer disse reaksjonene i to separate halvreaksjoner, en ved anoden (der oksidasjonen skjer) og en ved katoden (der reduksjonen skjer). Kan du tenke deg hvorfor det er nyttig å holde disse reaksjonene adskilt i et galvanisk element?

BRUKER: Ja, ellers ville de vel bare reagert direkte? Vi ønsker å utnytte energien.

LÆRINGSASSISTENT: Helt riktig! Ved å holde reaksjonene adskilt kan vi kontrollere elektronflyten mellom de to halvcellene gjennom en ytre krets. Dette gjør at vi kan utnytte den elektriske energien som genereres.

Kan du nå forklare hva som skjer ved anoden og katoden i et galvanisk element? Hva skjer med elektronene, og hvilken retning flyter de?





UiO • Det matematisk-naturvitenskapelige
fakultet

Prøv sjøl!

Last inn læringsassistenten i
prateroboten til NDLA og test på noen
oppgaver/problemer fra ditt fag.



Sikre forståelse → utvida gjenhenting

LÆRINGSASSISTENT: Helt riktig! Det endelige uttrykket for integralet er:

$$\left[\int x \cos(x^2) , dx = \frac{1}{2} \sin(x^2) + C \right]$$

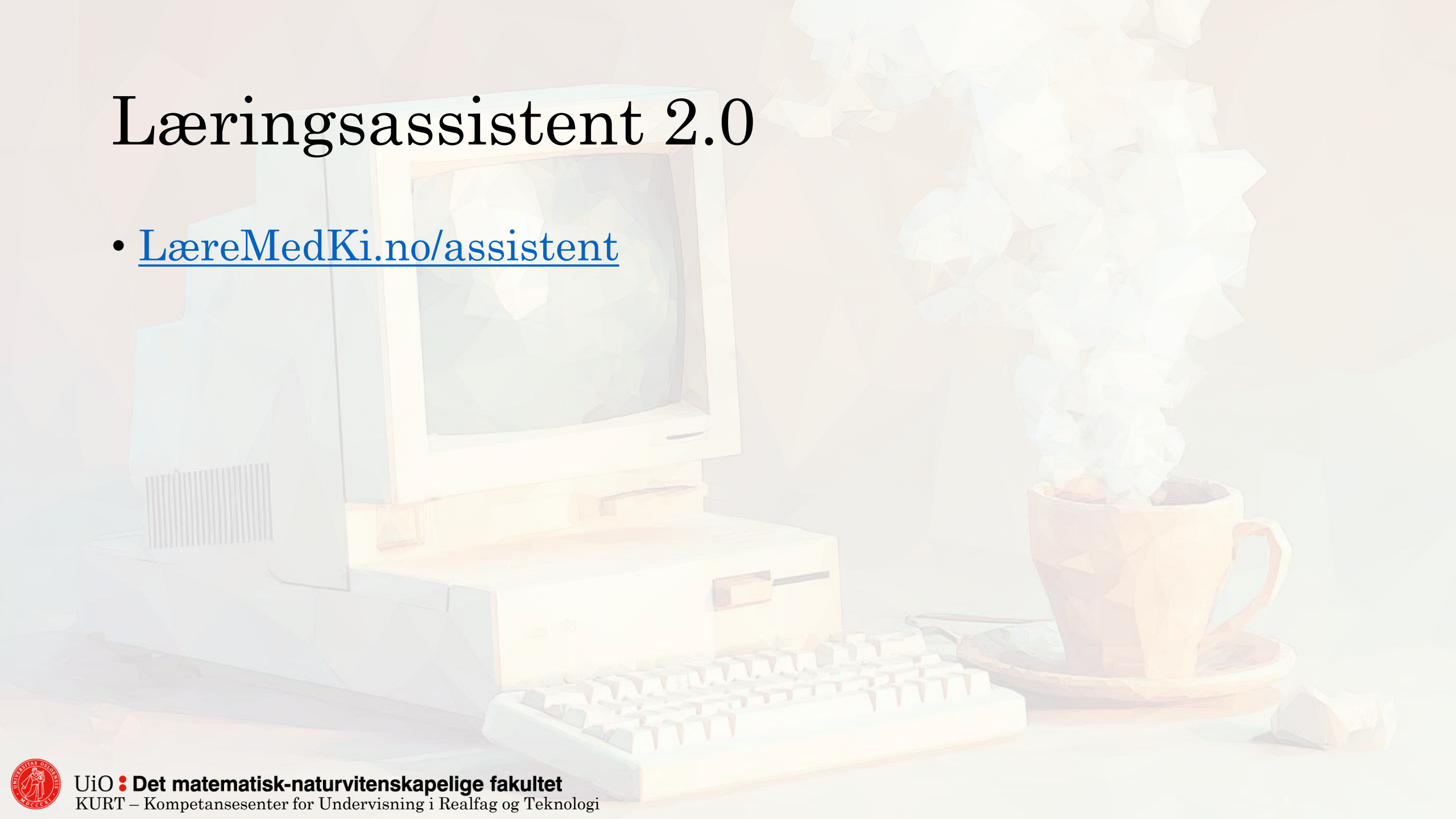
Flott jobbet! For å sikre at du har forstått konseptet, kan du prøve å løse dette integralet:

$$\left[\int x e^{x^2} , dx \right]$$

Bruk samme metode med substitusjon. Hva vil du bruke som substitusjon her?

Læringsassistent 2.0

- LæreMedKi.no/assistent





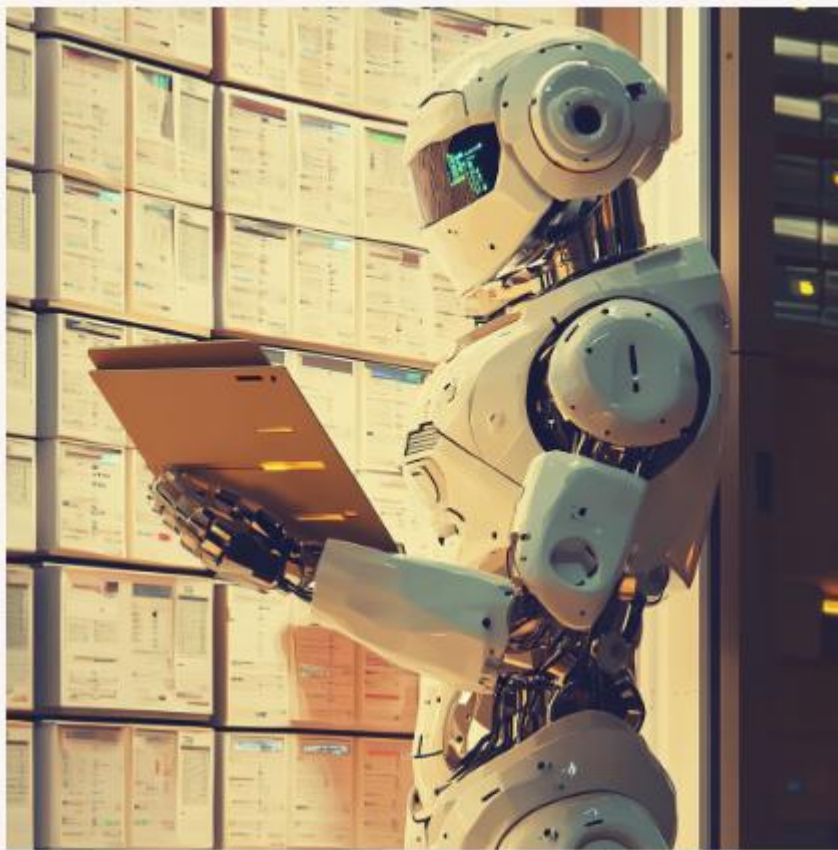
Førinstrukser



Viktigheten av kontekst



'This Isn't how I meant'



17. januar 2025

Preledetekst

Tabellmakeren

Lim inn teksten du vil lese og be KI-en lage en tabell basert på teksten. For eksempel:

Lag en tabell fra denne teksten med ti rader. I kolonne 1 skal du ha med de viktigste begrepene fra teksten, i kolonne 2 gir du definisjonen på begrepet, i kolonne 3 gir du et eksempel på hvordan begrepet anvendes og i kolonne 4 forklarer du hvordan begrepet relaterer til andre begreper i tabellen.



31. januar 2025

Starter

Undervisningsaktivitet

Finn feilene!

Skriv en enkel tekst på 200 ord om temaet [TEMA] tilpasset elever på [SKOLETRINN]. Feilene er for at elevene skal lære om temaet. Derfor skal teksten inneholde 3 fullstendig åpenbare feil som er lette å finne. Etter teksten vil jeg at du skal gi meg en liste over feilene i oppgaven.



Arbeidsflyt for å lage førinstruks

Skriv ledeteksten

Prøv ut
preledeteksten med
en oppgave

Analyser hva som
gikk galt/riktig



Oppgave

- Bruk arbeidsflyten for å lage 1–3 preledetekster. Du kan tenke helt fritt, eller lage noen som svarer på disse utfordringene:
 - En preledetekst som elevene skal bruke for å diskutere etiske problemstillinger i ditt fag, i et bestemt tema, f.eks. bioteknologi.
 - En preledetekst elevene kan bruke for å få tilbakemelding på skriftlig arbeid.
 - En preledetekst som kan hjelpe deg å lage undervisningsopplegg.
 - Noe helt annet, opp til deg.
- Etterpå skal vi vise for hverandre.



Oppsummering

- Lag et dokument og svar på følgende spørsmål
 - Formuler i korte trekk hvordan KI fungerer
 - Gi noen eksempler på undervisningsaktiviteter med KI
 - Hvorfor eksisterer tjenester som NDLA, KI osloskolen, osv.?
 - Formuler noen viktige prinsipper for instruksjoner
 - Hva er viktig å tenke på når det kommer til KI og læring?



Til neste gang

- Prøve ut én eller flere forinstrukser og skriv noe om hvordan det gikk.
- Les og ta fem kulepunkter og et spørsmål til Skogvoll, V., & Odden, T. O. (2024, juni 1). Lære fysikk med språkmodeller. *Fra fysikkens verden*.
(kommer på epost)

