

### Data, Learning Analytics, and AI for Language Learning

### Barbara Wasson, Professor & Director

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http://slate.uib.no

DIGI-LINGO FinalConference





Drawing on interdisciplinary collaboration, SLATE investigates the technological, pedagogical, interpretive, cultural, ethical, and legal aspects of learning analytics (LA) and artificial intelligence in education (AIEd), and promotes the responsible use of technology in education.

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FRIDE HARAM KLYKKE





KRISTIN BØRTE



















FARHAD VADIE

































GLEB BELOKRY





JELENA JOVANOV















**1** Associate Professor

1 Professor + 1 Emeritus (hiring 1 professor)

5 PhD fellows (5 defended the last year)

- 2 Senior Developers
- Communications (50%)
- 4 Professor II

8 Researchers

**3** Postdocs

**Affiliated Faculty** 



Associate Professor (Law)



### LA & AI PROJECTS (SELECTED)

### **ACTIVITY DATA FOR ASSESSMENT AND ADAPTATION (AVT)**

KS funded, with UDE Oslo Kommune – in Oslo schools

### **TEACHER'S TRUST IN AI-BASED EDUCATIONAL TECHNOLOGY**

survey of high school teachers in 9 countries: Sweden, Norway, Denmark, UK, Japan, Israel, USA, Brazil, Spain

### **AI IN EDUCATION: LAYERS OF TRUST (EDUTRUST AI)**

### **GENERATIVE AI IN LEARNING (GAILE)**

Generative AI in higher education - biology, mathematics, programming, ...

# SYNTHETIC DATA FOR LEARNING ANALYTICS (LASD)

**GENAI SUPPORT FOR LESSON PLANNING (ILUKS 2)** 

AI AND CREATIVITY IN SCHOOLS AND HIGHER EDUCATION



UNESCO's approach to AI focuses on the imitation of human intelligence: "machines capable of <u>imitating</u> certain functionalities of human intelligence, including such features as perception, learning, reasoning, problem-solving, language interaction, and even producing creative work"

(UNESCO, 2019)

Al refers to machine-based systems that can, given a set of human-defined objectives, make predictions, recommendations, or decisions that influence real or virtual environments. Al systems interact with us and act on our environment, either directly or indirectly. Often, they appear to operate autonomously, and can adapt their behaviour by learning about the context.

(UNICEF, 2021)

# Rules Data

### CLASSICAL PROGRAMMING (programmed algorithms)









#### MACHINE LEARNING

(data mining: statistics, learning algorithms: neural nets)



# **MACHINE LEARNING : MACHINE VISION**



### **MUFFIN OR CHIHUAHUA?**

https://www.freecodecamp.org/news/chihuahua-or-muffin-my-search-for-the-best-computer-vision-api-cbda4d6b425d/



# Rules

### CLASSICAL PROGRAMMING (programmed algorithms)

Answers

Data Answers

MACHINE LEARNING

(data mining: statistics, learning algorithms: neural nets) Rules (Model)

# LANGUAGE MODELS

Until about 2000 : manually formed rules and a lexicon 2000 – 2015: Machine learning (identify patterns & generalise)

2015 – 2023: Neural networks (deep learning)  $\rightarrow$  transformer algorithm

## **GENERATIVE LANGUAGE MODELS** LaMDA, PaLM, GPT, etc.



#### **GPT3**

**Datasets:** Crawling webpages (61.75%), Social media (8.86%); Libraries(15.9%), Wikipedia (3.49%) +++

**Languages of sources:** EN (92.647%), FR(1.819%), DE+ES +IT+PT+ NL (2.60%), ...CN (0.099%)

UNESCO

### **GENERATIVE LANGUAGE MODELS** LaMDA, PaLM, GPT, etc.



GPT3: 60-80 billion neurons

GPT4: trillion (500x larger)

 $\rightarrow$  Language prediction models

### **GENERATIVE LANGUAGE MODELS** LaMDA, PaLM, GPT, etc.



#### ChatGPT 3.5 ~



You

How can you tell the difference between a chocolate chip muffin and a Chihuahua?

#### GhatGPT

Well, one might argue that the smell could give it away. A chocolate chip muffin would likely smell sweet and chocolaty, while a Chihuahua, well, probably doesn't smell like chocolate at all! Also, if it's moving around and barking, it's more likely to be the Chihuahua. But hey, mistakes happen, so it's always good to double-check!

### $\rightarrow$ it can only generate text that is its training data

GPT-3/4 is a **language model**, that is it "is a computer based neural network that's being **trained on billions of web pages**, **blogs**, **books** and, in essence, on most of the **openly available textual content of the web**". That makes it work as "a very highly trained style and text completer".

The difference from the text completers on your phone is that instead of "suggesting just the next few words, **it can look back over the previous thousands of words, with the GPT4 version able to generate up to 25,000 words, so it can generate up to 50 pages of text**". The chatbot can "write in any style, in multiple languages, now including minority languages such as Welsh and Catalan".

**Professor Emeritus Mike Sharples** 

European Schoolnet (09/05/2023). ChatGPT and the role of AI in assessment, Data4Learning Webinar Series, Brussels, Belgium.



**APPLICATION** using an LLM

## Generative AI doesn't understand ...

- semantics
- the real world
- truth
- what it generates

# Generative AI is NOT a SEARCH ENGINE

Hallucinations



https://medium.com/data-science-at-microsoft/how-large-language-models-work-91c362f5b78f

# CHALLENGES & CONTROVERSIES (UNESO + others)



# *C*HATGPT is multilingual, but monocultural

Professor Jill Walker Retteberg

# AI AND EDUCATION

(since the 1970s)

#### ARTIFICIAL INTELLIGENCE AND EDUCATION

A critical view through the lens of human rights, democracy and the rule of law



A thorough and critical overview of the use of artificial intelligence in education

#### HUMAN RIGHTS DEMOCRACY RULE OF LAW

Wayne Holmes, Jen Persson, Irene-Angelica Chounta, Barbara Wasson & Vania Dimitrova (2022)

https://rm.coe.int/artificial-intelligence-and-education-a-critical-view-through-the-lens/1680a886bd



#### Learning with Al

#### Many technologies

Speech to Text Text to Speech Text to Animations Machine Vision Face Recognition Searching Planning Scheduling Generative AI (text, images, animations ...) etc.

#### Learning with AI

#### Administrative systems

Admission Systems Plagiarism detection Summative assessment Dropout prediction Course recommendation

Support for well-being

#### **For teachers**

Automatic feedback generation Forum monitoring Essay scoring Quiz generation Lesson planning Rubric generation Smart curation of learning materials

#### **For learners**

Intelligent tutoring systems (adaptive...) Dialogue-based tutoring Exploratory Learning Environments

Essay generation Essay critiquing

Chatbots Learning Companions

Language learning apps Collaborative Learning support

# **INTELLIGENT TUTORING SYSTEMS**

### (knowledge models, rule-based systems, belief models)

Individualise learning provided through the ability to:

- solve the problems
- diagnose what student knows and does not know



make tutor decisions (next problem, give a hint ...)
provide adaptive feedback during problem-solving

(ADAPTIVE tempo, content, difficulty, feedback)

# **COGNITIVE TUTORS**

(e.g., Anderson et al, 1985, 1995; Koedinger et al. 1997, 2016; Aleven et al. 2009)

- Pane et al. (2014) studied the effect of use of the ITS in high schools (16 800 students) in 7 states
- Increase of 8 percentiles for
   high school students in the
   second year of use (e.g., 56% →
   64%)



# INQ-ITS: PERSONALISED ONLINE LABS

(e.g., Gobert et al, 2013 ...; Dickler, R., Li, H., & Gobert, J. (2019)

complex, patented algorithms based on **machine learning** & **NLP** 





# **INQ-ITS: PERSONALISED ONLINE LABS**

(e.g., Gobert et al, 2013 ...; Dickler, R., Li, H., & Gobert, J. (2019)



inqits.com

Inq-ITS assessment algorithm is validated with through of students and matches human assessment with approximately 95% accuracy Using AI to learn about learning

> "LEARNING ANALYTICS IS THE MEASUREMENT, COLLECTION, ANALYSIS AND REPORTING OF DATA ABOUT LEARNERS AND THEIR CONTEXTS, FOR PURPOSES OF UNDERSTANDING AND OPTIMIZING LEARNING AND THE ENVIRONMENTS IN WHICH IT OCCURS"

> > 1st International Conference on Learning Analytics & Knowledge (LAK11)

# LA PROCESS (LIFECYCLE)



ISO/IEC JTC1/SC36 LA









# **INQ-ITS: PERSONALISED ONLINE LABS**





#### Mohammad Khalil & Gleb Belokrys

#### OXALIC



Notifications		Template			
$\geq$	Away for a long time	Subject Lykke til med innlevering av eksamen			
$\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{\mathbf{$	Lykke til med eksamensinnleveringen	Body			
$\geq$	Lykke til med innlevering av eksamen	Det er fint om dere husker å benytte kandidatnummer og emnekode(VUNG6000) i filnavnet:			
$\geq$	Call for a zoom call				
$\geq$	Lykke til med innlevering av eksamen				
SAVE	CANCEL				

# **AI & LANGUAGE LEARNING**



### AI to personalise the learning experience based on performance & progress

→ exercises @ perfect difficulty level based on an indivudual's strengths and weaknesses



https://blog.duolingo.com/large-language-model-duolingo-lessons/



every single exercise chosen by Birdbrain was written, reviewed, edited, and translated by human experts who constantly think about maximizing both the entertainment and learning value of every Duolingo lesson

### Learning Analytics: Student facing feedback



### Learning Analytics: Teacher facing dashboard



#### Using GenAl to help create lessons

#### $\rightarrow$ convenience

- $\rightarrow$  speed
- $\rightarrow$  productivity

#### What does AI look like in action?

#### Step 1: Curriculum design

The Learning Designer plans out the theme, grammar, vocabulary, and exercise types for a given lesson. For example, they may want to create a Spanish lesson with the theme "nostalgic memories" because it fits well with the grammar focus of the **preterite** and **imperfect**.

#### Step 2: Prepping the AI tool

It's time to fill in the blanks of our Mad Lib. Thanks to our amazing engineers, some blanks get filled in automatically (like the language, **CEFR level**, and theme of nostalgic memories). The Learning Designer fills in a few more blanks, such as the exercise type and the grammar focus, to steer the AI in the right direction.

#### Step 3: Generation and tweaks

In a matter of seconds, the AI model outputs ten exercises that fit the difficulty level, the grammar, and the theme.

Sample output:

1) Ayer visité la playa de mi infancia. Cuando era niño, visitaba esa playa a menudo.

2) La semana pasada, fuimos al cine el sábado. Antes, íbamos al cine los viernes.

3) Solía leer muchos libros de aventuras. El mes pasado, leí un libro de aventuras emocionante.

4) Ayer, cocinó paella para la cena. Mi papá cocinaba paella los domingos.

https://blog.duolingo.com/large-language-model-duolingo-lessons/

### Al generated content with GPT4 (collaboration with OpenAI)



**Roleplay** 

https://blog.duolingo.com/duolingo-max/

#### French & Spanish



#### "

We're using advanced AI technology to ensure that you can have an authentic speaking partner in Lily, and she's been "trained" to make the conversation feel as real, and helpful, as possible. She'll pause while thinking about her answer, she'll adjust to your skill level, and you won't hear her correct your grammar. After all, <u>one wrong word or mixedup verb ending</u> is completely fine as long as the other person understands you!

#### video call lets you have real life conversations with lily

Now you can practice your new language by having a quick chat with Lily!

SEP 24 | DUOLINGO TEAM



https://blog.duolingo.com/video-call/



**G** grammarly

Product  $\checkmark$  Work  $\checkmark$  Education  $\checkmark$  Pricing Resources  $\checkmark$ 

### Responsible AI that ensures your writing and reputation shine

Work with an AI writing partner that helps you find the words you need—to write that tricky email, to get your point across, to keep your work moving.

Sign up It's free →

G Sign up with Google

By signing up, you agree to the Terms and Conditions and Privacy Policy. California residents, see our CA Privacy Notice.

Trusted by 70,000+ teams and 30 million people

Get Grammarly It's free

Contact Sales

Log in

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https://www.grammarly.com/ai



https://support.grammarly.com/hc/en-us/articles/21940617172877-Introducing-your-writing-progress-dashboard





# GUIDELINES, POLICY & REGULATIONS

# PEAGOGICAL USE & ASSESSMENT

**Co-designing (teachers, students, learners) the use of GenAI in education** 

the second s	Table 5. Co-designing uses of GenAl as a 1:1 coach for the self-paced acquisition of foundational skills in languages and the arts							
Inesco 25	Potential but unproven uses	Appropriate domains of knowledge or problems	Expected outcomes	Appropriate GenAl tools and comparative advantages	Requirements for the users	Required human pedagogical methods and example prompts	Possible risks	
International Institute for Higher Education in Latin America and the Cathbaen       Pomerica Provide Higher Education for AB         Provide Higher Education in Latin America and the Cathbaen       Pomerica Provide Higher Education for AB	1:1 language skills coach	Language learning, including conversational practice.	Engaging learners in conversational practice to help them improve listening, speaking and writing skills by offering feedback, corrections and modelling of the mother tongue or foreign language. Helping learners improve their writing skills. Potential transformation: 1:1 language tutorials at beginner level	Starting with the list in Section 1.2, assess whether the GenAl tools are locally accessible, open source, rigorously tested or validated by authorities. Further consider the advantages and challenges of any particular GenAl tool, and ensure that it properly addresses specific human needs.	An age limit may be set for the independent conversations in view of the culturally insensitive or age- inappropriate output provided by GenAl systems. The learner must have the initial intrinsic motivation to engage in a conversation with an Al system. The learner should be able to take a critical approach to the GenAl's suggestions and check whether they are accurate.	When using general GenAl platforms, human teachers can guide learners to engage with GenAl tools to request feedback for improvement, correction of pronunciation or examples of writing. For instance: Engage me in a conversation in the [1] language, helping me to continuously improve. Suggest some ideas to help me write about [topic x].	Need to be alert to culturally insensitive or contextually inaccurate language, and the inadvertent perpetuation of stereotypes or cultural biases. Without proper pedagogical strategies to simulate learners' intrinsic motivations, it may limit children's creativity and orginality, leading to formulaic writing. It may also limit opportunities for real-life interactions, plural opinions, plural expression, and critical thinking.	or generative Al n and research
ChatGPT	1:1 art coach	Technical skills in areas of art such as music and drawing.	Providing suggestions for art techniques (e.g. tips on perspective and colour), or musical composition (e.g. melody and chord progression). Potential transformation: 1:1 art teacher at introductory levels	Starting with the list in Section 1.2, assess whether the GenAl tools are locally accessible, open source, rigorously tested or validated by authorities. Further consider the advantages and challenges of any particular GenAl tool, and ensure that it properly addresses specific human needs.	Learners must have some initial aims for creating art or music, a foundational understanding of the key elements of the domain of art or music, and basic abilities to analyse the artworks or musical compositions.	Human teachers should ask learners to compare Al tool' art techniques with their own artwork. Human teachers or coaches must encourage learners to develop and apply their imagination and creativity, which GenAl cannot replace. Example prompt: Suggest some ideas to inspire ne to create an image on [topics/ideas].	May expose children to inappropriate or offensive content, which may violate their right to safeguarding and well-being. GenAl tools raise the risk of stopping learners from developing their imagination and creativity.	
Quick start guide Portrait created by DALLE 2, an Al system that can create realistic images and art in response to a text description. The Al was asked to produce an impressionist portrait of how artificial intelligence would look going to university. Concept by UNESCO IESALC.	1:1 coach for coding or arithmetic	Conceptual programming knowledge and skills at the introductory level. It might also apply to the learning of basic mathematics.	Supporting self- pacel learning of basic coding knowledge and skills, finding bugs in learners' coding and providing immediate feedback, and tailoring answers to questions. Potential transformation: 1:1 coding teacher at introductory level	Starting with the list in Section 1.3, assess whether the GenAI tools are locally accessible, open source, rigorously tested or validated by authorities. Further consider the advantages and challenges of any particular GenAI tool, and ensure that it properly addresses specific human needs.	Finding and defining a problem, and designing algorithms to solve the problem, remain the core aspects of learning coding and programming. Learners must have intrinsic motivation to use the coding, along with some basic knowledge and skill is nu using the programming language.	Human teachers and coaches should teach basis knowledge and skills, and inspire learners to use computational thinking and programming to solve problems including through collaborative coding. Example prompt: Suggest some unusual ideas for adding.	The accuracy of feedback and suggestions remains a problematic issue as GenAI will not always be right. There is a high risk that GenAI tools will prevent learners from developing computational thinking skills and abilities to find and define meaningful problems for coding.	
				Education 2030				



