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# WP2 LEADER AI Toolkit

## Project LEADER AI



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## Section 1: Theoretical background

This section presents the theoretical background of the Toolkit with definitions of online/blended learning, personalised learning, learning analytics, educational data mining, and artificial intelligence, along with the role of these advanced technologies in education, their challenges, and their benefits. Having the definitions outlined early on sets a common ground for the Toolkit use; it allows all readers and users to be on the same page and catch up regardless of their current knowledge level. In addition, the section outlines the ethical issues concerning the use of these emerging technologies (e.g., accountability and responsibility). The section concludes with five case studies from the EU literature outlining how HEIs have integrated data-driven/AI-based approaches for personalised learning.

### Definitions of key terms

#### *Online and blended learning*

E-learning and online learning are two terms often used interchangeably. Some researchers state that it is difficult to use one universally accepted definition (Moore et al., 2011). The terms refer to the learning process mediated by the Internet and digital means (Greenhow et al., 2022; Keegan, 1986; Trakru & Jha, 2019). Some suggest that physical distancing (e.g., being in different physical locations) among the participants is not a prerequisite (Sangrà et al., 2012). Thus, fully online learning, similar to distance education, describes the type of learning supported solely by the Internet when the participants are not in the same place. In contrast, e-learning is electronic learning that can happen on the Internet, even within a physical space (e.g., a university room).



#### *Online learning*

“Online learning is defined as learning experienced through the internet/online computers in a synchronous classroom where students interact with instructors and other students and are not dependent on their physical location for participating in this online learning experience.” (Singh & Thurman, 2019, p. 302)

Regarding blended learning, the earliest definitions exploited the different meanings of the term “blended”. Driscoll (2002) referred to blended learning as a general combination and mixture of:

- Various web-based technologies (e.g., live virtual classroom, self-paced instruction).
- Various pedagogical approaches (e.g., constructivism, behaviourism, cognitivism)
- Various instructional technologies (e.g., web-based learning) and face-to-face instructor-led learning to achieve an educational goal.

Based on this, Cronje (2020) proposed that blended learning is “the appropriate use of a mix of theories, methods and technologies to optimi[s]e learning in a given context” (p. 120). However, the most common definition narrows down the concept of “blending”, referring to the combination of face-to-face and online learning, with the two modalities complementing each other.



### ***Blended learning***

Blended or hybrid learning nowadays refers to the learning process that combines face-to-face and online interactions in such a way that both complement each other (Hrastinski, 2019).

Based on this, various blended learning models are presented in detail below. In these, the online part of learning may include:

- presentation and delivery of content
- individual learning
- collaborative learning and networking
- assessment and (self)review
- self-reflection
- supplementary material

The face-to-face part of learning may include:

- teacher-led lessons
- hands-on, problem-based individual or group learning
- individual learning
- collaborative learning
- laboratory tasks/experiments

- breaks/discussion rooms

## ***Personalised learning***

Personalisation, adaptation, and differentiation are often used interchangeably to describe methodologies catering to students' unique needs and modifying teaching and learning to meet these.

Personalised learning is the process of modifying teaching and learning based on the student's profile, in advance or as the learning process unfolds.



### ***Personalised learning***

"a range of learning experiences, instructional approaches, and academic support strategies intended to address the specific learning needs, interests, aspirations, or cultural backgrounds of individual students" (Holmes et al., 2018, p.15).

Examples of personalised learning:

- Offering different resources and activities while using the Universal Design for Learning, an established framework to enhance accessibility for all.
- Dedicating time to getting to know the students through one-to-one communication, mentoring and tutoring while offering flexibility and autonomy.
- Defining specific learning objectives for each student and individualised learning plans accordingly.

In the context of emerging technologies, the term hyper-personalisation appears. In hyper-personalisation, artificial intelligence helps design a dedicated learning profile for each student and tailor the teaching and learning materials. Machine learning will consider the social identity of each student, the mode of learning, the student experience in the field of specialisation, the student's ability and preference in learning and the assessment delivery approach.

## ***Learning analytics***

Participants' activities and interactions are available through the digital tools implemented, which provide teachers and learning designers with vast



information regarding the formers' learning progress. By collecting and analysing such data properly, education stakeholders can take action to follow a practical approach (Klašnja-Milićević et al., 2020).

### *Learning analytics*



Learning Analytics is “the measurement, collection, analysis and reporting of data about students and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs” (Society for Learning Analytics Research<sup>1</sup>).

There are various sources from which you can draw data:

- **Learning Management Systems (LMS) or Virtual Learning Environments (VLE)** include, among others, records about the forums, wikis, such as the discussions started, the posts and replies), assignments such as grades, logins frequency, online presence duration and actions such as time taken to view, and watch resources such as pages, videos, students' demographic information (age, experience, success score). The latter can be found in digital questionnaires and digital profiles in other systems (e.g., a system used to record students' profiles across the university).
- **Research methods**, such as surveys, focus groups, interviews, and observation, offer insights into students' profiles (opinions, needs, skills, attitudes).
- **Digital tools** offer insights into users' activity; they provide records and reports similar to those of an LMS.
- **Social networking and social media** include messaging, sending friend requests, and accepting people using the system.

Some typical learning analytics applications developed are visualisations and dashboards that visually present student data for reflection. The instructors and students try to interpret these data and make decisions. The Learning Analytics Dashboards can be part of one or more courses and may present:

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<sup>1</sup> <https://www.solaresearch.org/about/what-is-learning-analytics/>

- Student overall grade.
- Requirements for passing the course.
- Course activities completed.
- Recommendations on topics to cover next or redo.
- Current performance in comparison to set goals.
- Information to plan learning (e.g., time needed).
- Current performance in comparison to past performance.
- Current performance in comparison to class (or other students') performance.
- Areas for improvement.
- Targets to reach (e.g., what to study).

Dashboards can contribute to students' self-regulation since viewing data might help students engage in a feedback loop: set goals, plan their study by selecting strategies and re-evaluate their progress. The instructors might also intervene in the following way:

- Change the communication or instructions given when students seem to lag.
- Increase their teaching presence (i.e., be more active during distance education or online learning by offering feedback, contacting students in activities, and sharing updates). Increased teaching presence will have a snowball effect on students' social presence.
- Make recommendations to students based on their progress (e.g., read additional material in activities they seem to struggle with).

### ***Educational data***

Educational data covers quite a broad scope, ranging from information on the student's background to well-being (connectedness to school, student morale, student safety, perceptions of relationships and classroom behaviour) or achievement. Educational data are also collected during the admission process when students have to provide information about themselves; this allows the teaching staff to know when students face particular problems (for instance, health-related issues).



### ***Educational data***

Educational data refers to any information collected in the context of education that offers insights into teaching and learning for informed decisions (e.g., demographic and enrollment data and institutional data).

## ***Artificial Intelligence***

Artificial Intelligence in education is a promising field that has attracted researchers' attention. AI is the machine's capacity to think like a human, learning and evolving (Limna et al., 2022). AI can support administrative tasks such as grading, teaching, and learning activities such as feedback provision. To some extent, AI can act like tutors by explaining concepts, giving feedback, and modifying teaching as in the case of adaptive systems, but also pedagogical tools which students can use during the learning process (e.g., for cognitive tasks, scaffolding). (Hwang et al., 2020).



### ***Artificial Intelligence***

Artificial Intelligence is a machine's capacity to think like a human, learning and evolving (Limna et al., 2022).

## *Role of AI and data-driven tools*

AI tools can take on many roles within education. The European Commission, Directorate-General for Education, Youth, Sport and Culture (2022) classifies AI systems in the following way:

- **AI that teaches students:** intelligent tutoring systems (ITS) that individualise learning, dialogue-based tutoring systems, and language learning applications.
- **AI that supports students:** exploratory learning environments, formative writing assessment, AI-supported collaborative learning.
- **AI that supports instructors:** grading, monitoring, teaching assistants, and pedagogical resource recommendation.
- **AI that supports system-wide planning:** educational data mining for resource allocation, diagnosing learning difficulties, and counselling/guidance services.

Holmes and Tuomi (2022) provide another taxonomy of AI in Education (AIED) systems based on the target user: student, teacher, or institution. This aligns with the above categorisation, as it shows that there are systems which are:

- **Student-focused:** teach and support students (e.g., ITS, chatbots, essay assistants).
- **Instructor-focused:** assist the teaching staff (e.g., with plagiarism detection, class monitoring, and assessment).
- **Institution-focused:** assist institutions (e.g., with admissions, security, and planning).

Of course, not all AI tools are used for personalisation. However, we can use the above categorisation and provide technology-based personalisation on the:

- **student-level**, with the AI system teaching or offering support in an individualised way.
- **teacher-level**, with the AI system providing the instructors with monitoring mechanisms to intervene or feedback and support to individualise.
- **institution-level**, with the AI system creating individualised learning plans or courses.

## ***Benefits and opportunities of LA and AI***

LA and AI can offer the following benefits:

- **Observations to intervene and adapt:** the analytics allow teachers to monitor students' progress and engagement (Bjælde & Lindberg, 2018; Tsai et al., 2020). For instance, they can see actions completed within the environment, such as accessing the material or contributing to the learning community's discussions. Such data help modify the teaching method or resources, guiding the students further. For instance, the instructor can choose different teaching materials, identify students at risk, analyse students' incorrect answers and suggest which teaching units require additional instruction.
- **Reflection and teaching improvement:** learning analytics can be used for reflection (Gkontzis, 2019; Rako et al., 2022) to re-evaluate the credibility and accuracy of the e-tests within the context of the actual course syllabus.
- **Improved communication and interaction:** tracking students' activity can promote transparent communication between the instructor and the students, as there is evidence of actions (van der Vorst & Jelcic, 2019). For instance, the instructor could spot if a student responded to forum activities online without studying the material first to recognise further whether the response was original or copied by other students. When students track their activity and see a lack of engagement, they might also seek to increase interaction with classmates.
- **Automation of tasks and learning design:** AI tools benefit task automation. By using AI tools to automate hectic tasks (Moşteanu, 2022; van der Vorst & Jelcic, 2019), the instructors have time for more difficult actions such as building personal rapport with students. This includes receiving automatic translations, answers to questions, content paraphrasing or summarising. In addition, generative AI tools can be used for lesson design by offering instructors learning activities examples or personalised language learning.

## ***Challenges and concerns related to LA and AI***

- **Technical and language issues:** tools might crash and not respond, be unavailable when needed, or produce inaccurate results. This might lead to frustration or lack of interest. In addition, a lot of tools have fees while being available only in English. If a translated version exists, localisation issues, such as a lack of natural speech flow or proper cultural interpretation, might exist.
- **Lack of skills, knowledge, and attitudes:** lack of knowledge regarding the terms and techniques could result in misusing these tools. For example, in generative AI like ChatGPT, instructors and students should be able to evaluate the content they receive critically. Otherwise, wrong interpretations might be drawn, with the students relying on cheating and spoon-feeding. Sufficient knowledge for all will tackle the issue of power one might have over the other. Additional support and collaboration among various stakeholders (teachers, support staff, IT) is required, including students who are often excluded from the decision-making (Beld-Medina et al., 2022; Holmes et al., 2018; Smyrnova-Trybulska et al., 2022; Tsai et al., 2020; van der Vorst & Jelacic, 2019; Vrkić, 2019).
- **Ethics and privacy:** data privacy is an issue raised, with researchers suggesting that higher-order measures are required along with policies and standards with which LA should comply on an institutional level (Amare & Simonova, 2021; Ifenthaler et al., 2019). Big Data analysis requires students to disclose personal data, regardless of their desire to do so or without the students necessarily being aware of such use of their data (Holmes et al., 2018; Renz et al., 2020). AI systems might misuse the data, or the data itself could be discriminatory. For this, it is vital to consider AI's transparency, explainability and predictability: AI should be difficult to manipulate, accountable for mistakes or biases, not prejudiced, respecting an individual's privacy and self-determination and supporting the educational goals. GDPR, education laws, laws on liability, and general regulations (e.g., copyright database law) all seem to apply (van der Vorst & Jelacic, 2019).
- **Interpretation and accuracy:** data is not always accurate. For instance, recommendation systems used for personalisation may not provide

accurate suggestions based on students' needs (Smyrnova-Trybulska et al., 2022). In addition, there might be differences in terms of how individuals interpret the digital footprint.

## Ethical issues and considerations

As seen in the previous subsection, the ethics underpinning the use of such emerging and data-driven technologies should be at the forefront of any intervention.

First, any policy regulations should focus on the following<sup>2</sup>:

- Informing students about the way their information is stored and the subsequent impact on their lives.
- Defining what data, not related to teaching, can be collected and how it can be used.
- Defining the way third-party AI tools can access university databases.

Rets et al. (2023) offer the following recommendations for ethical use of LA:

### 1. Involve end users in the design and use of LA tools

The end users can be instructors or students who make decisions based on the data provided. Engaging them in the research and design process ensures their voices are heard, supporting interdisciplinarity as the education, technology, leadership and administration fields are merged. Students need to be part of the process and interventions instead of having them simply receive information.

### 2. Consider students' diverse, individual needs

Individuals differ in their preferences. All technology tools integrated should be easy to access and use. For instance, the LA dashboards should offer insights in an accessible, non-technical way. It is crucial to directly consult the individuals whose data we are using to make sure we draw the correct conclusions (e.g., ask for clarifications about their offline study time, identify their personal opinions, and collect psychometric data such as satisfaction, confidence, anxiety, and self-efficacy).

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<sup>2</sup> <https://universityservices.wiley.com/wp-content/uploads/2020/12/201811-AI-in-Higher-Education-TLH-with-new-bage.pdf>

### 3. Promote the use of LA and act upon the data

Collecting data without making informed decisions would hinder the ethical use of LA. Teacher training and support are fundamental to ensure proper and effective use of such tools, especially to benefit at-risk individuals.

### 4. Apply an effective intervention strategy

The approach followed to intervene, according to the data collected, is context-specific. In some cases, early contact with students who seem prone to failure through university systems, asking them if they need support and what kind of support might be beneficial. On the contrary, some students might prefer something other than that immediate type of communication.

### 5. Test data to uncover hidden biases

It is important to engage multiple stakeholders, such as social and learning scientists, to identify which student characteristics might impact learning (e.g., socioeconomic status) and which may simply carry implicit biases (e.g., gender, ethnicity). This way, such data can be eliminated from the AI systems (e.g., the prediction models) so as not to intervene with the decisions and interpretations made.

In addition, Slade and Prinsloo (2013) outline the following ethical principles:

- Consider what is morally appropriate, not only what is effective.
- Remember that learning analytics are time- and context-specific, meaning they show an image of a situation at a specific time and context rather than a generalised one (e.g., students' performance).
- Ensure you do not rely solely on data, as success is multilayered.
- Be transparent about the data, i.e., the purposes for which data will be used, under what conditions the data will be used, who will have access to data, and how an individual's identity will be protected.

A whole university-wide policy for the ethical use of learning analytics is required. In a 2015 Jisc report about the code of practice for learning analytics, the educational institutions in the UK are recommended to apply the following principles<sup>3</sup>:

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<sup>3</sup> Published under the [CC BY 4.0 license](https://creativecommons.org/licenses/by/4.0/). Jisc (2015): Code of practice for learning analytics.



**1. Responsibility:** the university needs to decide who has overall responsibility for the legal, ethical and effective use of learning analytics, including the following:

- Collection of data to be used.
- Data anonymisation, where appropriate.
- Analytics processes to be performed on the data and their purposes.
- Interventions to be carried out.
- Retention and stewardship of data used for and generated by learning analytics.

Student representatives and key staff groups at institutions should be consulted about the objectives, design, development, roll-out and monitoring of learning analytics.

**2. Transparency and consent:** the university needs to define the objectives for using analytics (the why), what data will achieve these objectives and what is not the scope. All key stakeholders, such as students and staff, should be informed about the following:

- The data sources.
- The purposes of the analytics, the metrics used, who has access to the analytics.
- The boundaries around usage and how to interpret the data.
- The processes, including any algorithms.

The university should collect students' informed consent, especially for sensitive data such as ethnicity, in line with GDPR. Consent should be ensured prior to any intervention. If new projects are not covered in the existing arrangements, further measures such as impact assessment and additional consent should be applied and collected. Students should be aware of the consequences of (not) giving consent and be able to adjust their decisions next.

**3. Privacy:** only those the university identifies as legitimate should have access to student data and analytics. In addition, metadata or other data sources should be considered to ensure no identification. Additional consent might be needed if data is shared with third parties. Institutions may have a legal obligation to intervene and override some privacy

restrictions where data or analytics reveal that a student is at risk. Such circumstances should be specified.

**4. Validity:** Institutions should ensure that:

- Inaccuracies in the data are understood and minimised.
- The implications of incomplete datasets are understood.
- The optimum range of data sources is selected.
- False correlations are avoided.

Qualified staff should understand, validate, review and improve algorithms and metrics for predictive analytics or interventions. Other data and approaches should also be combined to validate learning analytics.

**5. Access:** students should have access to data in a meaningful and accessible way, and they can get copies of data in a portable digital format. They should be able to correct data about themselves if they disagree. If the universities believe the data harms students' academic progress or well-being, they might withhold it. The students should be able to see such data if they require it.

**6. Enabling positive interventions:** the exact conditions under which intervention happens should be clear, along with the type and nature of intervention (e.g., extra support to students, recommendation of different learning pathways) and whose responsibility this is. The student should be free to decide whether to act upon that information. The institutions should consider the impact of interventions, such as training, staff roles, and workload. Institutions should decide how to allocate resources for learning analytics appropriately for students with different requirements and ensure that diverse groups and individuals are treated equitably.

**7. Minimising impact:** data do not always paint a clear picture of an individual's learning, and all involved should be aware of that to prevent any biases, student categorisation, or labelling. Any interventions should be applied after institutions ensure that:

- the students have the autonomy to make decisions for their learning, using, for instance, learning analytics.

- they minimise any negative impact on the student's academic activity (i.e., non-participation or well-being issues), which may arise if students know someone monitors them.
- they minimise any negative impact from informing students and staff about students' performance or likelihood of success.
- the staff understands the legal, ethical and unethical practices.
- they minimise manipulation of the system.

**8. Data supervision:** learning analytics should comply with existing data policies and be:

- kept to the minimum necessary to deliver the purposes of the analytics reliably.
- processed in the European Economic Area or, if elsewhere, only following the GDPR.
- retained only for appropriate and clearly defined periods.

On request by students, any personal data used for or generated by learning analytics should be destroyed or anonymised, except for specific, clearly specified data fields required for educational or statutory purposes such as grades.

Some key reflective questions are:

- **Who** has access to data?
- To **what data**?
- To **do what**?
- **For what** reason?
- **What has been learnt** from this?

Given the AI advancements, the European Commission, Directorate-General for Education, Youth, Sport and Culture (2022) has provided the following guidelines for school educators' ethical use of AI and data-based technologies. Guiding questions accompany each aspect of ethical use. The guidelines can easily fit into the HE context. We present them below, with modifications for the HE context, as required.

**1. Human agency and oversight** (it refers to the protection of human rights)

- Is the instructor's role clear, and how does it change with the AI system?
  - Does the instructor have the agency to make decisions that impact students? Can s/he intervene in cases of discrimination by the system?
  - Can the instructor monitor the system and intervene (e.g., in case empathy is needed)?
  - Can the students leave or not engage with a system if they have concerns?
  - Are monitoring systems in place to prevent overconfidence or overreliance on the AI system?
  - Are the instructors equipped with the necessary skills and training to use the AI system(s) in ways that do not harm or violate human rights negatively?
- 2. Transparency** (it refers to traceability, explainability and communication)
- Do the stakeholders (e.g., instructors and leaders) recognise which AI methods and features the systems use?
  - Is it transparent what aspects AI can take over and what not within the system?
  - Do the stakeholders (e.g., instructors, leaders) know how the technology works (e.g., algorithms)?
  - Is the information provided clearly to all stakeholders (including students)?
  - Does the system work in favour of learning outcomes? Can we rely on the predictions the system makes?
- 3. Diversity, non-discrimination and fairness** (accessibility, protection against biases and inclusivity)
- Can everyone equally access the AI system without barriers?
  - Is the system appropriate for students with disabilities? Does the system respond and adapt to individual needs?
  - Is the system appropriate for the target group's profile (e.g., students' age) regarding usability?
  - Are there mechanisms to prevent biases and discrimination because of AI use? Are there measures to deal with inequalities if these biases occur?

- Does the AI documentation clarify any potential biases in data?
- 4. Societal and Environmental Well-being** (refers to sustainability and environmental friendliness, social impact, society, and democracy)
- How is the AI users' social and emotional well-being affected?
  - Is it clear that any interaction with the system is a simulation, and the system does not have real emotions (e.g., feeling empathy)?
  - Are the end users (e.g., students) part of the decision-making process to use the AI system?
  - Does using AI result in any fear and harm (e.g., for individuals or society)?
- 5. Privacy and Data Governance** (it refers to the respect for privacy, quality and integrity of data, and access to data)
- Are there protection measures to keep data anonymous and provide relevant access only to people who need it?
  - Is data kept in a safe place, used only for the purposes for which it was collected?
  - Can the stakeholders signal privacy-related issues?
  - Can the settings be customised?
  - Is there compliance with the General Data Protection Regulation (GDPR)?
- 6. Technical Robustness and Safety**
- Is there security to protect against breaches?
  - Is there a monitoring strategy to ensure the AI system achieves the intended goals, purposes, and applications?
  - Is information provided to end users about the system's technical robustness and safety?
  - Are there oversight mechanisms (i.e., taking responsibility for the operation, implementation, and outcome of a process) in place for data collection, storage, and use?
- 7. Accountability**
- Who is responsible for monitoring the AI system results? How are these results being used to improve teaching and learning?
  - How is the effectiveness and impact of the AI system being evaluated? How does this evaluation align with the values of education?

- Who is responsible and accountable for the decisions to buy and use the AI system?
- Is a Service Level Agreement in place defining the support and maintenance services to tackle problems?

Find more about the [ethical guidelines on the use of artificial intelligence \(AI\) and data in teaching and learning for educators](#).



## Case studies

This section provides five (5) case studies of HEIs in Europe and globally, integrating LA and AI for personalised learning. In some cases, the names of the universities are provided, whereas in others, they are anonymised, respecting the anonymisation process in the original research conducted.

### *Learning Analytics Dashboard for Early Intervention*

#### **No1** *General information*



This case study comes from the Open University, UK, a distance learning university.

#### *Detailed process*



Since 2013, the university has used the OU Analyse (OUA), an advanced predictive learning analytics system. Using machine-learning methods, the system makes weekly predictions about at-risk students who are most likely not to submit, fail, or succeed in their following assignments. These predictions are visualised on the Early Alert Indicators (EAI) Dashboard with relevant colours, i.e., red, amber, and green, respectively. In this way, the instructors who access this dashboard can get insights into individual students and classes, monitoring their engagement and performance weekly to intervene and support them in a personalised and proactive way. For instance, the instructors could provide students with additional study material and advice to improve studying practices.

#### *Conclusions*



The dashboard empowers the instructors to improve their teaching practices through systematically collected data. Without such a dashboard, it is up to the instructors to periodically collect information, such as students' log-ins and overall activity in an LMS, to make decisions. Using this approach has been linked to improved student performance and outcomes.

### *Personalised learning platform for recommendations and feedback*

#### **No2** *General information*



The University of Amsterdam is a public institution founded in 1632. There are 31123 students enrolled. The University of Amsterdam has implemented a personalised learning platform called Smart Education Analytics (SEA),

which uses data analytics and machine learning to provide personalised recommendations and feedback to students.

### Detailed process



**1 - Data Collection:** The first step in developing SEA was to collect data from online learning environments such as learning management systems (LMS), Massive Open Online Courses (MOOCs), and other educational platforms. This data includes **student demographics, course enrolment, and student interactions with the course content.**

**2 - Data Processing:** The collected data was then processed to improve its quality and prepare it for analysis. This involved tasks such as cleaning, deduplication, and normalisation of data.

**3 - Data analysis and interpretation:** One of the critical features of the SEA platform is its use of predictive analytics. The platform uses machine learning algorithms to analyse student data and predict their performance on future assessments. This allows the platform to provide personalised student recommendations based on their strengths and weaknesses. In addition to providing personalised feedback to students, the SEA platform also allows instructors to monitor student progress and intervene when necessary. The platform provides real-time data on student performance, allowing instructors to identify students who may be struggling and provide additional support.

**4- User Feedback:** The SEA platform was continuously refined based on user feedback and evaluation. Instructors and educators provided feedback on the usability and effectiveness of the platform, which was used to improve the platform and enhance its features.

### Conclusions



Implementing the SEA platform at the University of Amsterdam has successfully improved student learning outcomes and increased student engagement. The platform has been well-received by students and instructors and is an effective tool for personalised learning in higher education.

## Learning Analytics for predictions

### No. 3 General information



The current case study comes from the Faculty of Sciences, University of Porto. It is focused on the master's in Network and Computer Systems Engineering programme, conducted face-to-face in 2019. The target group was students with bachelor's degrees in Network and Computer Systems Engineering.



### Detailed process



The researchers created a methodology that uses the records collected by Moodle regarding the activities of students in a course unit over three years to predict their final grade.

The initial data was analysed, and the results were inconclusive. Additional information was required, for instance, from the duration of students' online sessions and interactions. Once all the information was obtained, the data was organised.

The independent and objective variables were identified and created in the next phase. These variables were used in conjunction with a machine-learning algorithm to make predictions. The training and test sets were defined. The training set was used as a supervised learning method, together with the variables, to allow the creation of a decision tree to make predictions. The test set was used to obtain the results and determine the model's predictive quality.

The results obtained by the study prove that this model is effective in making good-quality predictions at the beginning of the semester.

### Conclusions



The model can be implemented in a system of alerts for both students and instructors to warn them about the behaviours that can lead to a negative grade, giving both the opportunity to change the student's behaviour to pass the subject. Results show that over the semester, as the number of available data increases, the model becomes more effective at making predictions. The main limitation is related to the fact that this approach is only used in disciplines that use Moodle a lot during the whole educational process. The course used as a case study had several activities (tests, submissions, forums and choice of activities) associated with Moodle, which means that students were required to interact with the platform, increasing the number of available observations. This makes the model more effective at identifying activity patterns and predicting ratings.

## Learning Analytics for personalised feedback

### No. General information



The current case study comes from a research-intensive university in Australia. The target group was 414 (75 females, 339 males) first-year undergraduate students in a computer engineering course offered via blended learning mode.

### Detailed process



The LA tool used was [OnTask](#). The students engaged in course activities assigned in weekly cycles (e.g., videos, formative quizzes, summative exercises). This data is the input used for personalisation. In advance, the instructors had already designed feedback messages in line with the level of engagement (e.g., not viewed content, viewed partly, viewed to a great extent, viewed entirely, viewed multiple times) to enhance the personalisation of the message. The engagement was conceptualised differently, depending on the type of activity (e.g., for the video, the playing and watching time were considered; for the multiple-choice quiz and exercises, the number of wrong answers and exercises was considered, respectively). The email was sent to the students at the end of the week. Students' digital activity (watching the videos, completing the quizzes and exercises) in the LMS was monitored, and the algorithm processed the data to trigger the email sent to students. The instructor was responsible for preparing the personalised feedback messages to be sent (based on the level of engagement). At the same time, the student reviewed the message sent by email at the end of the week.

### Conclusions



The intervention results were compared to previous classes (2013, 2014). They compared the exam scores between the years to measure the impact on performance. Then, to identify students' perceptions about the quality of feedback, the self-report satisfaction surveys administered to the students as part of the course they attended were compared. Students' satisfaction with the feedback process was higher in the case of personalised LA-based intervention. In addition, the performance was positively affected, to a small to medium extent. Since personalisation is subject-specific, other student characteristics like learning strategies or study habits can be considered for similar interventions.

## ChatGPT for writing assistance

### No4 General information



The current case comes from a research study that explored the potential of using ChatGPT to support argumentative writing. The research is based on a well-documented need to provide students with timely, personalised feedback to improve their writing (e.g., structural components, multiple perspectives, language use.).

### Detailed process



In this case, ChatGPT seems a promising tool that can assist students during three different stages of writing: before – during - after writing. Specifically, ChatGPT can help with the following:

- Outline/idea preparation and planning (offer suggestions on generating ideas and evidence).
- Editing and revising content (suggest other perspectives to consider, feedback for specific content)
- Proofreading (offer corrections about errors in language, such as grammatical accuracy and alternative sentence structure).
- Post-writing reflection using the chat history to reflect on the programme and improve the quality of writing in the future.

To provide relevant feedback, especially in the pre-writing phase, outline and evaluation rubrics can be provided to ChatGPT for proper feedback provision.

### Conclusions



The study showed that ChatGPT could be used as a scaffolding tool in argumentative writing. It can provide personalised feedback, evaluate the responses and offer recommendations. However, there are various challenges to keep in mind. The first challenge concerns academic integrity, so ChatGPT should be used cautiously as a writing assistant. For this, it is key that higher-order thinking tasks are designed that require creativity, evaluation, and critical thinking. The second challenge related to fallacies in the content Large Language Models like ChatGPT may produce (e.g., hallucinations which refer to content that seems true and accurate). For this, students should know how to critically evaluate the information they receive. Training should come together with scaffolding and feedback from teachers.

## eLearning model for personalised learning experiences

### No4 General information



The current case comes from a research study at the University of Kragujevac, Serbia with second-year students (a group of Teachers' Department) and first-year students (the group of Pre-school Teachers' Department), introducing an adaptive eLearning model for personalised learning and smart decision making.

### Detailed process



The learning design process in the study involved designing and implementing an adaptive Learning Management System (LMS). This process included:

1. Deciding on the implementation of the adaptive model into the learning process.
2. Designing a flexible and suitable LMS structure.
3. Creating learning objects and educational materials based on existing pedagogical/didactic principles and methodologies.
4. Modifying the curriculum or parts of it processed by the LMS.
5. Implementing a model that supported both static and dynamic personalisation approaches. The static approach involved students filling in questionnaires at registration to determine learning style and prior knowledge, while the dynamic approach involved constant monitoring of students' activities in real-time for future personalisation and adaptation of teaching styles and learning materials.

The technologies used included the Moodle LMS with specific extensions (plugins) for adaptivity, enabling customised and personalised learning paths, decision-making exercises, independent revisions, and subject practices. The reason for using Moodle was its suitability for customisation, extensions, and personalisation of learning. The adaptation module and expert system were key components, allowing for the automated response of the system to student preferences and providing appropriate course elements.

The roles of teachers and students were aligned with the adaptive learning approach. Students interacted with the online learning system, completing questionnaires to identify learning styles, pre-tests to determine prior knowledge, and post-tests to assess learning performance. Teachers, on the other hand, monitored students' progress and performance, gaining insights from the data generated through students' activities and system-generated data, thereby facilitating more effective communication, learning, teaching, and evaluation.

During the implementation of personalisation, students were classified into specific groups based on learning style and prior knowledge. The system automatically adapted course content, tests, and even teacher instructions or comments based on students' activities, choices, and achievements. This approach provided a more accurate and tailored learning experience.

The evaluation method for the personalisation intervention involved statistical analysis using SPSS software. The data collected from the experiment were analysed to assess the effectiveness of the adaptive learning model.



## Conclusions



Overall, the intervention improved student learning ability and performance, enhanced learning experience and satisfaction, led to higher marks and pass rates for students in adaptive courses compared to traditional courses. However, there were various challenges including the need to consider both learning styles and prior knowledge for effective adaptivity, the requirement of a high degree of adaptivity and personalisation in LMS, and the necessity of continuous improvement in teaching/learning methods.

The study recommended further testing of the adaptive model for different courses and a larger number of participants. It highlighted the potential of adaptive eLearning to be applied at various education levels and emphasised the importance of adaptivity in enhancing educational processes and learning outcomes.



## Section 2: Learning Design Framework

This section provides a step-by-step learning design framework for designing personalised courses with data-driven and AI-based tools, including the learning design sequence and a collection of data-driven and AI-based tools focusing on open-source/freeware.

The learning design sequence focuses on a more “manual” approach, helping any instructor integrate existing AI systems for a more individualised approach. The aim is to offer a starting point for pedagogically exploiting tools that may not be related to personalisation, like adaptive systems. Similarly, the tools we collected are common tools analysed so that you can access them online and use them to serve your students’ needs better.

The learning design sequence was produced based on the results of the Transnational Research the partnership conducted and the literature review that supported it.

**Below each step, you may find tips and a space to keep notes with specific examples.**

### Learning Design Sequence

#### ***Step 1. Analyse the needs and define why personalisation is needed.***

The first step is to analyse the students’ needs. Have you spotted reduced engagement or lower performance rates? Such insights will help you define why a personalised approach is required. Having set this in advance helps you decide on an approach that aligns with an overarching goal – not simply using tools for the sake of innovation.

There might be more than one reason and goals to focus on, such as:

- improve performance
- improve knowledge retention
- increase motivation
- increase engagement
- increase interaction among participants
- improve metacognition

- improve self-regulation
- improve satisfaction
- reduce procrastination
- improve well-being
- increase course completion rate

To identify students' needs, you can collect data through:

- past/current assessment
- observations of skills, attitudes, behaviours, body language
- discussions
- questionnaires/feedback forms
- self-assessment, reflections, diaries
- students' commentaries in group work, discussions, meetings

### Tip!

Try to prioritise the needs based on their significance to students' success. Consider how feasible it is for you to cover these needs within the time you have, such as an academic semester. Hold individual meetings to identify what the students need, as your predictions might not be correct.

### Notes

**What needs have you identified, and how? Why personalisation is needed?**

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*Example: you have observed regular low participation of 2-3 students in your synchronous online sessions and low engagement in the asynchronous activities by reviewing the attendance and activity completion in your online course. You decided to discuss further with these students through 1-1 meetings, discovering*

*that two students are more advanced than the rest of the group. The other student cannot attend the synchronous sessions due to their part-time job, finding it difficult to catch up with the follow-up activities. The personalised intervention will target the improvement of students' engagement and participation.*

## **Step 2. Define what to personalise**

The next step is to decide what aspect of teaching and learning you will personalise (i.e., modify). This can be one or more of the following:

- Content
- Presentation of content
- Pace/Time of learning
- Support/guidance
- Teaching method
- Assessment method
- Assessment timeframe
- Students' work (e.g., assignment work and answers)
- Feedback

### **Tip!**

Try to combine the above aspects to achieve holistic personalisation.

### **Notes**

#### **What will you personalise?**

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*Example: for the two more advanced students, you decide to personalise the content and assignment, advancing the difficulty level. For the student who cannot attend the synchronous sessions and ask clarification questions, keeping up with the course pace, you decide to personalise the content presentation and pace/time of learning.*



### Step 3. Define source of personalisation

It is time to decide which information will inform the decisions for personalisation. This can be one or more of the following:

- Demographic profile (e.g., socioeconomic background)
- Individual goals
- Performance (e.g., skills acquired in assessment)
- Psychology (e.g., motivation, preferences, interests)
- Cognition (e.g., mental processes)
- Data patterns (e.g., achieved scores, repeated behaviours in a digital environment)

#### Tip!

Learning design is iterative. For example, if you decide to personalise teaching to improve students' performance, you will have to monitor their performance to readapt your planning.

#### Notes

##### Which student information will you use for personalisation?

*Example: you decide to review the students' performances (e.g., skills acquired, answers in activities) and data patterns in the online course (e.g., achieved scores, repeated behaviours in digital environment).*

### Step 4. Define who will use the tools for personalisation

The use of AI and LA should respect and promote human rights. Having a fully autonomous system in personalisation negatively impacts human (i.e., instructor, student) agency. For this reason, the student and instructor should

control the software - monitor the system and intervene, leave, or not engage with a system. At this point of the learning design sequence, you can decide who will use the tools for personalisation: the student and/or the instructor.

For instance,

- the student uses Learning Analytics Dashboards to regulate their learning, such as planning and managing their time and tasks, through the personalised recommendations received.
- the instructor uses Learning Analytics Dashboards to offer personalised feedback messages to the students, building rapport based on their learning progress.

### Tip!

Knowing who will use the AI or LA-based system is essential, as students might need training or human-led guidance before they are left to explore and use the tools.

### Notes

#### Who will use the tools for personalisation?

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*Example: There will be a shared control among the students and teachers.*

## Step 5. Select technology

At this step, you decide which tool will automatically personalise or which tool you will use to personalise teaching and learning. Below, we will provide a collection of relevant tools.

### Tip!

In this LEADER AI Toolkit you are reading, you can find a [collection of AI- and LA-powered tools](#) and a [Checklist with some essential criteria](#) to select tools properly. In addition, you may check out the websites “[There is an AI for that](#)” and “[Future Tools](#)” to stay updated about newly released AI tools.

## Notes

### Which tools will we use?

*Example: for the student that cannot attend the synchronous sessions, apart from the recorded sessions, you recommend using the Feyn or Teach Anything AI chatbots to clarify concepts they find difficult (apart from any 1-1 consultation they need). Alternatively, you can use the Kaya tool to upload all content covered in the synchronous sessions and produce an AI chatbot trained on this content with which the student can interact for self-studying. In addition, they can make flashcards for the key weekly readings using Wisdolia, which also generates self-assessment questions to keep up with the content they study.*

*For the two more advanced students, you use MagicSchool AI and the “Make it Relevant” feature to generate content modification ideas. Then, you assign the studying material and activities.*

## Step 6. Define timing

The next step is to define when personalisation will occur. For instance, whether it will be:

- Before instruction,
- During instruction,
- In the whole programme,
- In the whole course,
- Within a course unit.



**Tip!**

It is better if the personalised learning interventions occur throughout the programme rather than before its start, as students' needs may change dynamically.

**Notes****When will the personalisation occur?**

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*Example: personalisation will occur within each of the course units and during instruction to ensure that you can monitor students' progress at specific intervals (e.g., end of week).*

***Step 7. Apply personalisation, monitor, evaluate and revise.***

The last step is not part of the design process per se, but we mention it here as a more holistic view of the personalised approach. Once you finish steps 1-6, you can implement personalisation and monitor the progress. A trial is recommended before engaging students. To monitor and evaluate its application, you can refer to your goal of personalisation (step 1). For instance, if you offer personalisation to improve motivation, you can measure motivation before and after the application with observation, discussions and/or questionnaires. Defining the monitoring and evaluating mechanisms in advance allows you to stay on track. You can

# Learning design sequence

**STEP 01**

*Analyse the needs and define why personalisation is needed*



**STEP 02**

*Define what to personalise*



**STEP 03**

*Define source of personalisation*



**STEP 04**

*Define who will use the tools for personalisation*



**STEP 05**

*Select technology*



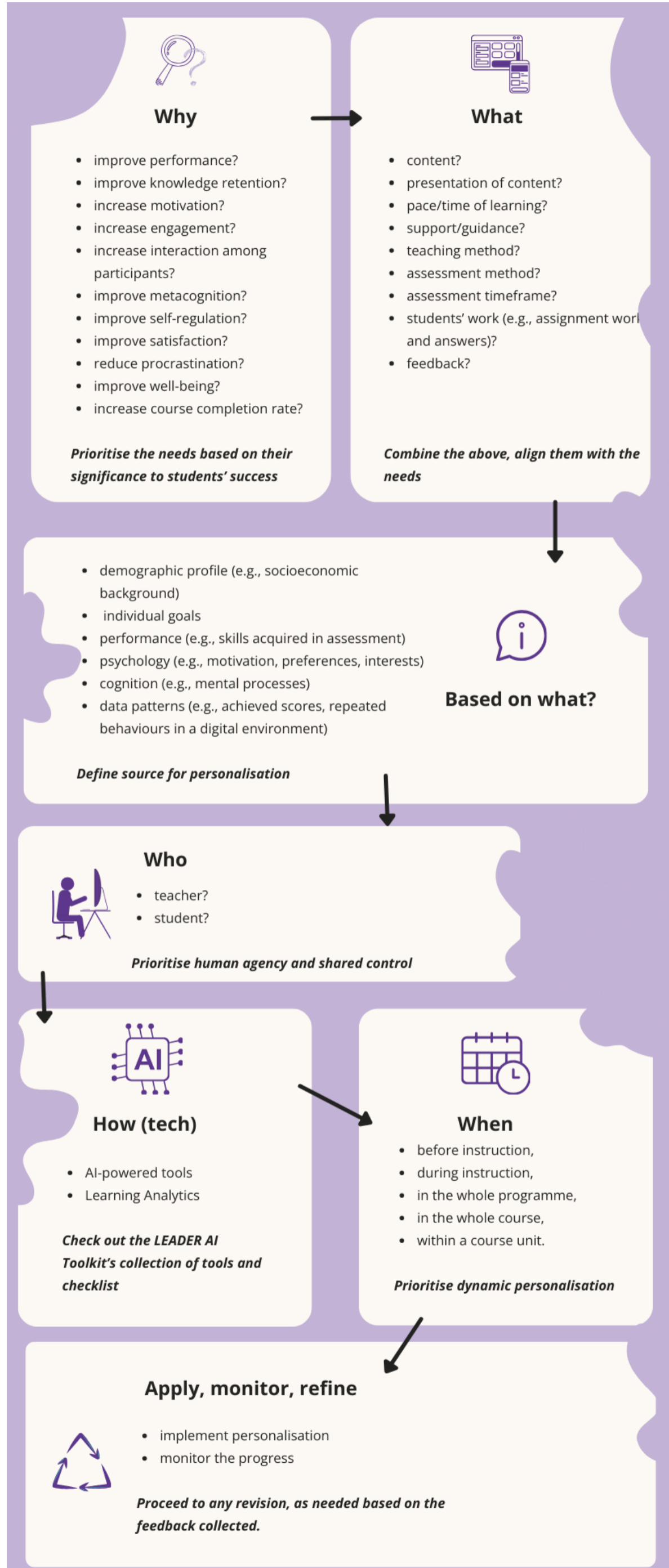
**STEP 06**

*Define timing*



**STEP 07**

*Apply personalisation, monitor, evaluate and revise*



## Collection of Tools for Personalised Learning

At this point, you will find a collection of AI tools and LA applications that you can use to personalise teaching and learning. Each tool has a short description, an explanation of why to use it, pedagogically speaking, what aspects it personalises, how you can access it, with a link to their websites, any tutorials and its cost.

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*Please note that we chose free or freemium tools (have a free version to use or experiment with, usually with restrictions in the available features) when we developed this toolkit. However, pricing is due to changes based on each company's needs, and the consortium is not responsible for any changes in these plans or features included.*

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The table below presents a summary of the tools we further explain below. We have grouped and divided the tools based on what personalised support they offer, i.e., which teaching and learning aspects they can augment.

Type of personalised support	AI generative tools
<b>Assessment support</b> <ul style="list-style-type: none"> <li>For students (e.g., self-assessment and improvement).</li> <li>For instructors, they offer recommendations for personalised teaching and accommodations.</li> </ul>	<a href="#">Bard</a> <a href="#">BingAI</a> <a href="#">ChatGPT</a> <a href="#">Feyn</a> <a href="#">FiberAI</a> <a href="#">Gradescope</a> <a href="#">MagicSchool AI</a> <a href="#">Praxy AI</a> <a href="#">Plaito</a> <a href="#">Wisdolia</a>

<p><b>Writing support</b></p> <ul style="list-style-type: none"> <li>• For students.</li> <li>• They offer personalised recommendations to improve writing.</li> </ul>	<p><a href="#">Bard</a>  <a href="#">BingAI</a>  <a href="#">ChatGPT</a>  <a href="#">Chatsonic</a>  <a href="#">GrammarlyGO</a>  <a href="#">Kanya</a>  <a href="#">Praxy AI</a>  <a href="#">Sayhi</a>  <a href="#">Quillbot</a>  <a href="#">ZenoChat</a></p>
<p><b>Research support</b></p> <ul style="list-style-type: none"> <li>• For students.</li> <li>• They offer personalised guidance for any inquiries and support the research process.</li> </ul>	<p><a href="#">BingAI</a>  <a href="#">Bard</a>  <a href="#">ChatGPT</a>  <a href="#">Chatsonic</a>  <a href="#">ZenoChat</a>  <a href="#">Kaya</a>  <a href="#">Praxy AI</a></p>
<p><b>Studying support</b></p> <ul style="list-style-type: none"> <li>• For students.</li> <li>• They offer personalised guidance, advice, feedback, help with organisation, and time management.</li> </ul>	<p><a href="#">Bard</a>  <a href="#">BingAI</a>  <a href="#">ChatGPT</a>  <a href="#">Chatsonic</a>  <a href="#">Feyn</a>  <a href="#">FiberAI</a>  <a href="#">Kaya</a>  <a href="#">Plaito</a>  <a href="#">Praxy AI</a>  <a href="#">Talk to Books</a>  <a href="#">Teach Anything</a>  <a href="#">TutorAI</a>  <a href="#">Wisdolia</a>  <a href="#">ZenoChat</a></p>
<p><b>Teaching support</b></p> <ul style="list-style-type: none"> <li>• For instructors.</li> <li>• They offer recommendations for personalised teaching and accommodations.</li> </ul>	<p><a href="#">Bard</a>  <a href="#">BingAI</a>  <a href="#">ChatGPT</a>  <a href="#">Chatsonic</a>  <a href="#">Gradescope</a>  <a href="#">MagicSchool AI</a>  <a href="#">Nolej</a>  <a href="#">Parlay Genie</a>  <a href="#">ZenoChat</a>  <a href="#">Paraly Genie</a></p>



## AI-based Tools

### Bard

- **Description:** Bard is similar to ChatGPT, supporting writing tasks, generation of lesson plans and quizzes.
- **Pedagogical purpose:** a) to help students during search and inquiry-based tasks, with personalised responses, b) to help students with preliminary thoughts before writing to visualise and understand the material by creating outlines.
- **What is personalised:** feedback, support/guidance, content.
- **Access:** access from the web and mobile app (iOS, Android).
- **Link:** [website](#), [guide](#).
- **Pricing:** free.



### Example of use

Students use Bard as a personal tutor, asking the tool to explain complex topics and concepts in a Finance course.

Act like an instructor. Please explain to me the financial statement analysis as if I were a primary school student.

Sure, I'd be happy to explain financial statement analysis to you as if you were a primary school student.

1 Financial statement analysis is a way to look at a company's financial statements to understand how it is doing financially. The three main financial statements are the balance sheet, the income statement, and the cash flow statement.

The balance sheet shows what a company owns (assets) and what it owes (liabilities) at a specific point in time. The income statement shows how much money a company made (or lost) over a period of time. The cash flow statement shows how much money a company came in and went out over a period of time.

Financial statement analysis can be used to answer questions like:

- How much money does the company have?
- Is the company making a profit?
- How much debt does the company have?
- Is the company able to pay its bills?
- What are the company's growth prospects?

There are many different ways to analyze financial statements. Some common methods include:

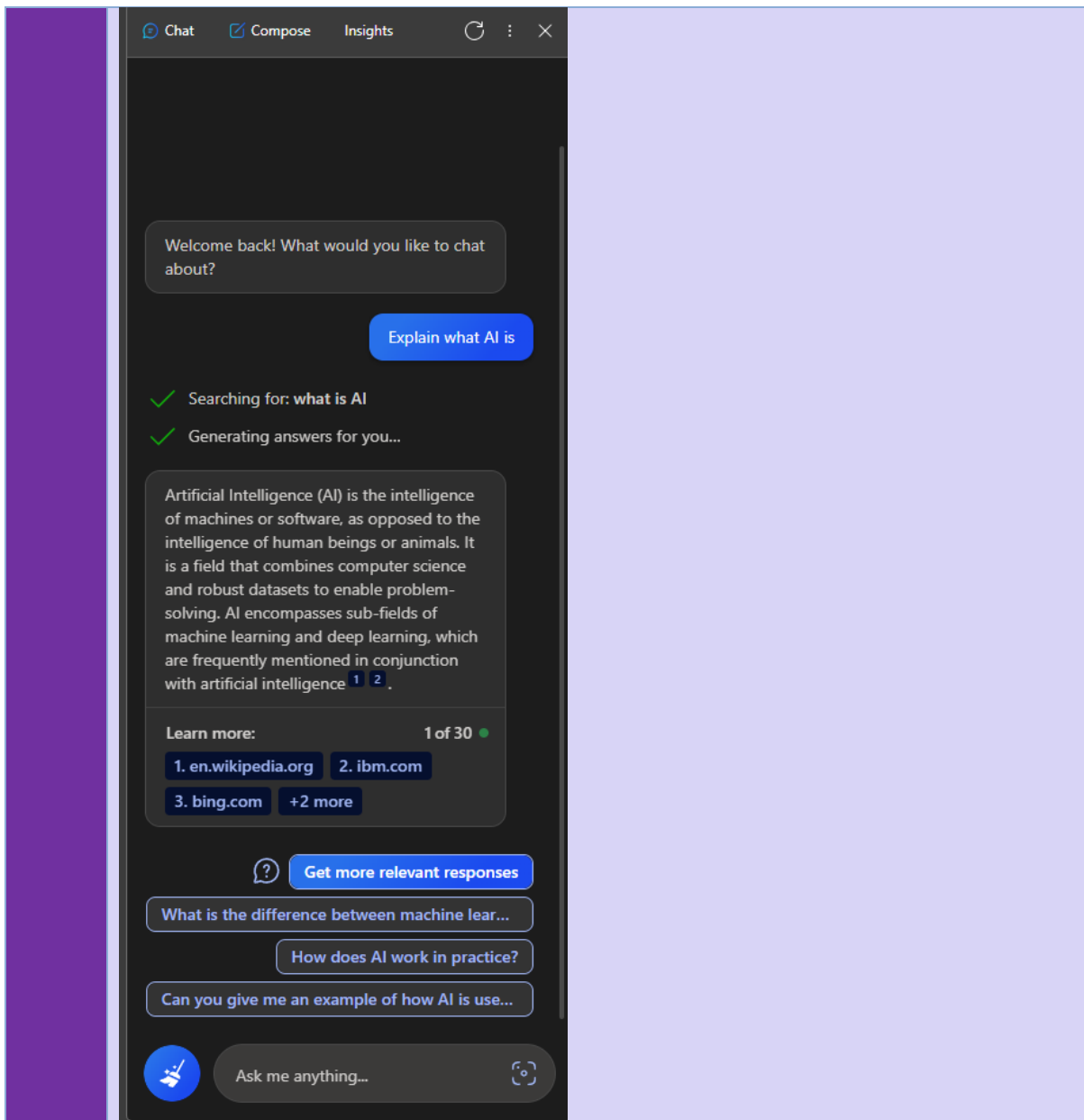
### BingAI

- **Description:** Bing AI is an AI-powered chatbot (based on large language models) developed by Microsoft. It supports human-like conversations, generating answers to users' queries. Bing AI also generates images using DALL-E.
- **Pedagogical purpose:** to help students with personalised responses during search and inquiry-based tasks.
- **What is personalised:** feedback, support/guidance, content.
- **Access:** access from Microsoft Edge web browser (sidebar), mobile app (iOS, Android), Skype (as a chat).
- **Link:** [guide](#).
- **Pricing:** free.



### *Example of use*

Students use BingAI for prompt explanations of concepts they might find difficult.



### ChatGPT

- **Description:** ChatGPT is an AI chatbot developed by OpenAI combining chatbot functionality with a Generative Pre-trained Transformer, a large language model.
- **Pedagogical purpose:** a) to help the students during search and inquiry-based tasks, with personalised responses, b) to help the instructors develop learning tasks, resources, and materials that suit each student's needs.
- **What is personalised:** feedback, support/guidance, content, teaching method, assessment method.
- **Access:** access from the web.
- **Link:** [website](#), [guide](#).
- **Pricing:** free and premium versions are available. See [pricing plans here](#).

#### Example of use



In a Finance course, an instructor uses ChatGPT to create a case study where students will explore the concept of game theory.  
See the [results given by ChatGPT here](#).

### Chatsonic

- **Description:** Chatsonic is an AI chatbot, an alternative to ChatGPT, that answers queries and produces text and images to a given prompt.
- **Pedagogical purpose:** a) to help the students during search and inquiry-based tasks, with personalised responses, b) to help the instructors develop learning tasks, resources, and materials that suit each student's needs.
- **What is personalised:** feedback, support/guidance, content, teaching method, assessment method.
- **Access:** access from the web.
- **Link:** [website](#), [guide](#).
- **Pricing:** free and premium versions are available. See [pricing plans here](#).

## Example of use



A student in English Language and Literature asks Chatsonic to provide additional resources to read on a particular topic. The chatbot presents a set of books related to the query, all in one place, and recommends that students explore their library or online databases for access.



Give me some additional resources to read for 19th century English poetry.



Certainly! Here are some additional resources you can explore to learn more about 19th century English poetry:

1. "The Norton Anthology of English Literature: The Victorian Age" edited by Stephen Greenblatt et al. This comprehensive anthology includes a wide range of Victorian poetry with insightful annotations and contextual information.
2. "The Penguin Book of Victorian Verse" edited by Daniel Karlin. This collection features a diverse selection of Victorian poems, including works by well-known poets like Tennyson, Browning, and Rossetti.
3. "The Cambridge Companion to Victorian Poetry" edited by Joseph Bristow. This book provides a detailed analysis of major Victorian poets, their themes, and the cultural context of their works.
4. "Victorian Poetry: An Annotated Anthology" edited by Francis O'Gorman. This anthology offers a selection of poems accompanied by informative annotations that delve into the historical, social, and literary contexts.
5. "The Victorian Poets: A Guide to Research" by Lionel Madden. This guidebook provides an overview of the major poets, critical approaches, and key themes of Victorian poetry, making it a valuable resource for further exploration.
6. "The Pre-Raphaelites and Their Circle" by Cecil Y. Lang. This book focuses on the Pre-Raphaelite Brotherhood, a group of artists and poets who significantly influenced Victorian poetry. It provides a comprehensive understanding of their artistic vision and impact.
7. "Victorian Poetry: Poetry, Poetics, and Politics" by Isobel Armstrong. This critical study explores the intersections between Victorian poetry and Victorian society, shedding light on the political, social, and gender issues of the time.

Remember to check your local library or online platforms like Project Gutenberg and JSTOR for access to these resources. Happy reading!

### Feyn

- **Description:** Feyn is an AI-powered chatbot that generates answers to text prompts, helping the users learn by explaining concepts and offering quizzes to test their understanding throughout their interaction.
- **Pedagogical purpose:** to help the students dive deeper into particular concepts they find challenging (e.g., they can ask the chat to explain the [x] topic) and receive quizzes to self-reflect on their understanding.
- **What is personalised:** content, support/ guidance.
- **Access:** access from the web.
- **Link:** [website](#).
- **Pricing:** free.

#### Example of use



A student uses Feyn to explain the concept of the “Pygmalion effect” that they found difficult in an “introduction to research” course. Feyn explains it and then provides a short quiz to check understanding.

Ah, the Pygmalion Effect! Now, that's a fascinating concept. It's like a self-fulfilling prophecy in a way. But let's not get ahead of ourselves. Let's start from the beginning, shall we?

Imagine you're a sculptor. You're chipping away at a block of marble, and you've got this image in your mind of what you want it to look like. You work day and night, pouring all your energy and belief into this piece of stone. And then, one day, it happens. The stone comes to life! It's exactly as you envisioned it. This, my friend, is the story of Pygmalion, a sculptor in Greek mythology. He fell in love with a statue he created, and his strong belief and love brought the statue to life.

Now, let's bring this back to the real world, away from Greek mythology. The Pygmalion Effect in research, or in any field really, is the phenomenon where higher expectations lead to an increase in performance. It's like the story of Pygmalion, but instead of a sculptor and a statue, it's a teacher and a student, or a manager and an employee.

The idea is that if you believe someone can do well, they're more likely to do well. It's a bit like magic, but it's not. It's psychology. The belief you have in someone's potential affects your behavior towards them. You might give them more opportunities, more feedback, or more encouragement. And this change in your behavior can boost their confidence, motivate them, and ultimately improve their performance.

So, in essence, the Pygmalion Effect is about the power of belief and expectation. It's about how our beliefs can shape reality, just like Pygmalion's belief shaped his block of marble. It's a beautiful concept, isn't it? And it's all based on the simple idea that believing in someone can help them achieve more.

Now, isn't that something you could have come up with yourself? It's just about connecting the dots, really. And that's the beauty of learning. It's all about discovering things that were right under your nose all along.

### Question

Which of the following best describes the Pygmalion Effect?

**The phenomenon where lower expectations lead to a decrease in performance**

**The phenomenon where higher expectations lead to a decrease in performance**

**The phenomenon where higher expectations lead to an increase in performance**

**The phenomenon where lower expectations lead to an increase in performance**

**Submit**





### *FiberAI*

- **Description:** an all-in-one space where you can store data and information and handle projects.
- **Pedagogical purpose:** students can use Fibery AI to brainstorm ideas, improve writing, automate tasks, store notes, get summaries and explanations, plan their studying, and/or manage group projects.
- **What is personalised:** support/guidance.
- **Access:** access from the web.
- **Link:** [website](#), [user guide](#).
- **Pricing:** free and premium options are available. See [pricing plans here](#).

### *Gradescope*

- **Description:** Gradescope is a tool that offers AI-assisted grading. Instructors can grade paper-based exams and online homework all in one place.
- **Pedagogical purpose:** to save time during grading and help the instructors offer individualised feedback to each student. The analytics offer insights into students' progress to intervene as required.
- **What is personalised:** feedback, support/guidance.
- **Access:** access from Microsoft Edge web browser (sidebar) and mobile app (iOS, Android).
- **Link:** [website](#), [tutorials](#).
- **Pricing:** free and premium versions are available. See [pricing plans here](#).

#### *Example of use*



An example from Gradescope's website of assessment in a paper-based computer science course.

6. (10 pts) Refer to the previous problem for an explanation of the context of this code. Fill in the missing line.

It can be solved with one line but there are multiple possible approaches. If your solution requires two or three lines, fill in those lines above and below the blank as needed.

```
/** replace last factor with the value i */
public void replaceLastFactor(int i) {
    int prev = data.set(data.size()-1, i);
}
```

Total Points

**5.0 / 10.0 pts**

1 +10.0

Correct:  
`this.set(this.size()-1, i)`  
 OR  
`set(size()-1, i)`

2 +10.0

Correct:  
`this.remove(this.size()-1)`  
`this.addFactor(i)`

3 +5.0

Partial credit: An answer that has the form  
`x.set(x.size()-1, i)`  
 but where x is some variable that is either out of scope, or an inappropriately declared instance variable.

4 +5.0

Partial credit for answer with logic errors:

`this.add(this.size()-1, i)`

Question and rubric courtesy of  
**Phill Conrad**

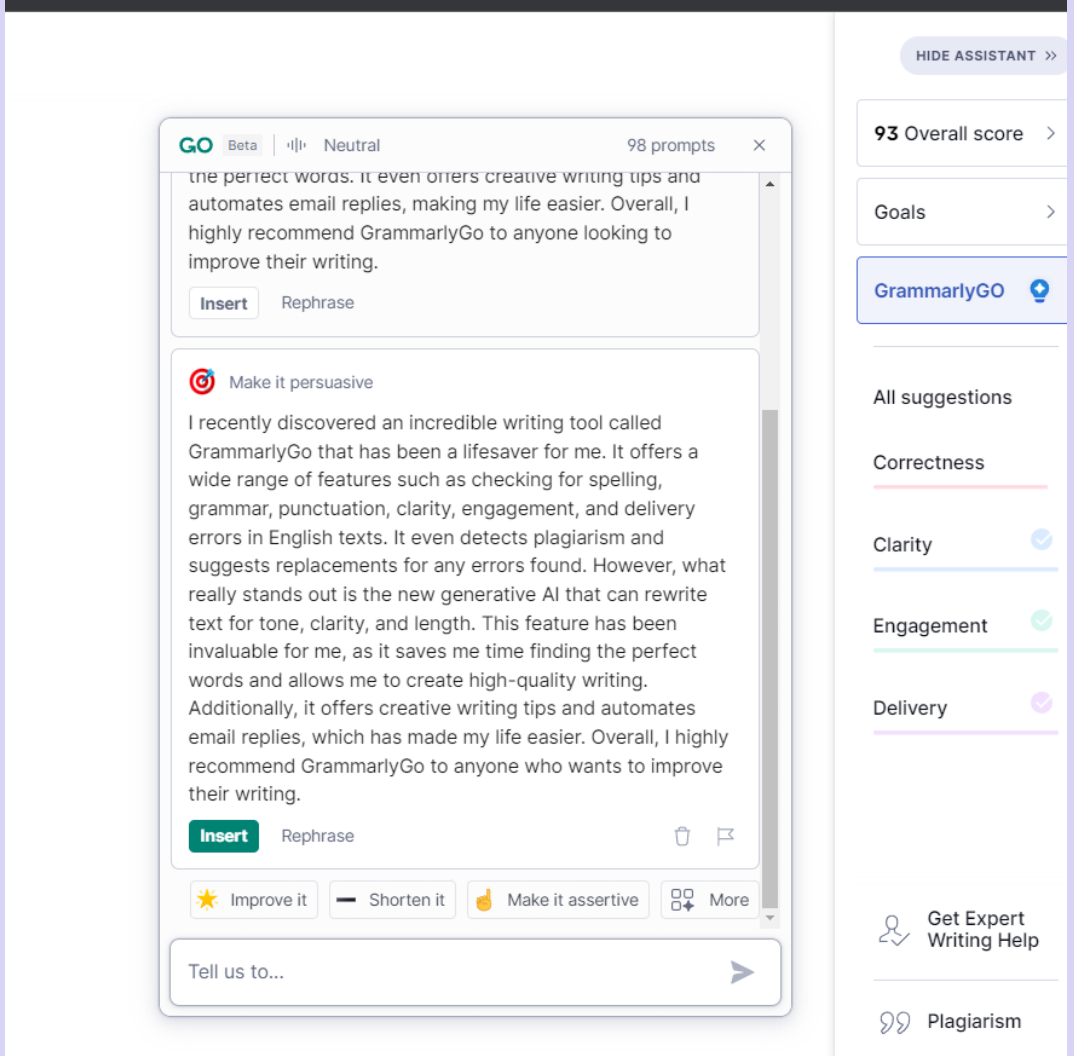
## GrammarlyGO

- **Description:** GrammarlyGo is an AI writing assistance tool. It reviews spelling, grammar, punctuation, clarity, engagement, and delivery mistakes in English texts, detects plagiarism, and suggests replacements for the errors. The new feature uses generative AI to rewrite for tone, clarity, and length, compose high-quality writing, offer creative writing tips, and automate email replies.
- **Pedagogical purpose:** to improve the students' writing skills (if this is a direct learning objective) or improve creative writing as part of a project (e.g., student essays, indirectly).
- **What is personalised:** feedback, support/guidance.
- **Access:** desktop app. Word Document installation, mobile app, browser extension.
- **Link:** [website](#), [demo](#).

- **Pricing:** free and premium versions are available. See [pricing plans here](#).

**Example of use**

Students in Business studies use ZenoChat to receive recommendations about how to write persuasive text.



The screenshot shows the GrammarlyGO interface. On the left, a text box contains a paragraph about GrammarlyGO. Below the text are buttons for 'Insert' and 'Rephrase'. On the right, a sidebar shows a '93 Overall score' and a 'Goals' section. Below the score, there are four categories: 'Correctness', 'Clarity', 'Engagement', and 'Delivery', each with a progress indicator. At the bottom right, there is a 'Get Expert Writing Help' button and a 'Plagiarism' section.

### Kaya

- **Description:** Kaya is a personal AI that learns from your notes, data and content. You can upload your document and store it as your “memory” to interact with it by asking questions and learning.
- **Pedagogical purpose:** a) to help the students interact with the studying material, uploading their notes, b) to help the instructors prepare

frequently asked questions regarding their courses or content they want students to focus on and share it with their students as a personal tutor for them to interact with it.

- **What is personalised:** content, support/ guidance.
- **Access:** access from the web.
- **Link:** [website](#).
- **Pricing:** free and premium options are available. [Create an account](#) to see the pricing plans.

### Example of use



An instructor in a Social Sciences course creates notes on “Social media and mental health” for students to study online independently. The students can access the material and ask clarification questions and explanations by interacting with the chat.

### MagicSchool AI

- **Description:** a free suite of 40+ powerful AI-powered tools that help instructors (including college-level instructors) save time and be more efficient. It offers features such as a rubric generator, text rewriter, proofreading tools, scaffolding tools, multiple explanations for complex concepts, text-dependent questions, a “Make it Relevant” tool, a class newsletter tool, and a quiz generator. It supports 25+ languages.
- **Pedagogical purpose:** to help the instructors personalise any aspect of teaching (e.g., content), save time by automating tasks, and give meaningful feedback to students while accommodating diverse students. Individualised Education Programs (IEPs) can also be prepared for each student.
- **What is personalised:** all aspects, according to the tool chosen (i.e., content, presentation of content, pace/time of learning, support/guidance, teaching method, assessment method, students’ work, feedback).
- **Access:** access from the web.
- **Link:** [website](#), [demo](#).
- **Pricing:** free.

## Example of use



An instructor prepares individualised education plans for their students in a small cohort. The IEP Suggestion Generator tool in MagicSchool.ai provides a customised plan for a dyslexic student. The plan includes dedicated learning objectives and accommodation/modification suggestions for the instructor, according to the specific student disability, behaviours, needs and strengths the instructor inserted. Then, the instructor could discuss with the students 1-1, get their input and finalise the plan.

← Choose Tool
IEP Suggestion Generator

Generate suggestions for students who have an individualized education program (IEP).

**Grade Level:**  
College

**Disability Category:**  
Dyslexia

**Description of student behaviors, needs, and strengths:**  
The student is highly creative, thinks outside the box and holistic understanding. The student has difficulty taking notes during lectures and recalling information.

**Generate**

Student IEP Draft - Review closely before implementation

**Present Levels of Performance**  
[Student Name] demonstrates a high level of creativity and exhibits strong holistic understanding. They excel in thinking outside the box and possess excellent problem-solving skills. However, [Student Name] experiences difficulties in taking notes during lectures and recalling information. They often struggle to organize their thoughts and may require additional support in these areas.

**Student Needs and Impact of Disability**  
Due to their dyslexia, [Student Name] faces challenges in their involvement and progress in the general curriculum. Their difficulty in note-taking and recalling information hinders their ability to fully participate in class discussions and effectively demonstrate their knowledge. This impacts their overall academic performance and may lead to feelings of frustration and low self-esteem.

**Goals and Objectives**

**Measurable Goal: Improve Note-taking Skills**  
Objective:  
- [Student Name] will learn and utilize a variety of note-taking strategies, such as using graphic organizers, abbreviations, and color-coding, to enhance their ability to capture and organize lecture information accurately.

**Measurable Goal: Enhance Information Recall**  
Objective:  
- [Student Name] will practice and employ memory techniques, such as mnemonic devices and visualization strategies, to improve their ability to recall information from lectures and readings accurately.

**Measurable Goal: Strengthen Organization Skills**  
Objective:  
- [Student Name] will develop effective organizational strategies, including creating to-do lists, using digital tools for scheduling and task management, and breaking down complex tasks into smaller manageable steps.

**Accommodations and Modifications:**

- Provide preferential seating near the front of the classroom to minimize distractions and enhance focus.
- Allow the use of assistive technology, such as text-to-speech software or speech-to-text applications, to support note-taking and written assignments.
- Provide additional time for assignments, tests, and projects to accommodate for processing and recall difficulties.
- Offer alternative formats for instructional materials, such as audio recordings or visual aids, to support comprehension and retention.
- Encourage the use of visuals, diagrams, and hands-on activities to reinforce learning and enhance understanding.
- Collaborate with teachers to provide advance notice of upcoming assignments and topics to enable [Student Name] to prepare adequately and manage their workload effectively.

Please review this draft and make any necessary modifications or additions to meet the unique needs of [Student Name].

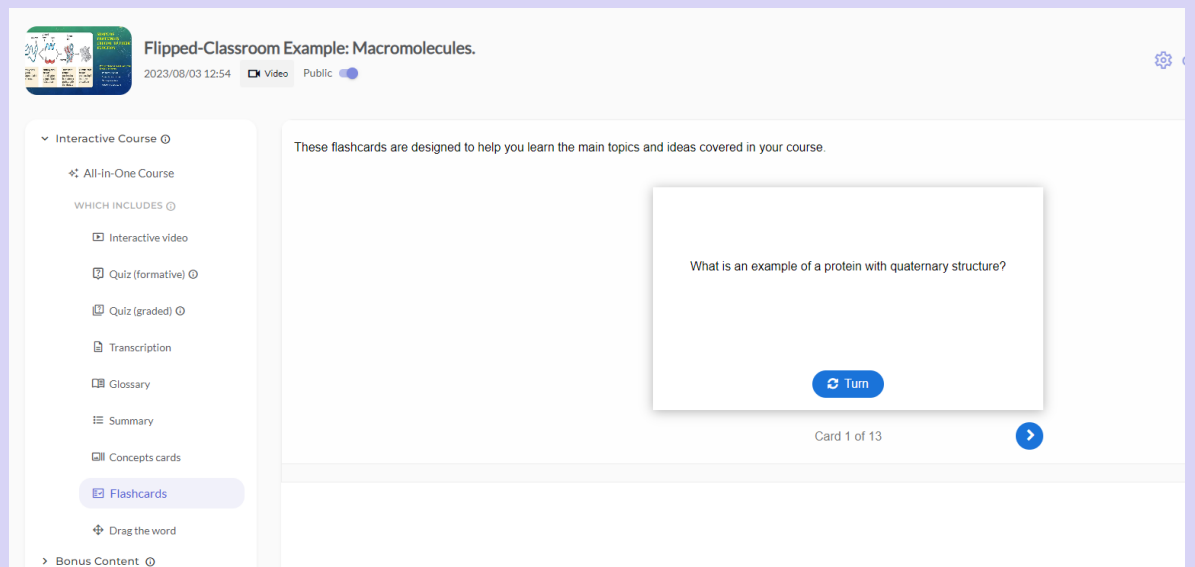
## Nolej

- **Description:** Nolej generates lots of interactive educational content -- like all-in-one courses, interactive videos, assessments, and plug-and-play content. You provide any content (like text, videos, audio, YouTube, and websites), and AI analyses it and generates educational material. Afterwards, you can embed, export, or integrate with your learning management system (LMS).
- **Pedagogical purpose:** to help the instructors personalise the interactive educational content based on students' needs, automatically preparing it for them.
- **What is personalised:** content, content presentation, teaching method, assessment method.
- **Access:** access from website.
- **Link:** [website](#).
- **Pricing:** free and premium options are available. See pricing plans [here](#).

## Example of use



A student struggles with understanding the macromolecules in a biology course. The instructor gathers educational material that can help, such as a video and uses Nolej to automatically generate educational content for the student, such as quizzes, glossaries, summaries, flashcards (see picture below) and concept cards.



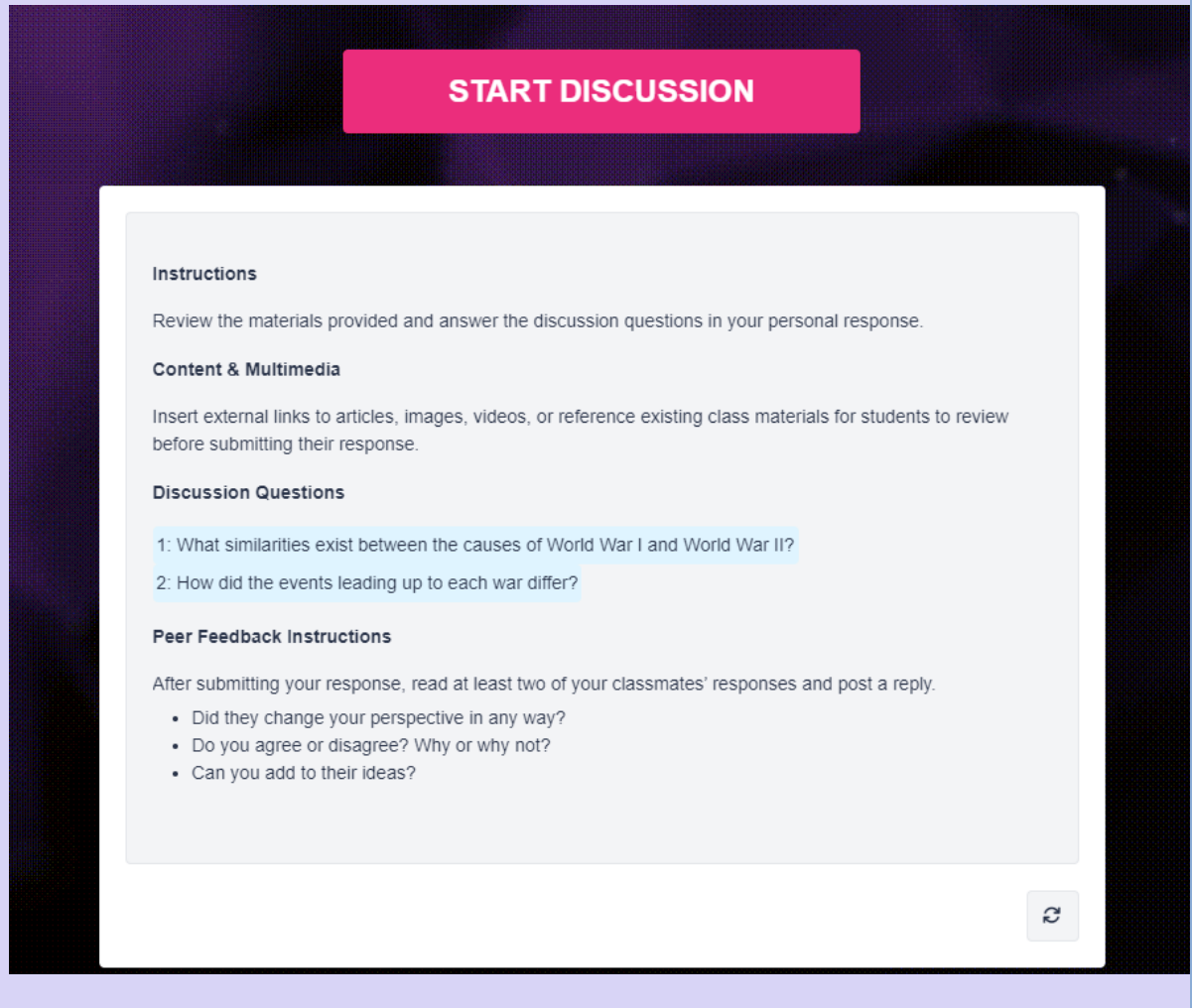
## Parlay Genie

- **Description:** Parlay Genie (part of Parlay) is a discussion prompt generator. It generates higher-order thinking questions based on a topic, a YouTube video, or an article. It uses ChatGPT to generate prompts for your students.
- **Pedagogical purpose:** to generate discussion prompts, personalising the questions based on a chosen topic or students' needs.
- **What is personalised:** content.
- **Access:** mobile app
- **Link:** [website](#).
- **Pricing:** free.

### Example of use



In a history course, the instructor uses Parlay Genie to generate discussion questions on the causes of World War I and II.



**START DISCUSSION**

**Instructions**

Review the materials provided and answer the discussion questions in your personal response.

**Content & Multimedia**

Insert external links to articles, images, videos, or reference existing class materials for students to review before submitting their response.

**Discussion Questions**

- 1: What similarities exist between the causes of World War I and World War II?
- 2: How did the events leading up to each war differ?

**Peer Feedback Instructions**

After submitting your response, read at least two of your classmates' responses and post a reply.

- Did they change your perspective in any way?
- Do you agree or disagree? Why or why not?
- Can you add to their ideas?

### Plaito

- **Description:** Plaito acts as a personalised coach, giving prompts and suggestions to move students forward as they write, debate, and collaborate. Some of the features are explanation, essay assistance, and summary generation.
- **Pedagogical purpose:** to help the students when studying at home by providing personalised support and feedback based on their work.
- **What is personalised:** content, teaching method, assessment method,
- **Access:** mobile app (iOS, Android).
- **Link:** [website](#).

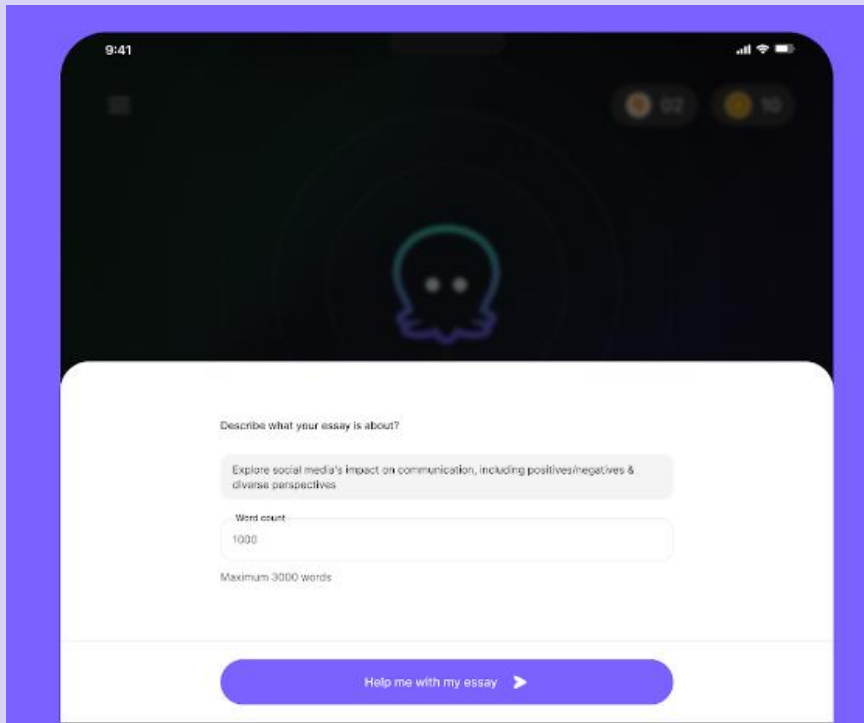


- **Pricing:** free and premium options are available. [Create an account](#) to see the pricing plans.

### Example of use



An example taken from the tool's website showing how students use Plaito to assist them in writing an essay on a given topic.



### Praxy AI

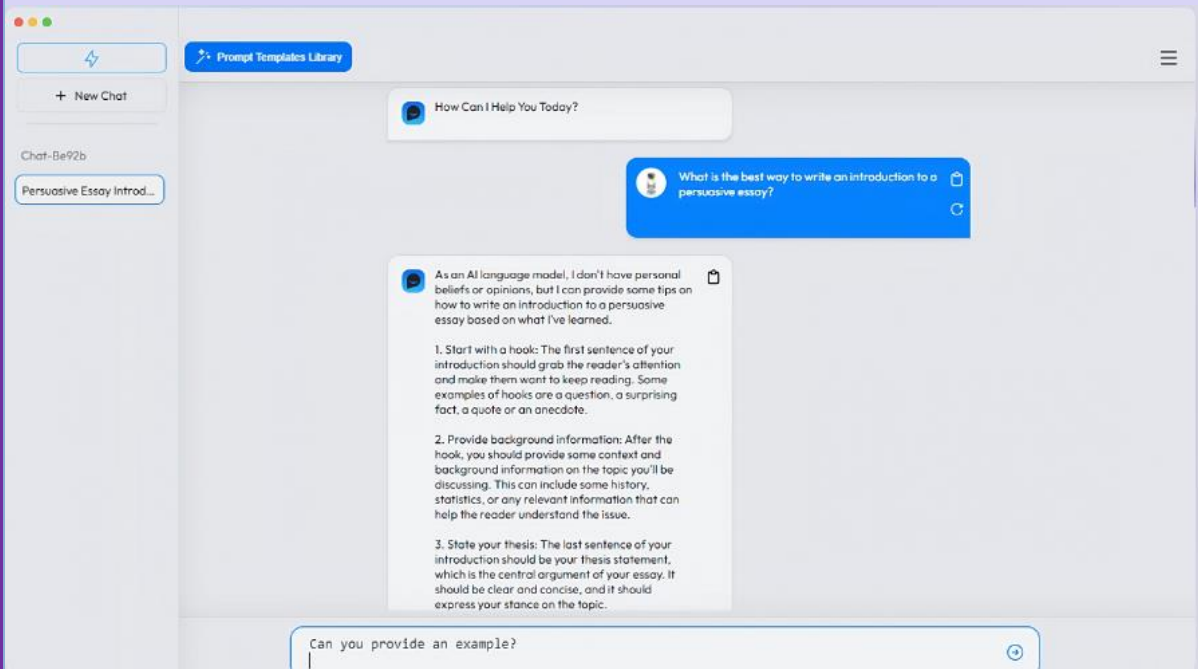
- **Description:** Praxy AI is an AI-powered study tool that helps students highlight online content and interact with it in various ways: search, summarise, paraphrase, explain with an example, or create a quiz.
- **Pedagogical purpose:** to help the students stay organised during their studies and actively engage with the learning material.
- **What is personalised:** support/ guidance.
- **Access:** browser extension.
- **Link:** [website, app site.](#)
- **Pricing:** free.



### Example of use



An example taken from the tool's website shows how students use PraxyAI to receive guidance about writing an introductory paragraph for an argumentative essay.



### SciSpace Copilot

- **Description:** SciSpace Copilot is an AI research assistant that helps understand scientific literature. As a browser extension, it helps you get explanations for the given paper (or report, blog), such as explanations about the abstract and tables. You can get explanations in your mother tongue and simple explanations about difficult, technical language. You may ask additional questions and interact with the chatbot provided.
- **Pedagogical purpose:** to help the students receive targeted, individualised support while reading scientific papers anytime.
- **What is personalised:** support/ guidance.
- **Access:** browser extension
- **Link:** [website](#).
- **Pricing:** free.

### MaxAI.me

- **Description:** MaxAI.me is a Chrome browser plugin that allows users to use AI anywhere online. It supports common AI tools like ChatGPT, Google Bard, New Bing Chat AI, and Claude with which you can interact while browsing various web pages.
- **Pedagogical purpose:** to help the students interact with web content, receiving personalised support and guidance regarding writing and content explanations. To boost students' productivity during studying.
- **What is personalised:** support/ guidance.
- **Access:** browser extension.
- **Link:** [website](#).
- **Pricing:** free and premium options are available. See [pricing plans here](#).

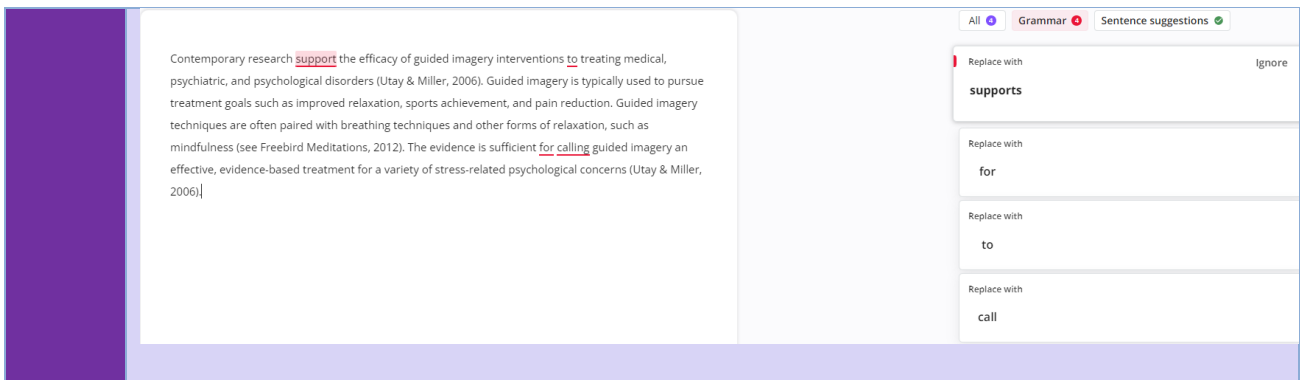
### Quillbot

- **Description:** Quillbot is an AI writing assistance tool that university students can use for paraphrasing, grammar checking, summarising, co-writing, translating, citation generation and plagiarism checking.
- **Pedagogical purpose:** to improve students' writing skills (if this is a direct learning objective), creative writing as part of a project (e.g., student essays, indirectly), and reading comprehension.
- **What is personalised:** feedback, support/guidance.
- **Access:** access from the web, browser extension and integration into other tools (e.g., emails and social media).
- **Link:** [website](#), [demo](#).
- **Pricing:** free and premium versions are available. See [pricing plans here](#).



#### Example of use

Students write essays and use Quillbot to receive grammar corrections or recommendations.



### Sayhi

- **Description:** Sayhi is a mobile app that automatically detects your language (e.g., in text and speech) and translates the content into any chosen language.
- **Pedagogical purpose:** to help all students converse with each other, regardless of their linguistic background, including international students in group work.
- **What is personalised:** presentation of content.
- **Access:** mobile app (iOS, Android).
- **Link:** [website](#).
- **Pricing:** free.

### Talk to Books

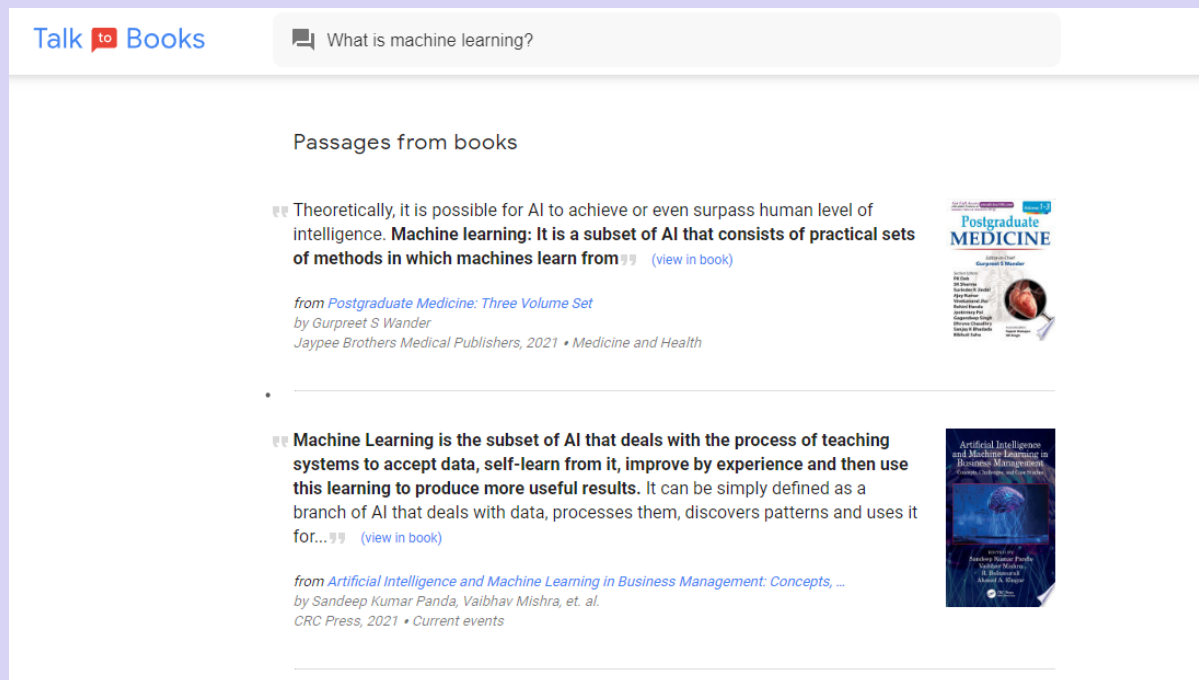
- **Description:** A Google AI experiment, Talk to Books allows users to converse with books by offering extracts and passages from books in response to users' queries.
- **Pedagogical purpose:** to help the students dive deeper into particular concepts they find challenging, retrieve evidence from books or easily spot information according to their search needs.
- **What is personalised:** content, support/ guidance.
- **Access:** access from the web.
- **Link:** [website](#).
- **Pricing:** free.



## Example of use



A student uses Talk to Books to spot passages from books related to machine learning. They compare the answers and use them to grasp the concept better. They search for related books via their university's library.



The screenshot shows the 'Talk to Books' interface. At the top, there is a search bar with the query 'What is machine learning?'. Below the search bar, the results are categorized under 'Passages from books'. Two results are visible:


- Result 1:** A passage from 'Postgraduate Medicine: Three Volume Set' by Gurpreet S Wander. The passage states: 'Theoretically, it is possible for AI to achieve or even surpass human level of intelligence. **Machine learning: It is a subset of AI that consists of practical sets of methods in which machines learn from**' (view in book). The book cover is shown to the right.
- Result 2:** A passage from 'Artificial Intelligence and Machine Learning in Business Management: Concepts, ...' by Sandeep Kumar Panda, Vaibhav Mishra, et. al. The passage states: '**Machine Learning is the subset of AI that deals with the process of teaching systems to accept data, self-learn from it, improve by experience and then use this learning to produce more useful results.** It can be simply defined as a branch of AI that deals with data, processes them, discovers patterns and uses it for...' (view in book). The book cover is shown to the right.

## Teach Anything

- **Description:** Teach Anything is an AI-powered platform that generates answers to text prompts.
- **Pedagogical purpose:** to help the students dive deeper into challenging concepts (e.g., they can ask the chat to explain a given topic).
- **What is personalised:** content, support/ guidance.
- **Access:** access from the web.
- **Link:** [website.](#)
- **Pricing:** free.

## Example of use

A student uses Teach Anything to understand better what thematic analysis in qualitative research is.



### Teach you **Anything** in seconds

1,063,505 answers generated so far.

- 1 Write your question
 

Explain to me what thematic analysis in qualitative research is.
- 2 Select your language
 

English
- 3 Select difficulty
 

Easy

Generate answer
Get Pro version →

### The answer is

Hey there! I'm GPT-4, your friendly AI assistant. I'd be happy to explain thematic analysis in qualitative research to you in a simple way.

Thematic analysis is a fancy term used by researchers to understand and find patterns in people's thoughts, ideas, and opinions. It helps us figure out what different groups of people think about a certain topic, like their favorite hobbies or their feelings about school.

Let's imagine we want to know what students in your school think about their favorite hobbies. We would gather information by talking to a group of students and asking them questions like, "What do you like to do in your free time?" or "What is your favorite hobby?" We might interview five students and write down their answers.

Next, we would read all their answers and try to find common themes or patterns. For example, let's say three students mentioned playing football, while two students mentioned drawing. So, we can say that football and drawing are the themes that came up the most.

After identifying the themes, we can analyze them further. We might ask ourselves, "Why do these students like playing football? Is it because they enjoy being part of a team or because it helps them stay active?" We would also think about why the other students enjoy

teach-anything.com

*TutorAI*



**Co-funded by  
the European Union**

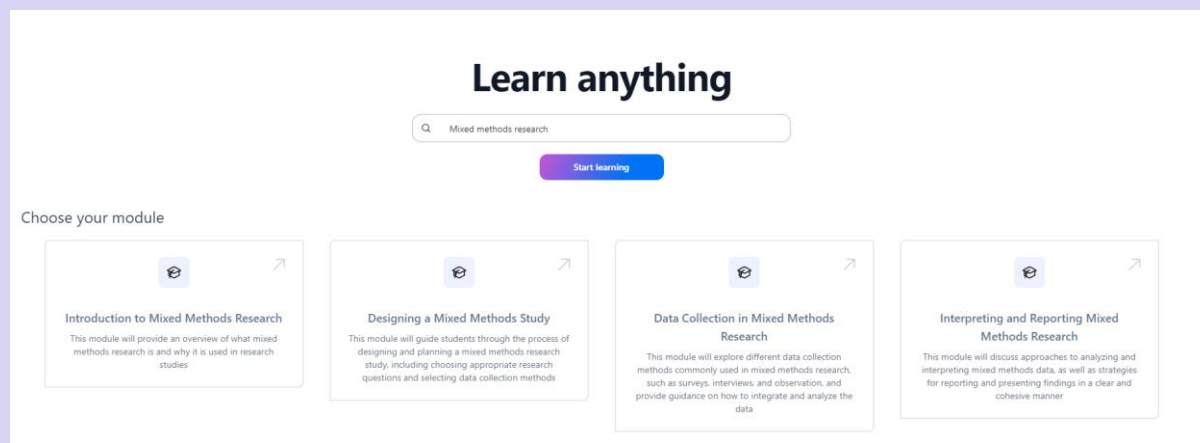
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them. Project Number: 2022-1-CY01-KA220-HED-000086763

- **Description:** TutorAI is an AI-powered platform that generates online modules and lessons for the prompt given (e.g., on a particular topic).
- **Pedagogical purpose:** to help the students dive deeper into particular concepts they find challenging.
- **What is personalised:** content, support/ guidance.
- **Access:** access from the web.
- **Link:** [website](#), [demo](#).
- **Pricing:** free.

### Example of use



A student in an introductory research course, uses TutorAI to dive deeper into the mixed method research, receiving relevant modules to attend.



The screenshot shows the TutorAI interface with the following elements:

- Header:** "Learn anything" with a search bar containing "Mixed methods research" and a "Start learning" button.
- Section:** "Choose your module"
- Modules:** Four cards are displayed, each with a lightbulb icon and an arrow:
  - Introduction to Mixed Methods Research:** This module will provide an overview of what mixed methods research is and why it is used in research studies.
  - Designing a Mixed Methods Study:** This module will guide students through the process of designing and planning a mixed methods research study, including choosing appropriate research questions and selecting data collection methods.
  - Data Collection in Mixed Methods Research:** This module will explore different data collection methods commonly used in mixed methods research, such as surveys, interviews, and observation, and provide guidance on how to integrate and analyze the data.
  - Interpreting and Reporting Mixed Methods Research:** This module will discuss approaches to analyzing and interpreting mixed methods data, as well as strategies for reporting and presenting findings in a clear and cohesive manner.

### Wisdolia

- **Description:** Wisdolia automatically generates flashcards from YouTube videos, web pages, and PDF documents.
- **Pedagogical purpose:** to help the students dive deeper into particular concepts they find challenging by reading notes.
- **What is personalised:** support/ guidance.
- **Access:** browser extension.
- **Link:** [Chrome extension](#).
- **Pricing:** free.

#### Example of use



A student in a Biology programme course uses Wisdolia to generate flashcards for three key research papers that the instructor shared with them. The student uses the flashcards throughout the academic semester for [spaced repetition](#).

### ZenoChat

- **Description:** ZenoChat is a ChatGPT alternative that engages users in human-like conversation. It generates texts and answers questions.
- **Pedagogical purpose:** to help students during text writing, to rewrite sentences, fix grammar and spelling, summarise text, reduce or enlarge text, and translate. You can add your data sources from which the tool will draw to answer, making the tool look like a personal assistant.
- **What is personalised:** feedback, support/guidance.
- **Access:** access from the web, desktop app, browser extension and integration into other tools.
- **Link:** [website](#), [guide](#).
- **Pricing:** free and premium versions are available. See [pricing plans here](#).

#### Example of use



Students write argumentative essays and use ZenoChat for recommendations on improving their writing.

## LA applications

### Loop

- **Description:** Loop is a learning environment tool that uses data from Moodle or Blackboard for visualising. Being a government-funded (Australia) collaborative project, it is a self-hosted server software.
- **Pedagogical purpose:** to visualise student behaviours in a learning management system. The dashboard component displays student log data through the learning management site, such as class materials accessed, discussion forum activity, and assessment performance. These data can be viewed at the classroom or individual student level. At the same time, the tool incorporates information about the course structure and schedule within its visualisations.
- **What is personalised:** anything deemed necessary by the instructor.
- **Access:** integration into LMS.
- **Link:** [research](#), [tool presentation](#).

### Privacy-friendly Moodle Learning Analytics

- **Description:** a privacy-friendly Moodle Learning Analytics plugin (Dondorf, 2022)
- **Pedagogical purpose:** to visualise student behaviours in a learning management system. The dashboard component displays known student data such as the number of clicks on the learning material, total clicks on all quizzes and most used activities. The data are available to both teachers and students.
- **Access:** integration into Moodle.
- **Link:** [plugin installation](#).

### Example of use



An instructor observes that three students score lower than the class average on the assignments, they have not accessed the optional activities, and the time spent on the weekly knowledge quizzes is higher than the class average. The instructor believes that these students might struggle. They decide to intervene by sending an email to



each student separately. The emails ask students whether there are any concerns they would like to discuss, encouraging them to reach out through office hours. The instructor also provides additional helpful resources for the students and offers guidance (e.g., study techniques) in the 1-1 meetings they organise. They also decide to promote extra collaborative activities, pairing these students with more advanced students to assist indirectly. The instructor evaluates the intervention by reviewing the data again.



## Section 3: Checklist with criteria for AI and LA tools integration

This section provides a set of key criteria in the form of self-reflective questions you can use when exploring existing or new tools to properly select those that align with your organisation’s needs and goals. The list is not extensive; you do not need to find tools that meet all the criteria but rather tools that fit your needs, using this checklist as a reference guide. The criteria are divided into categories for easier navigation to help you make an informed decision.

Criteria	Yes	No	Comments
<b>Personalisation features and pedagogy</b>			
Does the tool help achieve the personalisation objectives (i.e., improve performance, motivation)?			
Does the tool align with the learning objectives?			
Can the tool support your chosen teaching method (i.e., problem-based, project-based)?			
<sup>4</sup> Can the tool create personalised learning pathways for each student? If yes, does the tool			

<sup>4</sup> These criteria are applicable to adaptive AI systems or intelligent content recommendations are used.

guide the student during their learning based on their progress?			
<sup>4</sup> Does the tool use AI to recommend relevant and appropriate content (i.e., activities, resources)?			
<sup>5</sup> Can the tool analyse students' engagement patterns for interventions?			
<sup>5</sup> Does the tool provide insights to intervene (i.e., enhance engagement, make adjustments)			
Does the tool offer scaffolding to help the students overcome challenges?			
Does the tool provide hints or explanations when the students struggle?			
<b><sup>6</sup>Ethical use and privacy</b>			
Does the tool comply with relevant data			

<sup>5</sup> These criteria are applicable to learning analytics applications (i.e., dashboards, etc.).

<sup>6</sup> Please refer to section 1 of this Document, "[Ethical issues and considerations](#)" for detailed explanation of this.

protection laws and regulations?			
Is there a clear policy on data handling and anonymisation?			
Are student data and personal information stored securely and protected from unauthorised access?			
Can the target audiences (i.e., instructors and students) control the tool (or data collected)?			
Does the tool promote human agency (i.e., human rights support)?			
Is there transparency (i.e., users know and understand the algorithms)?			
Does the tool promote diversity, non-discrimination, and fairness (i.e., accessibility, inclusivity)?			
Does the tool promote technical robustness and safety?			
<b>Goal-setting and progress</b>			



Does the tool allow the students to set their learning goals? Can the students track their progress on these goals?			
Can the students visualise their achievements or areas for improvement?			
Does the tool provide immediate and constructive feedback to the students?			
Is feedback tailored to individual learning needs?			
<b>Integration, usability and support</b>			
Can the tool integrate with existing learning management systems (LMS) or other educational technology tools used within the institution?			
Is the tool easy to use for the target audience (i.e., students, instructors)?			
Does the tool have a friendly interface that requires			

minimal training (easy to learn)?			
Does the tool require advanced skills to use it?			
Is there support provided (i.e., chat, user guide, contact support)?			
Does the tool offer scaffolding to help students overcome challenges?			
Does the tool provide hints or explanations when students struggle?			
Which digital skills are required to use the tool?			
<b>Cost and effectiveness</b>			
Does the tool offer a cost-effective solution, considering its features and benefits?			
Is there research evidence supporting the tool's effectiveness for teaching and learning?			
Has the tool been validated through rigorous testing?			

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