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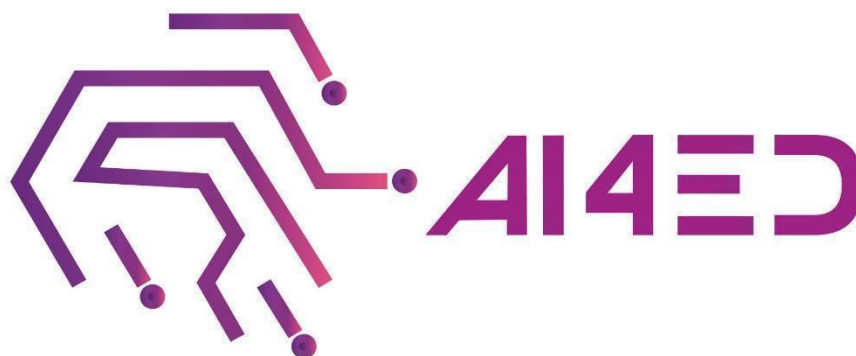
AI4ED

TOWARDS AN AI DRIVEN EDUCATIONAL PROCESS
INTEGRATING MODERN CAREERS IN THE EDUCATIONAL SYSTEM

Deliverable

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V5	Unizar	Last toolkit with the incorporation of suggestions about Chatbot	06/05/2025
V6	Unizar	Revision with the comments of the project officer	16/07/2025

Table of Contents

EXECUTIVE SUMMARY / ABSTRACT

Abstract	The toolkit includes the key aspects for the use and transfer of the programs developed in this project.
Keywords	AI, active learning, tutoring, preventing dropout

. **Image Disclaimer**

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Section 1. Theoretical and ethical context
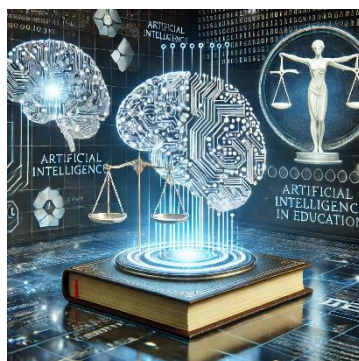
1.1. What do we mean by AI in education? Positioning ourselves to design

1.1.1. AI in Education.

- Academic research into the application of AI in education has been ongoing for more than 30 years. It combines linguistics, psychology, sociology, and anthropology to support the development of educational applications of AI and other AI tools that are flexible, inclusive, personalized, engaging and effective to support formal education and lifelong learning.

- Current concerns regarding the usefulness and uses of AI in education relate to its cultural transfer, adaptation to different linguistic and social contexts, and the needs of educational inclusiveness.

- Educational research in this field seeks to promote the development of key, transversal and future-oriented competences, to develop a learning culture and dynamics, learning to learn skills and a sense of initiative, to promote learning possibilities and scientific, technical and social competences that respond to the new challenges of society in the short, medium and long term.

1.1.2. Possibilities of use (good practices).

- Active Learning: Problem-based and project-based learning at its core. Focused on collaborative learning.

- Personalised Tutoring: Personalised academic tutoring and teaching follow-up for each student, adapted to individual learning needs, different rates of learning and particular characteristics.

- Dropout Prevention: Early detection of indicators leading to dropout in order to be able to preventively target them. Adaptation of tutoring to these more sensitive cases that require more specialised or intensive intervention.

1.1.3. Future lines

- Immersive learning

- Predictive Analysis

- Adaptive learning

- Improved accessibility

- Automated administration

1.2. What is our ethical framework? Raising awareness to protect

1.2.1. The legal framework that limits the use of AI

- The rapid development of AI has presented both significant opportunities and complex challenges, demanding a comprehensive regulatory and ethical response from stakeholders worldwide.

- There is a first legislative reference framework developed by institutions such as the European Commission and UNESCO.

- Governments, International organizations, Industry companies… are also contributing with their initiatives.

1.2.2. Ethics of AI application in Education

- The scientific community has raised concerns about the ethical aspects of AI in education for a responsible use in teaching and learning.

- Ethical guidelines on the use of AI in teaching and learning stress the importance of human rights, fairness, and transparency.

- It is necessary to include ethics, career planning, and technical learning in education for middle school students, in preparation for a future where AI holds significant sway.

1.2.3. Transparency in the application of AI in Education

● Transparency and accountability need to be ensured when deploying AI technologies in educational settings.

● The DigComp framework offers a comprehensive overview of digital competencies to offer transparency in the application of AI in Education.

● Transparency should involve making all those involved in the educational process aware of how AI works, helping to make informed decisions about AI implementation.

1.2.4. Data protection in evaluation processes

● Ethical guidelines on the use of AI and data in evaluation processes stress the importance of human rights, fairness, and transparency.

● Data privacy and security measures should be robustly implemented: No personal data should be exposed.

1.3. What is the psychological and pedagogical framework of our designs?

The theoretical framework for the development of the AI based educational tools has been built on 4 current theories of psychology and pedagogy. In turn, these 4 theories are based on 3 classical macro-theories of our field of knowledge.

1.3.1. Macro-theories framework

1. Behaviourism is particularly nourished by effective evaluation based on pedagogical feedback, as can be seen today in any computer application with loyalty strategies, or to prevent abandonment, or even in AI research based on machine learning by reinforcement.

2. Cognitivism made it possible to focus on the internal processes of learners, their thinking and the mental processing of information. It later allowed the development of theories that developed key phenomena for learning, such as working memory or mental imagery, and allowed the specific approach of computational and connectionism to be applied to AI.

3. Constructivism brought the view of the learner as the active protagonist of his or her learning, as a behavioral, mental or practical engagement. Directed attention, intention and motivation towards learning become highly relevant. This theory establishes a direct link between how learners learn and how they can and should be taught. The most important aspect of producing learning: understanding the actual starting point of each student/learner in order to create rich and challenging situations accordingly. Today, this can be optimized with dynamic AI systems that tailor teaching to prior knowledge and learning speeds, mistakes made, etc.

1.3.2. Theoretical models proposed for AI-based educational tools

1. Cognitive Theory of Multimedia Learning (CTML) to support effective learning and pedagogical approach to support effective teaching. CTML is a theoretical framework that explains how students/trainees learn from multimedia presentations that include both words and visuals.

2. Self-Determination Theory (SDT) is a broad theory in human psychology that focuses on motivation, development, and well-being. It centres on the concept of autonomy, which involves the ability to regulate one's own behaviour within a social context of influence.

3. Educational Gamification involves incorporating elements of video game design into non-recreational contexts. This theory aims to change students' behaviour towards learning by using actions that influence their motivation in an engaging way. It is proposed the mechanical-dynamic-aesthetic model to design technological environments or programs.

4. Interactive Audiovisual Activity (IAA) design principles that explain what and how videogames allow learning.

1.3.3. Didactic process from which courses are implemented with Chatbot integration

The methodological option that best responds to the technical tools of this project is the one that follows the following process:

1st) Exhaustive programming of general, specific and operational objectives, with rigor and hierarchy.

2nd) Programming and timing of closed sequences of activities, intimately related to the objectives and strictly ordered.

3rd) Design of the most appropriate activities and materials to be hosted on Moodle. It is very important that all activities are aimed at obtaining products in text format. The more detailed the narrative product produced by the student, the more relevant and operational the reports generated by the AI will be.

4th) Detail checkpoints in the learning processes for students to obtain partial grades, feedback reports and propose questions to the Chatbot.

5th) Integrate questions aimed at stimulating learning, deepening the learner's particular interests, having to search or read outside the Moodle material, etc.

6th) Evaluation by the teacher through Moodle, leaving a record of grades, qualitative observations, and anything else he/she deems necessary.

7th) Proposal of recovery, reinforcement and extension activities for those with high performance.

Section 2. Before starting

Considering our experience and the difficulties/problems encountered developing case studies, what aspects do we highlight for those embarking on a similar project to be considered?

2.1. Define your objectives of your course, related to AI use

- **Educational Goals**: Identify what you aim to achieve with AI in education (e.g., personalized learning, dropout prevention, skill assessment).

- **Specific Use Cases:** Outline specific scenarios where AI will be applied (e.g., VET student progress tracking, university student performance prediction).

2.1.1. Understand the Model Requirements

- **Model Types**: Determine the types of models you need (e.g., predictive, classification, clustering).

- **Input Data**: Identify the input data required for these models (e.g., student demographics, academic records, engagement metrics).

- **Output Data**: Define the expected output (e.g., performance scores, dropout risk indicators).

2.1.2. Conduct a Need Analysis

- **Stakeholder Consultation**: Engage with educators, administrators, and students to understand the data needs.

- **Literature Review**: Research existing studies and models in educational AI to identify common data types and structures.

2.1.3. Identify Data Sources

- **Internal Data**: Review existing data within your educational institution (e.g., student information systems, learning management systems).

- **External Data**: Consider external data sources (e.g., standardized test scores, external assessments).

2.1.4. Data collection

- **Quantitative Data**: Numerical data such as grades, attendance records, test scores.
- **Qualitative Data**: Textual or categorical data such as teacher comments, student feedback, survey responses.
- **Behavioral Data**: Interaction data from digital platforms (e.g., time spent on tasks, clickstream data).

2.1.5. Data preparation

- **Data Cleaning**: Ensure data accuracy and consistency by handling missing values, outliers, and duplicates.
- **Data Transformation**: Convert data into suitable formats (e.g., numerical encoding for categorical data).
- **Feature Engineering**: Create new features that may help improve model performance (e.g., aggregating scores over time).

2.1.6. Ethical and legal issues

- **Data Anonymization**: Remove personally identifiable information (PII) to protect student privacy.
- **Consent and Compliance**: Ensure data collection complies with legal and ethical standards (e.g., GDPR).

2.1.7. Data integration

- **Data Merging**: Combine data from multiple sources into a unified dataset.
- **Data Storage**: Use databases or cloud storage solutions to manage and access the data efficiently.

2.1.8. Data analysis

- **Quality Assurance**: Validate data accuracy and completeness through sampling and testing.
- **Stakeholder Review**: Get feedback from stakeholders on data relevance and quality.

2.2. Continuous Monitoring and Updating

- **Data Updates**: Regularly update data to keep models relevant and accurate.
- **Performance Monitoring**: Continuously monitor model performance and make adjustments as needed.

Section 3: Resources for teachers. Module 1: Tools to enable learning with AI

Objective: Promote collaborative and problem-based learning to enable learning with use of Generative AI (Chatbot):

- Interactive Scenarios: AI can generate interactive conversations through questions and answers, based on student doubts and decisions, helping them engaging more deeply with the material.

- Collaborative Learning Platforms: AI can facilitate group projects by creating collaborative platforms where students can work together on problem-based learning tasks, providing hints and feedback in real-time.

3.1. Indicators and criteria for the better design of teaching process

Criteria	Indicators
Development of course-specific competences	● participation in the course ● achieve learning objectives ● analyze videos and other multimedia ● make interesting questions ● report self-assessment

Individual progress and difficulties	● average mark
	● attendance to the sessions
	● percentage of completed assignments

Cognitive motivation, discourse coherence, creativity, …	● supplementary lectures attendance
	● students' status of enrolment
	● creations

Development of soft skills	● positive social relations
	● teamwork
	● emotional skills
	● commitment and persistence management
	● resilience

3.2. Types of data for assessing these indicators and criteria

- Demographic Data: Age, gender, socioeconomic status
- Academic Records: Grades, course enrollments, completion rates
- Engagement Data: Participation in class, submission of assignments
- Behavioral Data: Time spent on teamwork
- Textual data, in a broad format, including descriptions, interpretations, essays, critical analysis, narratives, self-assessment, etc.

3.3. Types of reports produced by the Chatbot

- Qualitative reports on each student, in which the AI provides the teacher with partial or final feedback on how the student is progressing in the course. In relation to this report, the more activities there are in moodle that report narrative data, the more times the student is graded through moodle, and the more questions the teacher has proposed and answered, the more complete and reliable the report will be.

- Report at the end of the course, summarizing the progress of all students and the development of the activities. It is a report that aims to provide feedback to the teacher on the design of the course itself (meta-evaluation), on the functionality of the activities and on his/her teaching activity (self-evaluation).

3.4. Advice for Teachers:

3.4.1. Training course design:
- Define the pedagogical model taking into account the learning context (create the pedagogical action trainer guide),

- Building the learning roadmap,

- Structure the context learning (individual/collaborative learning, synchronous/asynchronous moments…),

- Defining the tutoring and communication system,

- Define learning activities and strategies,

- Create learning contents (case studies, related learning contents and activities),

- Define the assessment system (formative and quantitative assessment).

3.4.2. Running the training course:
- Create Moodle account,

- Organize the learning binder for each trainee,

- Explain the methodology and structure of tasks,

- Introduce the context learning,

- Establish communication channels during the process.

3.4.3. Guiding the student during the course:
- Monitor trainee progress and performance (tracking Moodle data: grades, number of attempts, time spent, amount trials, etc.,

- Offer formative and quantitative feedback during the process,

- Organize sessions to present and discuss solutions relating to the tasks.

3.4.4. Engagement:
- Use active methodologies as much as possible,

- Offer Moodle delivery exercises to keep up to date (test, puzzles, fill-in-the-blanks…),

- Use Moodle in online and face-to-face modalities,

- Promote consumption of optional material, sites, etc. through Moodle.

3.4.5. Chatbot:

- Encourage your students to interact with the Chatbot as much as possible,
- AI provides the teacher with partial or final feedback on how each student progresses in the course. The more activities there are in Moodle that report narrative data, the more times the student is graded through Moodle, and the more questions the teacher has proposed and answered, the completer and more reliable the report will be,
- 24/7 availability: Chatbots provide assistance outside of class hours, allowing students to get answers to their questions at any time. This reduces the workload for teachers by eliminating the need to always be available,
- Continuous assessment: Chatbots can provide instant feedback to students, allowing teachers to continuously assess student performance and adjust their pedagogical approach based on the results obtained,
- AI provides the teacher with a report at the end of the course, summarizing the progress of all students and the development of the activities. It is a report that aims to provide feedback to the teacher on the design of the course itself (meta-evaluation), on the functionality of the activities and on his/her teaching activity (self-evaluation),
- Improved tracking of student progress: The chatbot can record student interactions and provide feedback on their performance, allowing teachers to identify areas where students need more support, as well as continuously track their progress without having to manually review each interaction.

Objective: Provide personalized tutoring according to students' needs and learning capabilities.

Use of Generative AI:

- Adaptive Learning Paths: Generative AI can create adaptive learning paths tailored to each student's progress and learning style.
- Chatbots and Virtual Tutors: AI-powered chatbots can offer instant feedback and tutoring on-demand. These virtual tutors can answer questions, explain concepts, and guide students through difficult topics.

Creating a personalized tutoring system from scratch without relying on existing tools is a challenging but feasible task. Here's a detailed approach to building such a system:

4.1. Define the Scope and Objectives

Define Scope and Objectives: Identify the topics the tutoring system will cover and specify the target audience.

Build a Content Repository: Gather high-quality educational materials and organize them into modular units for flexibility.

Design System Architecture: Develop an intuitive user interface and set up the backend infrastructure for

data management.

Implement Adaptive Learning Algorithms: Collect data on student performance and use machine learning to personalize content recommendations and adjust question difficulty.

Create Personalized Learning Paths: Use initial assessments to set starting levels, then adapt pathways dynamically with extra help or advanced content as needed.

Add Interactive Features: Incorporate a chatbot for assistance and interactive exercises with instant feedback.

Integrate Continuous Feedback Mechanisms: Use frequent assessments and feedback to monitor and support student progress.

Ensure Data Privacy and Security: Encrypt student data and comply with data protection regulations.

4.2. Example Implementation Steps:

Step 1: Initial Setup

1. Content Repository:
   - Collect and digitize educational materials (e.g., textbooks, videos, quizzes).
   - Organize content into a database with metadata tags for easy retrieval.
2. System Architecture:
   - Design a database schema for storing user data and educational content.
   - Develop a web-based user interface for students and administrators.

Step 2: Adaptive Algorithms

1. Data Collection and Storage:
   - Implement mechanisms for tracking student interactions, quiz results, and time spent on tasks.
2. Machine Learning Models:
   - Develop and train a recommendation engine using historical data to suggest the next learning activity.
   - Implement knowledge tracing models to track student understanding over time.

- Design adaptive testing algorithms to dynamically adjust quiz difficulty.

Step 3: Personalized Learning Paths

1. Initial Assessment:
   - Create diagnostic assessments to determine students' starting knowledge levels.
2. Dynamic Pathways:
   - Develop algorithms that generate personalized learning paths based on assessment results and ongoing performance data.

Step 4: Interactive Features

1. Chatbot Tutor:
   - Develop an AI-powered chatbot using natural language processing (NLP) to interact with students.
   - Train the chatbot to provide explanations, answer questions, and offer hints.
2. Interactive Exercises:
   - Create interactive exercises and simulations using tools like HTML5 and JavaScript.
   - Integrate instant feedback mechanisms into these exercises.

Step 5: Continuous Feedback

1. Formative Assessments:
   - Integrate formative assessments at regular intervals to monitor progress.
2. Feedback Loop:
   - Implement feedback mechanisms that provide students with insights into their performance and suggest areas for improvement.

Step 6: Data Privacy and Security

1. Data Encryption:
   - Implement data encryption protocols to secure student data.
2. Compliance:

- Ensure compliance with data protection regulations by incorporating necessary legal and security measures.

Step 7: Pilot and Iterate

1. Beta Testing:
   - Conduct a pilot program with a select group of students and teachers.
2. Feedback and Improvement:
   - Collect and analyze feedback from pilot participants. Continuously refine and improve the system based on user feedback.

4.3. Indicators and criteria for the better design of tutoring

Criteria	Indicators
Initial and Ongoing Support	Subject knowledge, use of digital tools, participation, adherence to timelines, etc.
Personalized Learning Plans	Average grade, percentage of competencies acquired, percentage of completed assignments, learning goals, learning styles.
Constructive Feedback	Quality of feedback, content popularity, student interest in topics, pass rate per subject.
Reflective Practices	Implementation of reflective practices by both students and tutors.
Technology Integration in Tutoring	Use of online resources and learning platforms.

4.4. Data collection and registration processes tools with AI

Tutors will conduct questionnaires to collect narrative data on the following topics:

- Definition of needs before the start of the course
- Difficulties in the learning process

- Possible lack of motivation
- Needs for adaptation of the teaching process to learning difficulties or disabilities.

4.5. Types of reports produced by the Chatbot

- Qualitative reports on each student, in which the AI provides the teacher with an individualized proposal for student counseling. According to the questions proposed by the teacher in the questionnaires, the Chatbot will offer information about the needs of reinforcement, support or adaptation of pedagogical resources that each student has.
- A report at the end of the course that provides feedback to the teacher on the usefulness of the tutoring process to implement improvements in both the data collection questionnaire and the tutoring action itself.

4.6. Advice for Teachers:

4.6.1. What Teacher should do:
- Conduct questionnaires to collect narrative data on the following topics: Definition of needs before the start of the course, Difficulties in the learning process, Possible lack of motivation, Needs for adaptation of the teaching process to learning difficulties or disabilities, etc.,
- Explain the structure of the learning process,
- Make the tutorials as productive as possible,
- Design navigation patterns that allow individualized tutoring,
- Self-organized navigation through a learning environment with a high degree of freedom,
- Offer instant feedback,
- Offer an appropriate timespan to students,
- Evaluate the progress of each student and redesign if necessary.

4.6.2. What Peers should do:
- Enhance peer-to-peer learning (face-to face/online, synchronous/asynchronous…),
- Promote recommendations between them.

4.6.3. What about Chatbot:
- Promote its use for personalized tutoring,

- AI offers qualitative reports on each student, in which the AI provides the teacher with an individualized proposal for student counseling. According to the questions proposed by the teacher in the questionnaires, the Chatbot will offer information about the needs of reinforcement, support or adaptation of pedagogical resources that each student has,

- AI offers a report at the end of the course that provides feedback to the teacher on the usefulness of the tutoring process in order to implement improvements in both the data collection questionnaire and the tutoring action itself.

Section 5. Resources for teachers. Module 3: Tools to prevent dropout with AI

Objective: Identify and prevent potential dropouts through early intervention.

Use of Generative AI:

- Predictive Analytics: AI can analyze student data to identify at-risk students by recognizing patterns that precede dropouts. This allows for timely intervention by educators.

- Personalized Interventions: Based on predictive analytics, AI can generate personalized intervention plans to re-engage at-risk students through tailored support and resources.

5.1. Indicators and criteria for preventing dropout

Criteria	Indicators
Individual progress	gap in student competencies from initial to target level
Topic relevance motivation	Popularity and interest on the topic
Enrolment	motivation, tutorial attendance, …

Warning signs	absences from classes, continuous late deliveries, …
Personal and social difficulties	Difficulties in social or economic context, some disability, …

5.2. Types of data for assessing these indicators & criteria (ideas to check)

- Academic resilience (López Aguilar et al. 2023), tolerance for frustration, perseverance at work, etc.
- Academic Records: Historical grades, GPA trends
- Attendance Data: Consistent patterns of absence
- Engagement Data: Low participation in activities
- Socioeconomic Data: Financial aid status, family background
- Survey Data: Student satisfaction, feedback

5.3. Data collection and registration processes tools with AI

- Quantitative data, such as grades, absences, attendance records, test scores.
- Qualitative data, such as textual or categorical comments, student feedback, survey responses.
- Behavioral Data, such as time spent on tasks, clickstream data.

5.4. Advice for Teachers

5.4.1. What Teacher should do:

- Encourage to engage in the subject from the start,
- Evaluate the learning: Moodle delivers tracking data, (for example: sites visited, passed assessments, number of trials) that can be analysed with regard to the mean values. Might be used to estimate the mean learning success and for feedback,
- Provides continuous feedback.

5.4.2. What about Chatbot:

- Explain its usefulness to students from the beginning in order to motivate them to use it constantly,
- Personalize tutoring on an ongoing basis,
- AI offers qualitative reports on each student, in which the AI provides the teacher with information on whether the student is following the course. This makes it possible to detect problems and

prevent dropouts. Early detection of signs of disengagement: The chatbot can monitor student interactions and detect patterns of demotivation or underachievement. If a student shows signs of losing interest, the chatbot can alert teachers or tutors, who can quickly intervene to offer additional support,

- Constant reminders and motivation: The chatbot can send reminders about pending assignments, exam dates and other important events, helping students stay organized and engaged with their studies. In addition, it can offer motivational messages or words of encouragement, helping to keep morale high and prevent students from feeling overwhelmed,

- Workload Manager: Can help students manage their assignments and deadlines by providing automatic reminders, scheduling deadlines and offering suggestions on how to better organize themselves to meet course requirements.

Section 6. CHATBOT uses and strategies

What is a chatbot integrated in a virtual course

How to prepare and format lesson content to use a Chatbot with

These two sections (submenus) include a short description and are displayed in the following second-order submenus:

6.1. What is a chatbot integrated into a virtual course?

6.1.1. What is this chatbot?

- It is an interactive application for students that consists of a Moodle plugin in the form of a side-panel wizard.

- It has two functions:

The Learning Reinforcer checks that the student has learnt the lesson.

The Solution Guider to help the student resolve doubts.

6.1.2. How does the Learning Reinforcer work?

- Ask the student questions about the content

- If the student answers correctly, they move on to the next level.

- The chatbot asks the same questions (phrased differently), shortening the time between them if the answer is incorrect, or spacing them out if the answer is correct, until it finally considers them learned. Academic

Coach: The chatbot can provide general guidance on the course, offering information on how to organize study time, how to prepare for exams or how to make the best use of the available learning materials. It acts as a study advisor on the platform.

6.1.3. How does the Solution Guide work?

- Acts as support for the student when they encounter a doubt or a concept they do not fully understand.

- The student asks the chatbot a question, and instead of answering directly, the bot encourages the student to think and try to find the solution on their own.

Step-by-step problem solving: The chatbot can guide learners through solving complex exercises or problems by providing clear, step-by-step instructions. It can provide detailed explanations of the logical and methodological steps needed to reach the solution, without directly giving them the answer.

Solution suggestions: Instead of directly providing answers, the chatbot can ask guided questions or provide hints that help students think of the correct solution on their own. This encourages critical thinking and learner autonomy.

6.1.4. How do Learning Reinforcer & Solution Guide work together?

- Both functionalities are integrated into the same chatbot, so the user uses it as a single component.

- Initially the Learning Reinforcer will trigger a question for the student. The student will not be able to ask the Solution Guider anything until the Learning Reinforcer allows it.

- Once allowed, the chatbot will inform them that they can either ask another question to try to solve it or ask a question about the content.

- Based on the user's input, one or the other functionality will be triggered.

6.2. How to prepare and format lesson content to use a Chatbot with?

6.2.1. You need to convert all the information in the lessons into text. How do you do this?

- PDFs: Copy and paste the text content.

If you have subject material in PDF format within the platform, all this content must be converted into understandable text so that the chatbot can process it correctly. To do this, simply copy and paste the PDF content and save it to a text file (.txt). This step ensures that the chatbot can access the information in a structured way and provide accurate and useful answers to the learners.

- External web pages: Copy and paste the text content.

If the subject material includes links to external websites, it is important to keep in mind that the chatbot cannot directly access or process the content of those websites. Therefore, to ensure that the chatbot can provide complete and accurate answers, it is advisable to transcribe the relevant information from those websites into a text file (.txt) and add it to its knowledge base. In this way, the chatbot will be able to integrate and use that external information to enrich its ability to assist learners.

- Images: Upload them to ChatGPT and ask it to describe them. Copy and paste

and paste the text output.

- Videos: Use a tool that transcribes the audio from the video, such as Glasp. Particularly useful for YouTube videos. It installs as a browser add-on. Copy and paste the text output. The chatbot does not have the capacity to automatically interpret the content of images or videos. For this reason, it is essential to complement these resources with a detailed description in text that explains the information conveyed by the image or, in the case of videos, provide a transcript of the content in text format (.txt). This will allow the chatbot to access all relevant information and provide more accurate and contextualized answers to learners.

- Tables: Prepare them in CSV format.

And finally, design a set of questions organized by topic, allowing the chatbot to effectively guide and support the learner in their learning process.

Once all the information has been collected and prepared, it is essential to structure it in an organized database. This will allow feeding the chatbot efficiently, ensuring that it can process and access the data in an optimal way. A well-structured database facilitates knowledge management, improves the accuracy of the chatbot's responses and ensures its correct functioning in the learning process.

6.2.2. Which is not useful information?

- A resource that is merely supplementary.

Videos or images that are used only as visual support to reinforce or complement an explanation previously processed by the chatbot in text format do not need to be re-incorporated into its knowledge base. Since the essential information has already been provided in textual format, these resources fulfill an illustrative function without requiring additional processing by the chatbot.

- A video where the visual element is crucial, and the audio alone would not add much value.

add much value.

- The resource is an anecdotal example to help the student understand the lesson but does not contain any valuable information.

- Exercises such as "state the true statement" as the false statements could confuse the bot.

could confuse the bot.

Exercises that include true and false statements, such as "indicate the true statement", are not suitable for the chatbot, as incorrect statements can lead to confusion in its learning process. To ensure accurate and consistent responses, it is advisable to provide only truthful and clearly structured information.

-The resource is a diagram or summary of a text to be provided.

Overly simple examples or summaries intended only to facilitate basic understanding of the subject matter are not necessary to feed the chatbot, as their purpose is to provide more detailed and specific information. The chatbot should focus on relevant and structured content that delves deeper into key concepts, avoiding material that does not add additional value to the learning process.

Section 7. Mentoring and coaching processes to boost the use of AI and increase performance (pedagogical recommendations complementary to the tools)

7.1. Conditions which facilitate and optimize digital tutoring

7.1.1. To generate a close relationship.

1. The first purpose is to make the student feel welcomed and supported by the tutor. Show kindness and affection, talk in a relaxed and receptive way. Compensate the distance with warm words and interest towards the student.

2. In the first interview, look for a shared theme with the student and discuss it informally. Any opinion, idea, experience, provenance, etc. is valid. The goal is to find something you have in common. The fact of sharing something increases the perception of closeness.

7.1.2. Once the relationship has been activated and trust has been facilitated, the more targeted mentoring process begins.

1. Ask the student about his/her goals, priorities, and needs. It is about collecting information and empathizing with its processes (past, present and future).

2. Ask him/her questions aimed at reflecting on his/her strengths and aspects to improve.

3. Explore together the options and possible supports available to in his/her social and institutional context.

4. Prepare together a list of possible difficulties, limits and conditioning factors for the achievement of his/her objectives.

7.1.3. After developing the framework for the student's progress, a less directed mentoring process begins.

1. The tutor accompanies the student in the elaboration of the work plan.

2. The tutor is at the student's disposal to answer his/her questions and redirect him/her to other services or sources of information when deemed appropriate.

3. Empower the student, activate his/her leadership and entrepreneurial skills, to facilitate his/her growth and creativity.

4. Contribute to the student seeking and taking advantage of extra-curricular training opportunities, internships and experiences related to training.

5. Support the student to integrate the education program in his/her life project and to find a connection between it and his/her needs, values, personal characteristics, etc.

7.2. Conditions that facilitate learning through peer tutoring

7.2.1. Multilevel modality: direct helping relationship.

1. To the student to benefit from the role of tutor (higher level student) may benefit, it is important that his/her level of competence is only a little above the zone of proximal development (ZPD, Vygotsky) of the other student.

2. The dynamics of the tutoring must include several phases of awareness of the learning process for both. Each student must identify their initial level and what the tutoring relationship provides them with respect to knowledge, practical skills, soft skills, and so on.

3. The student in the role of tutor will become aware of a much deeper vision of the subject, increase his/her self-concept and perception of self-efficacy and develop communication skills.

4. The student-tutor must be trained so that he/she knows how to give emotional and motivational support, not just intellectual boost.

5. The student-tutor needs guidance and accompaniment from the teacher to know how to structure knowledge, make it more understandable, organize tasks, etc.

7.2.2. Interlevel modality: bidirectional helping relationship and collective learning.

1. Cognitively, tasks that generate conflict and achievable challenge should be set. It is important that the level of difficulty is within everyone's zone of proximal development (ZPD, Vygotsky)to avoid frustration and early abandonment.

2. It is advisable to provide social reinforcement to the group through words of support, praising the work process and encouraging participation.

3. It is desirable to carry out explicit and strategic metacognition activities on the learning process and results. Not only is more effective further learning promoted, but it allows them to be more confident that they can achieve even more, and that their success is the result of their own efforts.

4. In the case of assigning roles within the couple or team, it is important to rotate so that everyone assumes all the functions.

5. Within the collective learning process, self-assessment plays a fundamental role. For example, questions like: What have we learned so far? What difficulties do we have? What is our next goal?

7.3. E-tutoring to facilitate peer learning

7.3.1. First steps: accompaniment for collective awareness.

1. Tutoring should facilitate the construction of cooperation frameworks and fluid communication channels between students. The most common is to use tools such as forums and chats.

2. Students need to know that learning is built together through sociocultural interaction directed towards common goals. The first task of the e-tutor will be to achieve a shared definition of these objectives and the cooperation framework in which they will work.

3. A good relationship between the students who work together is essential, where no authoritarian position is distinguished by any student or the tutor; and a good attitude on his part, based on enthusiasm, security and understanding.

7.3.2. How to activate peer learning during the process.

1. The e-tutor must facilitate the processes of organization of tasks, assignment of roles, management of role rotation and provision of information sources to start the project.

2. The negotiation of meanings, through a type of interaction based on dialogue, is one of the main mechanisms for the internalization of shared knowledge in a situation of interaction between equals. The e-tutor has the function of facilitating these negotiation processes and mediating possible conflicts.

3. Assuming that divergent cognitive conflict is very productive in peer learning, the e-tutor must generate questions that activate this conflict. In this way, the rethinking and revision of the concepts can be favored at the same time for a greater organization of them, around the task that is executed.

7.3.3. Assessment-learning cycle.

1. Computer-assisted formative assessment is needed in all e-tutoring systems, so that both tutors and mentees receive regular, frequent and just-in-time feedback on the effectiveness of joint learning.

2. Make a guide that facilitates the monitoring of the learning process. Check questions and items with rating scales may be included.

3. Make available to students an evaluation rubric with the expected and graded performance to facilitate their autonomous management and results-oriented decision-making.

Section 8. Implementation and evaluation of the tools: development of spiral cycles

8.1. Phases of implementation

- *Context analysis: exploration of needs, target groups and resources,*
- *Purpose of the course and goals,*
- *Definition of the data we want to collect,*
- *Pilot implementation and data collection,*
- *Using generative AI to analyze and compile results,*
- *Evaluation and adaptation to improve tools.*

8.2. Summary to digitalise a subject

- Divide the subject into blocks of contents.

- Add theory summaries during the course. Write all the text of the ppt-s slides in Moodle as well (so that the chatbot can be fed).

- Add in each section two exercises in the H5P format so that the students can do them little by little and we have an idea of how the progress is going.

- Ask students to do online exercises, activities such as: crossword puzzles, fill-in-the-blanks…, tests during the course and add the grades in the Moodle delivery.

8.3. What are the key aspects?

- Interactive Scenarios (student-teacher): The goal is to make the tutorials as productive as possible (with specific questions), as the chatbot would take care of the other questions.

- Collaborative Learning (between peers): They have the option of helping each other in the activities they are unable to do.

- Engagement: The delivery exercises should help them to keep up to date with the material.

- Performance: To squeeze the most out of the personalized tutorials that the chatbot offer.

8.4. Diagram to summarize

START

Goal and problem definition:
1. dropout prevention
2. personalized tutoring
3. active learning.....

Data acquisition and preparation - DMP

FAIR – Findable, Accessible, Interoperable and Reusable

Ethics and legal restrictions

Data acquisition:
- Internal data of the institute
- public databases (Zenodo..)
- simulations and synthetic data

eAsistent

moodle

sensors

*ERP sist.

cameras

Data cleaning:
- removing missing values
- removing duplicate or meaningless values
- formatting data to the same scale
- eliminating abnormal values

Data transformation:
- structured data (Excel, CSV...)
- non-parametric data into numeric

Additional data acquisition

Model Selection and Design - Example

Problem Type	Best Model
Predicting numerical values (e.g. temperature, price)	Linear Regression, Neural Networks
Classification (e.g. is an email spam or not)	Logistic Regression, Random Forest, SVM
Image Recognition	Convolutional Neural Network (CNN)
Text Analysis (e.g. sentiment analysis)	NLP Models (e.g. BERT, LSTM)
Anomaly Detection (e.g. machine failure)	K-means, Isolation Forest

e.g. for linear regression we build an AI model in Python with the Scikit-Learn library. But ChatGPT can also help...

Model Training - Example
- Splitting data into training (80%) and test (20%) sets
- Choosing an algorithm (e.g. neural networks...)
- Model training (with multiple iterations – epoch) Evaluation (e.g. using matrices: accuracy, RMSE)

Python Libraries:
- Tensor Flow
- PyTorch
- Scikit-Learn

Google Colab

MATLAB

Evaluation and Optimization
- Accuracy Metrics (e.g. Accuracy, Precision, Recall)
- Finding Optimal Parameters (GridSearch, Bayesian Optimization)
- Overfitting/Underfitting Analysis (Adjusting Model Complexity

Is the model accurate enough?

No

Yes

Yes

Implementation and Usage methods

- As a REST API (e.g. FastAPI, Flask)
- Integration into existing systems (ERP, IoT - Raspberry Pi)
- Edge AI (on embedded devices)

Continuous Monitoring and Updating

END

*ERP - enterprise resource planning

NEXT STEP

1. Has the ultimate goal been achieved?
2. Modules from AI4ED together cover the content - areas in the Flowchart!
3. Problem statement!!