



AI4ED

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

Deliverable

D5.3 – Report on Use cases implementation of AI4Ed

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EXECUTIVE SUMMARY / ABSTRACT

Abstract	This deliverable compiles four AI-enhanced educational use-cases and the accompanying AI4Ed Training Program. For each initiative we outline its purpose, the learner group addressed, the course layout designed for systematic data collection and evaluation, and the main challenges and refinements identified. Together, these examples provide a concise overview of how AI can be applied, assessed, and continuously improved across diverse teaching and learning contexts.
Keywords	Artificial Intelligence, education, use-cases, training program, evaluation, personalized learning.

I Introduction

This deliverable consolidates the practical experience gained in AI4Ed through four AI-enhanced educational use-cases and the project's seven-module Training Program. Each use-case is documented with a uniform template that describes its purpose and learning objectives, the intended student profile, the course content and data-collection design that support rigorous evaluation, and the challenges encountered alongside subsequent refinements. By presenting a consistent set of indicators, from engagement metrics to learning-outcome measurements, the report enables direct comparison across vocational and higher-education contexts. The Training Program is included as a transversal initiative, equipping educators with the competencies needed to replicate and scale the approaches demonstrated in the use-cases.

2 IMH Use Case (Spain)

2.1 Summary and objective

The objective of this use case at IMH is to reorganize the Moodle platform in order to collect data that will help with the integration of artificial intelligence to improve the quality of the students' learning process.

2.2 Student Profile

This use case is implemented in the first-year programming course of the Engineering in Innovation of Products and Processes. The students in this course come from both high school and vocational training backgrounds, with ages ranging from 18 to 22 on average. This group typically has no prior programming experience, making this their first contact with programming, specifically with the Python language.

2.3 Course content and structure for proper data collection

2.3.1 Course content:

Designing the course content in a way that would allow for the efficient collection of meaningful data to inform future improvements, particularly for dropout prevention and AI integration, required a methodical and thoughtful approach. The structure was carefully tailored to ensure that data could be captured effectively, while maintaining an engaging learning experience for the students. Below is a detailed explanation of the course structure:

- **Theory:** To provide students with the necessary foundational knowledge, the course starts with the presentation of theoretical content. Initially, this content was uploaded as PDFs, which is a familiar format for the students. However, it was soon realized that providing solely PDF materials might not foster the level of engagement required for better data collection. As a result, the content was gradually supplemented with text-based summaries to ease students into the learning process, allowing for a smoother transition between formats.
- **Interactive Activities (H5P):** After presenting the theoretical content, the students engage with interactive activities in the H5P format. These activities play a crucial role in reinforcing the concepts introduced in the theory sessions and provide a mechanism for real-time data collection. The H5P activities were specifically chosen because they allow for various forms of student engagement, such as multiple-choice questions, drag-and-drop activities, fill-in-the-blank exercises, and even interactive videos. Each activity is designed to assess the students' understanding of key concepts, ensuring that the learning process is not passive. By tracking student progress through these activities, detailed data can be collected, including response times, accuracy, and patterns in learning. This helps identify areas where students may struggle, providing insights into which aspects of the course need further clarification or attention. The interactive nature of H5P also allows for immediate feedback to students, which is a valuable tool for both their learning and for data analysis. The feedback mechanisms embedded in the activities help students understand where they went wrong, reinforcing the learning process.
- **Assignments:** At the end of each topic, students are tasked with completing assignments that serve as both a practical application of the theoretical knowledge and a further data collection point. These assignments are designed to assess how well students can apply the programming concepts they have learned to solve real problems. The design of the assignments also allows for longitudinal data collection,

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tracking student progress over time and ensuring that their learning is progressing as expected. This continuous data collection is especially valuable in the context of dropout prevention, as patterns of decline in performance can be detected early and addressed accordingly.

Figure 1 is an image that visually the structure described above, providing a clearer overview of how each component of the course contributes to gathering insights for improving student learning and the overall course experience.



Figure 1 - Image of the moodle

2.3.2 Integration of AI and Chatbot:

One of the most innovative aspects of this course structure is the integration of a chatbot powered by artificial intelligence. The chatbot was designed to act as an assistant, helping students with their questions and offering step-by-step guidance on solving problems. The chatbot is an integral part of the course's data collection strategy, as every student interaction is logged, providing valuable insights into their learning process.

The students have shown considerable interest in the chatbot, often turning to it first when they have doubts or need assistance with programming problems. This has helped foster a more independent learning environment, where students are encouraged to solve problems on their own before seeking direct help from instructors. The chatbot interactions also provide data on common student questions, allowing instructors to identify the topics that may require more focused attention in future lessons.

The integration of AI into the course serves multiple purposes: it not only aids in the immediate learning process but also allows for the collection of large volumes of data on student behavior and engagement, which will ultimately contribute to improving the learning process through AI-driven insights.

2.3.3 Data Collection Mechanisms:

All of these components— the theoretical content, interactive activities, assignments, and chatbot interactions— were designed with data collection in mind. The primary goal is to gather as much relevant data as possible to inform decisions regarding both the immediate learning experience and long-term

D5.3 – Report on Use cases implementation of AI4ED improvements to the course structure.

Data is collected in a variety of forms, such as:

- Student progress through activities and assignments.
- Time spent on each activity and lesson.
- Patterns in student errors or difficulties with particular concepts.
- Interaction patterns with the chatbot, including frequency, duration, and the types of questions asked.
- Grades and performance metrics from assignments and quizzes.

The goal of this data collection is not only to monitor individual student progress but also to identify broader trends and patterns that may indicate potential areas for course improvement. For example, if a large number of students struggle with a specific topic, it may indicate that the teaching materials or methods need to be revised.

2.4 Evaluation and measurement of results

The evaluation of students has been positive, with strong engagement in the course and the chatbot. The chatbot, which students often turn to first when they have doubts, allows them to resolve issues step-by-step and encourages independent learning. This is a valuable tool in helping students understand programming concepts.

In addition to the chatbot interactions, student progress is evaluated through quizzes, assignments, and interactive activities, providing measurable data on engagement and understanding. Immediate feedback from these activities helps students identify mistakes and correct them quickly, enhancing their learning experience. The ability to track student performance in real-time is crucial for identifying struggling students early on.

For professors, organizing Moodle in this way has made it easier to track student progress and performance. The use of automated grading for quizzes and activities reduces the need for manual corrections, allowing instructors to focus on providing targeted support where needed. This structure enables instructors to monitor student progress more efficiently and intervene when necessary, without the added burden of constant grading.

Overall, this approach has proven effective in both supporting students' learning and streamlining the evaluation process for instructors.

2.5 Challenges and improvements

Reorganizing the Moodle platform and integrating data collection was not without challenges. One of the main difficulties was ensuring that the course structure didn't overwhelm the students, as this was their first experience with programming. We had to ensure a gradual transition to the new format so that it didn't disrupt their learning.

The shift from traditional PDFs to interactive elements like quizzes and H5P activities was initially met with

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resistance, but students gradually adapted. The immediate feedback provided by these activities proved to be valuable in maintaining engagement and helping students improve their understanding.

A significant challenge has been dropout prevention. The data collected so far hasn't been sufficient to make accurate predictions about dropouts, but we are optimistic that with more data over time, we will refine our models. This area remains a key focus for future improvement.

The integration of AI, particularly the chatbot, has also been both beneficial and challenging. While it provides valuable support to students, ensuring that it stays up-to-date and meets their needs has required ongoing effort. Despite these challenges, the overall feedback has been positive, and we're confident that with continued refinement, the course will continue to improve in its effectiveness.

3 UBREMEN Use Case (Germany)

3.1 Summary and objective

This cases study aims at using **active learning** to identify **navigation patterns**, that allow **individualized tutoring** to **prevent drop-out**. For this purpose, an asynchronous e-learning with a high number of degrees of freedom to navigate for the learners is installed on moodle. Results reveal a manifoldness of various navigation patterns and already some indicators for clusters of navigation patterns, that help identifying students at risk.

The objective of the use case of ITB Uni Bremen is a comprehensive, work-process oriented course on Additive Manufacturing (AM) in **German** language, consisting of 9 modules.

3.2 Student Profile

The course is designed both, for apprentices in technical Vocational Education and Training (VET) schools and Higher Education (HE) students in technical domains. Piloting took place in three classes in a VET school and one HE course for students, becoming VET teachers.

3.3 Course content and structure for proper data collection

3.3.1. Course content:

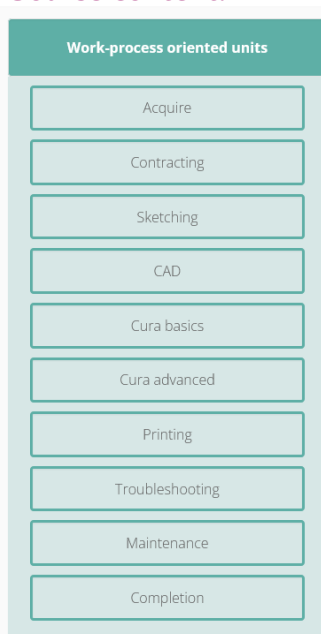


Figure 2 - Content of Uni Bremen use case (own translation)

The module “Printing”, for example, has the following detailed content:

- Start
 - Welcome!
 - How to use this learning unit
 - Introduction

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- Learning objectives
- Tools and materials needed
 - What you need
- Print settings in Cura
 - Settings for the 3-d model
- Preparing the filament and printer
 - Preparing the material
 - Change material – remove filament
 - Change material – inserting filament 1
 - Change material – inserting filament 2
 - Ensuring build plate adhesion
- Starting the print/adjusting print settings
 - Starting and adjusting
 - Time-lapse video of the print
- Postprocess the print
 - Needed tools
 - Video of post-processing
- Observing safety regulations
 - Safety regulation
- Final test

3.3.2. Course structure


At the very beginning, each learner is asked to fill in a short questionnaire; focussing on interests in AM etc.

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What is your highest level of education?				
<input type="checkbox"/> lowest school-leaving certificate	<input type="checkbox"/> intermediate school-leaving certificate	<input type="checkbox"/> Advanced technical college certificate	<input type="checkbox"/> Gymnasium	
In which educational pathway are you?				
<input type="checkbox"/> Apprenticeship Metal	<input type="checkbox"/> Apprenticeship Electro	<input type="checkbox"/> Other apprenticeship	<input type="checkbox"/> Higher education	
In what year of training/study are you in?				
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
Is German your native language?				
<input type="checkbox"/> Yes.		<input type="checkbox"/> No.		
Do you like to learn via online platforms?				
<input type="checkbox"/> With many pleasures	<input type="checkbox"/> With pleasure	<input type="checkbox"/> Neutral	<input type="checkbox"/> Rather without pleasure	<input type="checkbox"/> Without pleasure
What experience with additive manufacturing do you have?				
<input type="checkbox"/> None	<input type="checkbox"/> Basic knowledge	<input type="checkbox"/> First experiences	<input type="checkbox"/> Advanced user	<input type="checkbox"/> Expert
What interest do you have in the topic of additive manufacturing?				
<input type="checkbox"/> Very great	<input type="checkbox"/> Great	<input type="checkbox"/> Neutral	<input type="checkbox"/> Low	<input type="checkbox"/> Very low


Figure 3 - Entry questionnaire (own translation)

Afterwards the learners are free to start their learning journey with the module they want to and to work on as many modules as they are interested in. It is important to highlight, that the order of the content (as drafted for module “Printing” above) is only a suggestion, each learner is free to find an own path. At the end of each module, they are asked to answer a couple of Multiple Choice (MC) questions, if they reached <50%, it is recommended to restart the module, if they reach between 50% and 80% to restart the test – and if they reach >80% the test is passed.



Test your knowledge!

Exercise 1



Please set your answer by clicking the corresponding button. When finished go to next page.

What do you know about a draft angle in FDM parts?

- ☐ A draft angle is always necessary.
- ☐ A draft angle is never necessary.
- ☐ A draft angle is only needed on thin walls.
- ☐ A draft angle may be added to small holes.

Figure 4 - First question of the final test of module “Printing” (own translation)

At the very end of the learning journey, learners are, again, asked to fill-in a short feedback

D5.3 – Report on Use cases implementation of AI4ED questionnaire:

Overall, how satisfied are you with the structure and content on our learning platform?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
How would you rate the usability of our learning platform?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very good	Good	Neutral	Poor	Very poor
How satisfied are you with the quality of the learning materials on our platform?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
How well did you like the flexibility of the learning paths in relation to your individual needs and preferences?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very good	Good	Neutral	Poor	Very poor
How do you rate the technical performance of our learning platform (e.g. speed, reliability)?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very good	Good	Neutral	Poor	Very poor
How satisfied are you with the support and assistance on our learning platform?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
Would you recommend the learning platform to a colleague?				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Yes	Yes, main parts	Neutral	No, only few learning units	No

Figure 5 - Final questionnaire (own translation)

Additionally, as in all other use cases, a chatbot was installed, for details cp. for example chapter 6.3. of this report.

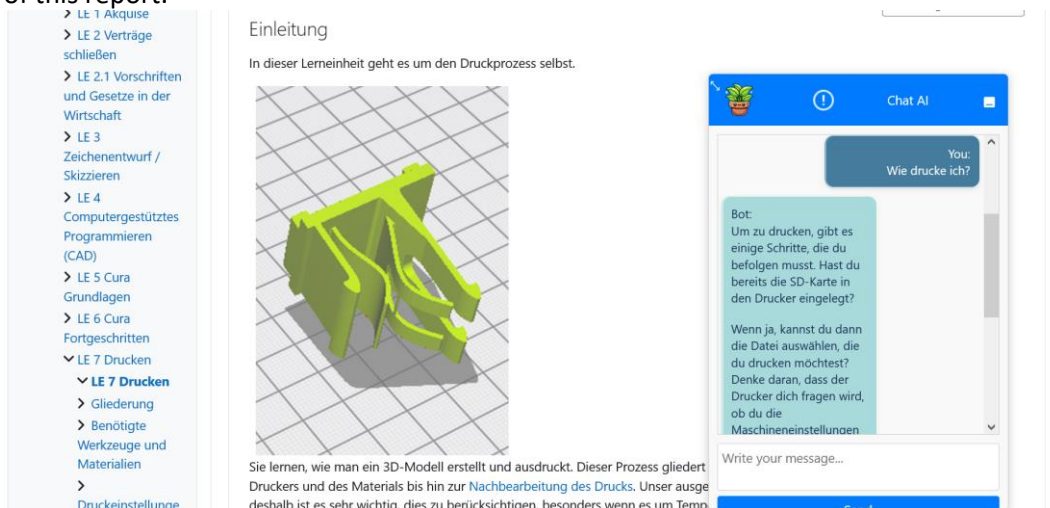


Figure 6 - Screenshot from chatbot

3.3.3 Data collection

Due to the very (partly too) high standards of German data protection laws, no personnel data is collected. Teachers prepared envelopes with functional e-mail addresses (user1@ITB.uni-bremen.de – user100@ITB.uni-bremen.de) and the corresponding passwords; each participant picks one of the envelopes and logs in as, for example, “user46”. Then all activities are tracked, the answers on the questionnaires, the modules chosen, the order of visiting the different slides of modules, time spent on each slide, whether optional content was visited or not, number of trials on the final tests, interactions (quantitative and qualitative) with the chatbot, etc.

3.4. Evaluation and measurement of results

Although evaluation is still “work in progress”, it can be summarised that piloting the use-case was quite a success. Feedback from participants received was very positive and the (preliminary) results of learner tracking and chatbot communications are really promising; some examples:

- Entry questionnaire (What experience with additive manufacturing do you have?):

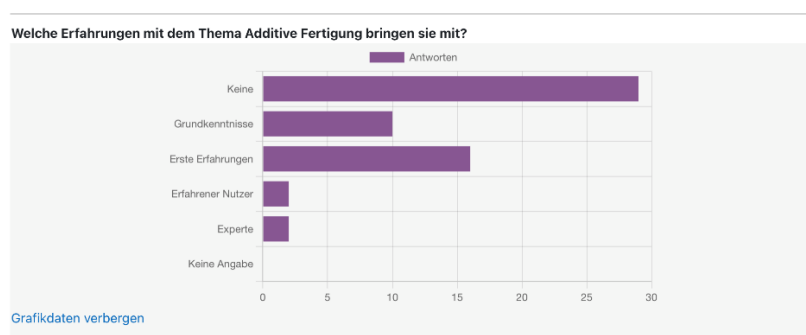


Figure 7 - Answers from entry test.

As Figure 7 indicates, most learners have no or only few experiences.

- Performance:
The learners very were engaged – and successful, as the following graph illustrates. Among the learners, who worked on module 1, the scores in the final test were as follows:

Gesamtzahl der Teilnehmer/innen, die einzelne Bewertungsstufen erreicht haben

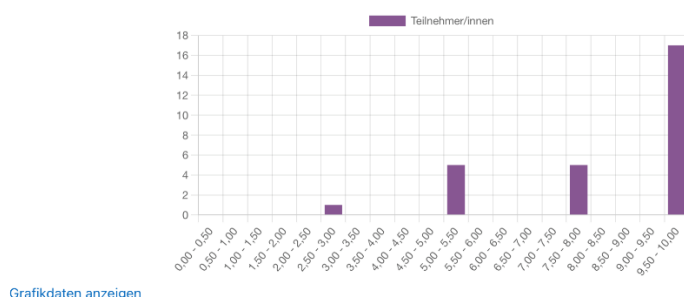


Figure 8 - Scores in the final test of module 1; scale: 2.5/3.0: 1 question out of 4 correct, 5.0/5.5: 2/4, 7.5-8.0: 3/4, 9.5/10.0: 4/4.

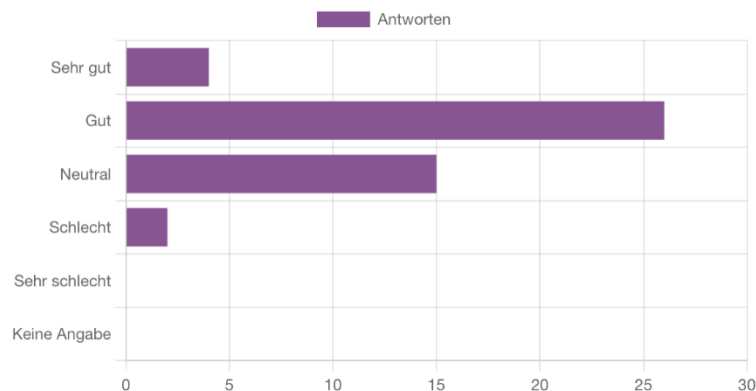
- Chatbot: It has been used very frequently, here an exemplarily communication:

„User53: Wofür ist das Datenformat STL wichtig
 Chatbot: "Das **STL-Dateiformat** ist besonders wichtig, weil es für die **Weiterverarbeitung in CAM-Programmen** benötigt wird. Es speichert 3D-Modelle durch angenäherte Dreiecke, was bedeutet, dass die Genauigkeit des Modells von der Anzahl der verwendeten Dreiecke abhängt. **Haben Sie sich bereits Gedanken darüber gemacht, wie die Wahl des STL-Formats die Qualität Ihres 3D-Drucks beeinflussen könnte?** Wenn Sie mehr Informationen dazu benötigen, können Sie den Abschnitt in Ihrem Kurs unter folgendem Link einsehen: [Link zum Modul](https://ai-moodle.itb.uni-bremen.de/course/view.php?id=6§ionid=90)." 2025-03-31 07:29:22"

'User53: What is the STL data format important for?
 Chatbot: 'The **STL file format** is particularly important because it is required for **further processing in CAM programmes**. It saves 3D models using approximated triangles, which means that the accuracy of the model depends on the number of triangles used. **Have you thought about how the choice of STL format could affect the quality of your 3D print?** If you need more information on this, you can view the section in your course at the following link: [link to module](https://ai-moodle.itb.uni-bremen.de/course/view.php?id=6§ionid=90).' 2025-03-31 07:29:22'

- Feedback: The question, how the users rate the quality of the learning material, was answered quite positive, but honestly. Most answered "good" or "neutral"; only 2 said "poor" and only 4 "very good".

Wie würden Sie die Qualität und Verständlichkeit des Lernmaterials bewerten?



[Grafikdaten anzeigen](#)

Figure 9 - Feedback on "quality of the learning material".

- Navigation patterns: With the help of zoola, it was possible to track the navigation patterns of all learners individually. Figure 10 documents a short part of the interactions of "user 79" in LE 1. Afterwards he/she continues with very brief visits of most materials.

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user79 user79	Einheiten für den Arbeitsprozess additiver Fertigungen	Additive Fertigung verfügt über viele Vorteile geg...	label	00:00:03
		Anwendung grundlegender Gestaltungsrichtlinien Addi...	label	00:00:09
		Aufnahme für das Automodell VW Golf VDanach vermes...	label	00:00:04

Figure 10 - 1st steps of user 79 in LE1.

As Figure 11 reveals, “user79” was the only one who answered only 1 out of 4 questions in LE 1 correctly (cp. picture 7) – a clear indicator that this kind of navigating through the modules shouldn’t be recommended.

Nachname	Vorname	Anmelden ame	E-Mail-Adresse	Status	Begonnen am	Beendet	Verbrauchte Zeit	Bewertung/10,00	Antwort 1	Antwort 2	Antwort 3	Antwort 4
user79	user79	user79	user@local host.de	Beendet	1. April 2025 08:43	1. April 2025 08:45	1 Minute 52 Sekunden	2,50	Durch Additive Fertigung kann das Gewicht reduziert werden.	Additive Fertigung hat grundsätzlich keine Designeinschränkungen.	Der Einsatz von FDM ermöglicht einen höheren Grad an Gestaltungsfreiheit	Nur Materialkosten, Energie und Personal.

Figure 11 - Score of “user 79” in the test of LE 1.

To summarise the findings and evaluation so far:

AI enhanced tools like semantic learning analytics (SLA) or chatbots widen the range of evaluable data; but still fail in evaluating and concluding automatically. Thus, it is still up to humans, to work on hypotheses like:

- An, in the first impression, promising navigation pattern like the one from “user 79” (visiting all material, but very brief); obviously without “real learning” of the materials leads to poor results.
- The quantity and quality of interactions with the chatbot correlates positively with success.

3.5 Challenges and improvements

The first challenge encountered was that the e-learning was prepared in the data format *.scorm; each module as a *.scorm file. Unfortunately, *.scorm files are treated as “black boxes” by moodle; moodle tracked only when a learner opens a *.scorm file and when he leaves – but not the navigation patterns within the module. The solution found, was to rebuild the learning environment on moodle – not very complicated, but time consuming.

2nd challenge was that the data structure collected by moodle (a *.csv file with thousands of lines) was too complex for the Semantic Learning Analytics (SLA) AI-model that was originally foreseen – thus other SLA models and AI applications had to be tested and applied – including the chatbot.

3rd challenge was the training of the chatbot. As the case of ITB Uni Bremen is quite complex (many modules/sub modules); data transformation was again (as in the 1st challenge) not complicated, but time consuming – it took till 03.2025 till the learning platform was finalised and piloting could start.

4 CENFIM Use case (Portugal)

4.1 Summary and objective

The CENFIM use case centers on the training and learning process within the technical domain of CNC (Computer Numerical Control) programming and machining. This is implemented through short-duration training units, typically ranging from 25 to 50 hours, and is situated within the broader framework of lifelong learning.

The main goal is to test, evaluate, and critically review the methods and strategies used to develop learning materials and activities. A second aim is to identify possible needs for reorganizing and improving the learning platform, especially to support better data collection for integrating artificial intelligence into the learning process. In the end, the objective is to enhance the learning experience and improve trainees' performance throughout their educational journey.

4.2 Student Profile

This use case is primarily intended for trainees enrolled in the CNC training course under the individual training modality or group approach. These participants are either employed or unemployed adults seeking to acquire or strengthen their skills in CNC programming and machining.

4.3 Course content and structure for proper data collection

4.3.1 Course structures and contents

Project and case study-based learning is the core approach. Over an estimated 50 hours, trainees work on a project that requires them to gradually acquire a range of knowledge and skills through the completion of smaller case studies (practical scenarios). These case studies are designed to account for each trainee's prior knowledge, skill level, and individual learning pace.

The image below represents the structure and the first component of the course (estimated time of 20h) that the learner can complete entirely online and through self-learning, being the preliminary stage before the face-to-face training. The learning platform (moodle) layout it was designed for simple and intuitive navigation, to keep the learner motivated and engaged in learning activities, as well as to enable effective data collection regarding the learner's performance throughout the learning process.

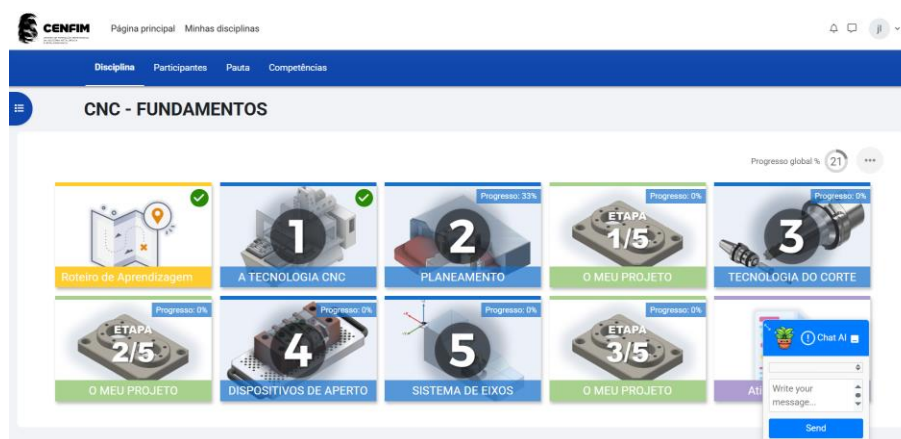


Figure 12 - Screenshot of moodle layout

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Each section can be described as follows: The orange section is about the learning roadmap, the blue sections are the case studies, the green ones cover the project development stages, and the purple one includes the final transition activities for the face-to-face training.

Case studies are a key element in this use case, primarily aimed at stimulating critical and creative thinking. Through these case studies, trainees are presented with challenges that require them to find solutions, using an active learning approach. From the very beginning, trainees can easily relate their learning activities to practical, real-world scenarios.

Figure 13 is an example of the structure of a case study. It begins with the presentation and framing of the scenario or challenge, followed by a series of learning resources designed to support the acquisition of knowledge and skills. These resources enable trainees to develop the competencies required to address and solve the challenge.

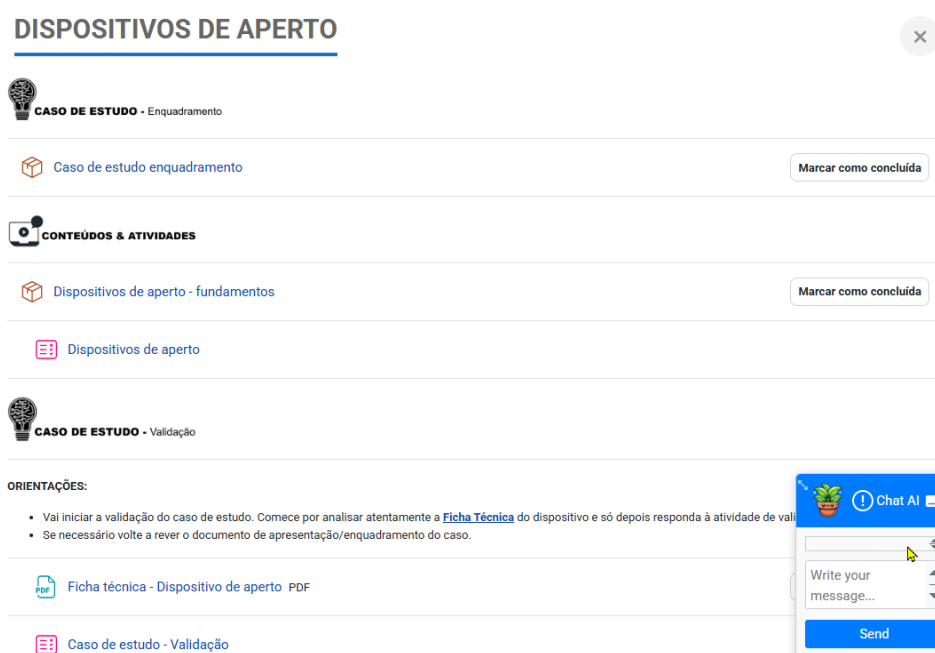


Figure 13 - Screenshot of an sructure case study.

The learning resources are developed in different formats, aiming to keep trainees engaged and involved in the learning process, with particular emphasis on:

. Presentation of the scenarios, presentation of practical activities, and knowledge acquisition:

Based on interactive PowerPoints that incorporate videos and other animations, allowing trainees to navigate freely, according to their interests and learning pace. These PPT resources are converted into SCORM packages to enable integration with the LMS platform and tracking the student progress.

Interactive and practical activities for the acquisition and/or consolidation of knowledge and skills, as well as to gain inspiration for solving the case study challenges:

By using interactive videos and quizzes to support practical activities, the goal is to provide trainees with immediate feedback, enabling them to assess their own progress and make independent learning decisions.

4.3.2 Data Collection

Beyond what has already been identified, the resources developed and used in this use case allow for the collection of data in various formats (as noted in the IMH use case). This facilitates the identification of areas where additional support may be needed and enables the tracking of trainees' progress and performance over time. Moreover, the analysis of this data supports decision-making regarding potential improvements to the learning methods and resources in use.

4.4 Evaluation and measurement of results

Case study-based learning has been stimulating for the trainees, who have provided very positive feedback. The challenges presented in the cases encourage trainees to engage more effectively, even during more theoretical moments. Knowledge and skills are acquired in an integrated manner, as the case challenges remain in the trainees' minds until a solution is found.

The integration of the Chatbot in this use case is undoubtedly an important improvement and a tool that could become highly relevant for the trainees, both in consolidating learning and in solving the various challenges associated with the case studies. The feedback has been positive, although more time of use is needed to obtain more consistent data (how the trainees interact with chatbot) to allow for a more objective analysis, something that will take place over the next few months of using.

From the trainer's perspective, one of the most relevant aspects of feedback is the moodle platform and how it is organized in our use case, as a kind of shared knowledge database between trainees and trainers. This setup offers a wide range of possibilities for the training and learning process. The ability to monitor trainees' performance and progress in real time, while providing personalized support and tutoring, is particularly valuable.

4.5 Challenges and improvements

SCORM packages are a challenge, as they often function like a 'black box', making it difficult or even impossible to extract meaningful metrics and track navigation patterns. This limits the ability to analyse the effectiveness of the resource and hinders opportunities for continuous improvement. In our use case, exploring alternative tools for creating resources that, when integrated with the Learning Management System (LMS), enable the collection of such data becomes particularly important.

The application of active learning methodologies remains a central focus in the continuous improvement of this course format, even more so with the use of AI and the integration of a chatbot. Fostering critical and creative thinking, as well as problem-solving skills, are key aspects for the course's target audience. Developing branching scenarios is an improvement to be pursued.

Despite the positive feedback, it was not possible to gain a clear understanding of how trainees interacted with the chatbot, more time is needed, this remains a key point. The ability to interact and formulate questions clearly, to obtain the best possible answers from the chatbot, is one of the key skills to be developed with the trainees. Must be clear for trainees that AI is a support tool, not the only source of information. Prompt literacy to enhance the use of artificial intelligence in training is essential for both trainees and trainers.

Having interactive learning content is very important to keep learners motivated and engaged in carrying out the activities. The major challenge for those responsible for creating such content, usually the trainer, is knowing how far the levels of interactivity should go and finding a balance, considering the learners' profiles,

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the nature of the topics covered in the content, and so on, factors that have always been considered in the development of the materials for this course. AI can assist and play a crucial role, the trainers must be able to use it.

The experience so far with this course/use case shows that using active learning methods together with AI and chatbots creates dynamic situations where trainees are constantly being challenged — and they end up challenging the trainers too. Trainers need to be ready for this kind of environment and dynamics, because real growth starts when you step out of your comfort zone.

Lastly, it's important to emphasize that critical and creative thinking must also be continuously developed on the trainers' side, these are key skills they should continuously strengthen. AI became clear that the trainer's role is even more challenging and essential than ever.

As a final note, it is important to mention that, given the expected improvements in the Moodle platform, as well as in the contents and the emergence of new topics, it is essential for us to progressively implement the chatbot. Therefore, within the scope of the partnership and the project's conclusion, it is important to ensure a way to continue enhancing the chatbot's performance, both for each use case and in its application to other learning scenarios.

5 SCSKZ Use case (Slovenia)

5.1 Summary and objective

The goal of the "Programming U-lab" program is to develop digital, technical and creative competencies of second-year students of the mechanical engineering program at the School Center of Slovenske Konjice-Zreče.

The program follows modern trends in Industry 4.0, with an emphasis on programming, artificial intelligence and XR/VR technologies, and encourages active learning, project work and the development of soft skills.

Key objectives:

- Strengthening algorithmic thinking and programming skills.
- Basic understanding of artificial intelligence and machine learning.
- Developing applications in XR/VR environments.
- Strengthening teamwork, independence and creative thinking.

5.2 Student Profile

The target group is second-year students of the mechanical engineering program, aged 16 to 17, but the module can also be implemented as an educational course for adults or as an interest activity for students within the framework of free choice.

Table 1 - Student Profile

Parameter	Data
Age	16–17 years
Educational program	Mechanical Technician (V. level)
Prior knowledge	None, or basic computer literacy
Target competencies	Programming, AI basics, working with VR/XR
Inclusion options	Full-time students, adults, interest groups

Note:

The program allows for flexible inclusion of students with different prior knowledge and adaptation of the methodology for inclusive education.

5.3 Course content and structure for proper data collection

Within the scope of his professional profile, a mechanical engineer designs and constructs simple elements and devices, produces and uses technical and technological documentation, which he edits and archives using modern tools. He is qualified to operate numerically controlled machining and other machines and devices, and can also lead groups in production, maintenance, service or manage a small company. As part of the open curriculum, the second year of study includes the "U-lab Programming" program module, which lasts 50 hours. The module is divided into three content areas: an introduction to the functioning of programming languages, learning the basics of artificial intelligence, and in-depth work with augmented, virtual and mixed reality technologies (XR, VR, AR). For the needs of the AI4ED project, the field of artificial intelligence was specifically deepened, developed in five units. The module is based on the approaches of

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active learning, work in groups and pairs, and individual research, where students develop soft skills such as cooperation, responsibility, and solving real-life problems through teamwork. Classes take place in a computer classroom equipped with workstations, appropriate software and 3D glasses, with the presence of additional teachers ensured due to the use of XR technologies. The process also includes mentoring, which supports the individual development of each student in creating their own models.

Students have access to materials and submit assignments via MS Teams and Moodle. The initial implementation in the Moodle environment showed the need to upgrade monitoring and evaluation, which was appropriately adjusted in the second school year. Most of the content is organized in the form of project work, and the results are presented every year as part of project days. The content is directly linked to the modules of the AI4ED program, which allows students to in-depth and meaningfully connect theoretical knowledge with practical application.

The program consists of three main content areas:

Table 2 - Definition of program

Section	Durati on	Key topics
1. Programming - Arduino	5 h	Fundamentals of algorithms, basic electronics
2. Artificial Intelligence	5 h	Introduction to AI, machine learning, object classification
3. VR and XR technologies	40 h	Working in Unity, VR application development, interactions

Implementation structure (also visible in the flowchart):

- Phase 1: Introduction to concepts (theoretical part, interactive lectures)
- Phase 2: Practical work (project tasks, group work)
- Phase 3: Development of own models (individual work, mentoring)
- Phase 4: Product presentation (technical days)

Data collection systems:

- Submission of tasks in MS Teams/Moodle.
- Self-evaluation questionnaires.
- Teacher monitoring and evaluation of procedures.

Data sources:

Progress monitoring in MS Teams, Moodle (adapted for the AI module during the project), evaluation questionnaires, quality analysis of completed projects for evaluation purposes.

5.4 Evaluation and measurement of results

Table 3 - Indicators and Methods for Evaluating Learning Outcomes and Project Success

Indicator Measurement	Method
Project success	Product quality and functionality
Programming skills	Practical tasks
Understanding AI concepts	Project task

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Indicator Measurement	Method
Using VR/XR technologies	Developing a working application with AI support
Soft skills (teamwork, communication.)	Self-evaluation

First implementation and upgrades

- The first year of implementation (2023/24) showed problems in converting data from the Team environment (the environment is used at the school level), then tracking data in the Moodle environment, especially in the ongoing evaluation of learning outcomes. Artificial intelligence frameworks for the needs of the project were not sufficiently known.

In the first year, the knowledge was based on obtaining data from existing databases (LMS), editing data, and sending anonymized data to the partner, which was processed by the partner's artificial intelligence tool. The volume of data was insufficient for any quality analysis. For quality analysis, the need arose for more frequent, continuous and automated data collection. The process was also based on frequent feedback from students (satisfaction, competencies, etc.) at the subject level. Data collection required an incomparably high investment of time. Data was collected in the Forms tool, the volume of feedback from students was on the one hand large, but at the same time too small due to the lack of certain students. The data was not generated in real time and consequently was not collected in the same time period. Due to multiple responses (possibly also boredom from frequently answering the same questions) the data became trivial and unsuitable for use.

An additional challenge is the fact that the data in this phase was collected from students, teachers and class teachers. All of the above challenges and the emergence of generative AI led to a change in the project concept.

- In the second year (2024/25), the system was changed by establishing a Moodle classroom (at the project level, at the partner), where data upon registration of the participant and work in the online classroom is automatically captured and processed for the needs of the joint project. The artificial intelligence tool is used as an aid in guiding and acquiring knowledge. By using interactive tools, quizzes, animations, practical tasks, the use case and thus the goal of the project became achievable.

The use case is based on the use of the H5P tool, which in addition to interactivity also includes questionnaires, references to external sources, practical tasks, schemes. The work is organized in such a way that the student performs it independently and performs a self-evaluation at the end of the topic. The participant has the opportunity to access the material (pdf format) and perform tasks according to his knowledge and needs for knowledge in the field of artificial intelligence. The ultimate goal is to create an independent AI tool (application supported by artificial intelligence).

5.5 Challenges and improvements

Table 4 - Identified Challenges and Corresponding Improvement Measures in SCSKZ Use Case Implementation

Challenge	Measure for improvement
Traceability of learning progress	Establishing a tool for data capture and user notification of progress (feedback loop, dropout prevention), monitoring personalized learning
Demanding integration of XR technologies with AI	Directing and setting up additional options and tools for integrating XR technology knowledge
Differences in students' prior knowledge	Differentiated mentoring, additional learning resources, increasing the number of hours to achieve module objectives

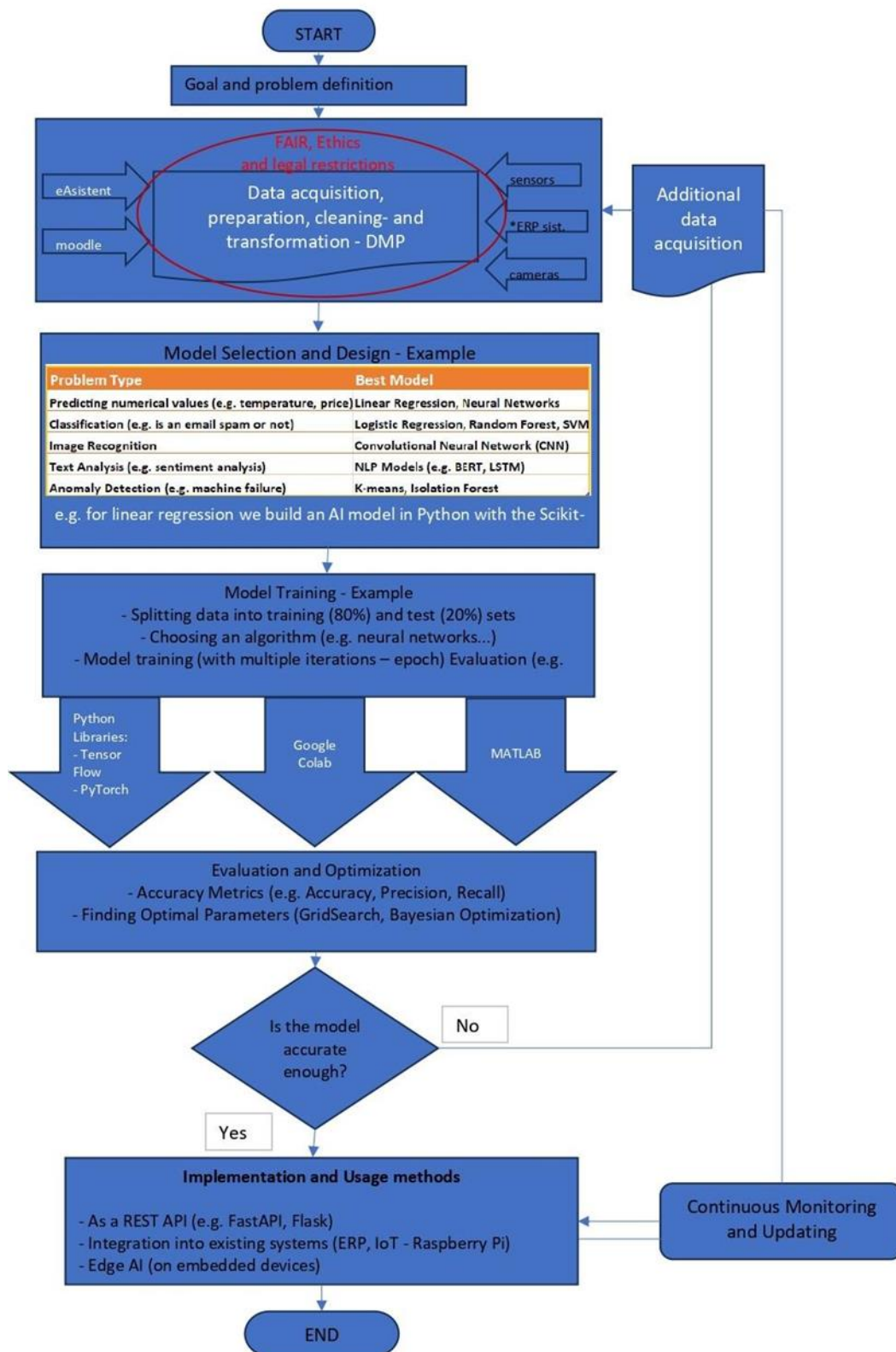
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Challenge	Measure for improvement
Motivation for project work	Greater emphasis on presentations and rewards, promoting healthy competition
Professional support in AI, XR and VR	Properly train staff, interdisciplinary cooperation, cooperation of multiple teachers

Possible further improvements:

- Implementation of a more advanced LMS system with built-in AI progress tracking.
- Expanding connections with industry partners to conduct practical workshops.
- Increasing the number of hours for integrating AI tools into XR technologies and for standalone use.

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6 AI4Ed Training Programme (Unizar)

6.1 Summary and objective

The AI4Ed training programme was piloted at the University of Zaragoza (UNIZAR). The main purpose of this implementation was to validate the AI-based educational resources and assess their performance under real-use conditions.

The specific objectives of the pilot were:

- To validate the AI4Ed tools developed in WP2, including training content, interactive activities, and the AI-powered chatbot.
- To assess the alignment of the programme with the Key Performance Indicators (KPIs) defined in D2.1, focusing on:
 - Learner engagement.
 - Effectiveness of personalized learning.
 - Early identification of potential dropout.
- To test the data collection and management framework established in WP3 (D3.1, D3.2), ensuring:
 - GDPR compliance.
 - Use of appropriate data formats and minimization principles.
 - Monitoring via learning analytics (e.g., Moodle logs and dashboards).

6.2 Student Profile

Piloting involved a group of students from the University of Zaragoza, primarily from the fields of Industrial Engineering and Education. The participants represented a diverse academic background and were selected to reflect different levels of familiarity with digital tools and AI.

Key characteristics of the student group included:

- **Academic background:** Students from both technical (engineering) and educational disciplines.
- **Digital skills:** Mixed levels, ranging from basic to advanced.
- **AI knowledge:** Most participants had only basic or introductory knowledge of AI-related topics.
- **Language proficiency:** English levels varied between basic and fluent.

This diversity allowed the training programme to be tested under realistic conditions, providing valuable insight into how learners with different profiles interact with AI-based educational resources.

6.3 Course content and structure for proper data collection

Enrolment process

To access the training programme, students were first required to create an account on the AI4Ed Moodle platform. Once the account was created and the user logged in, they could directly enrol in the course without the need for additional approval steps. This simple process ensured quick and autonomous access to the programme, encouraging participation and reducing technical barriers at the entry point.

AI4ED: Training Programme

Enrolment options

AI4ED: Training Programme ➔



Teacher: Nerea Arregi



Self enrolment (Student)

No enrolment key required.

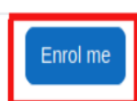


Figure 14 - Screenshot of the enrolment page

Modular structure

Once enrolled, students accessed a structured programme composed of seven modules. These were designed to progressively introduce the fundamentals of Artificial Intelligence in education, moving from conceptual understanding to practical application and implementation.

The modular structure presented in the Training programme is as follows:

1. **Introduction to AI**

Introduces core AI concepts, historical evolution, and modern applications such as virtual assistants and machine learning.

2. **Data management, data semantics and formats**

Covers Open Science, research data management, and the role of structured data in AI projects.

3. **Key Performance Indicators (KPIs)**

Explains key metrics in education; engagement, personalization and dropout, and how AI can track and respond to them.

4. **Ethics and Artificial Intelligence**

Addresses legal, ethical, and privacy aspects of AI in education, including Intelligent Tutoring Systems and LMS-based AI tools.

5. **Implementation curriculum and recommendations**

Provides guidance to help educators design and digitise subjects, integrating AI into course content and planning.

6. **Active Learning, Personalized Tutoring, and Dropout Prevention**

Explores how AI can address educational challenges such as high dropout rates and improve teaching effectiveness through adaptive methods.

7. **Maintenance and monitoring of AI models**

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Explains how to maintain, retrain, and monitor AI models over time using tools like Neptune.ai, Arize AI, and Grafana, ensuring they remain accurate, fair, and effective in changing environments.

Platform design and interaction structure

The programme was delivered via the AI4Ed Moodle platform, designed to support not only content delivery but also continuous data collection for performance monitoring.

The platform included:

- Interactive activities implemented in each module, such as:
 - Multiple choice quizzes

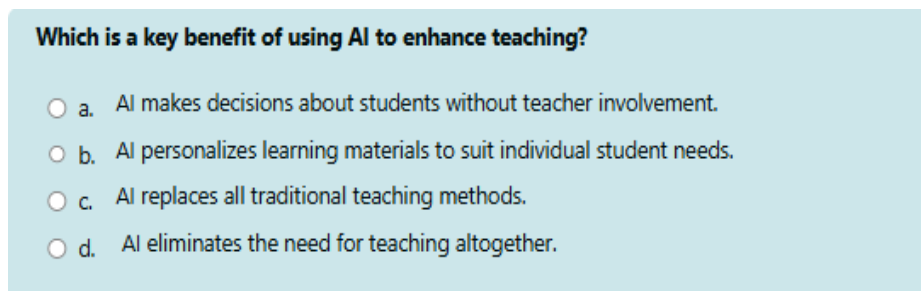


Figure 15 - Multiple choice example

- Drag-and-drop exercises

Drag the correct words

Artificial Intelligence (AI) refers to the ability of machines or computer programs to carry out tasks that would typically require intelligence to complete. This encompasses a wide range of activities, such as understanding and processing natural language, learning from previous and patterns, making decisions based on and reasoning, and solving complex problems in dynamic environments. Essentially, AI equips computers and machines with the capability to mimic human-like thought processes, enabling them to not only analyze situations but also adapt and respond in ways that closely resemble human behavior. In simpler terms, AI allows machines to cognitive functions such as reasoning, learning, and problem-solving, making them capable of performing tasks that were once thought to be to human beings. As AI continues to evolve, it expands the boundaries of what computers can achieve, allowing them to operate more and intelligently in a variety of settings.

machine
exclusive
simulate
autonomously
data

Figure 16 - Drag and drop exercise example

- Feedback and evaluation section
 - AI model simulation
- An integrated AI-powered chatbot, providing guidance, clarification, and reinforcement of concepts through conversational interactions.

While the chatbot is not a standalone module, it plays a central role throughout the training programme by offering real-time, contextual assistance to learners. It is integrated across modules to support understanding and maintain learner engagement.

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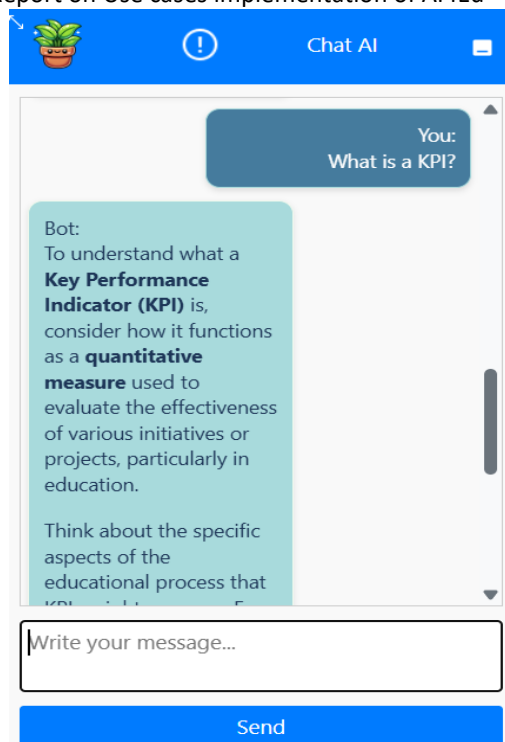


Figure 17 - Chatbot answer example

Data monitoring and compliance

Data collection was carried out across all phases of the training: before the course, during its delivery, and after completion. This included reuse of prior data, competence assessments, performance evaluations, and post-training feedback. The process was clearly communicated to users and integrated into the platform's structure, as illustrated below.

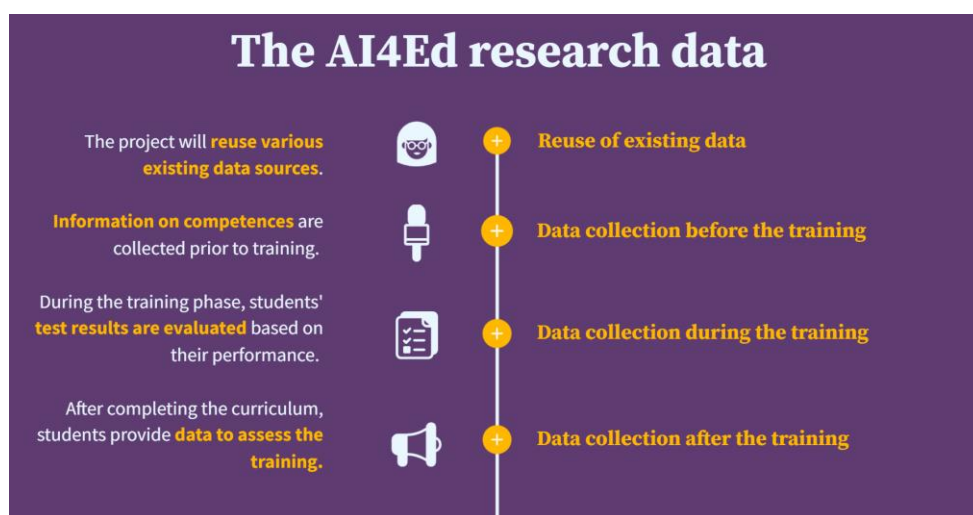


Figure 18 - Phases and Types of Data Collection in the AI4Ed Training Programme

6.4 Evaluation and measurement of results

A core feature of the AI4Ed training programme is the structured integration of Key Performance Indicators (KPIs), which are used to evaluate the effectiveness of the course and the impact of AI-driven strategies on the learning process. These KPIs serve not only as measurement tools but also as decision-making supports for refining educational content, adapting delivery methods, and improving learner outcomes.

The project defines five categories of KPIs, which have been also implemented into the training programme to measure user's experience:

- **Engagement KPIs:** Engagement KPIs in the AI4Ed training programme assess how actively students participate throughout the course. These indicators measure the average time spent on the platform, completion of interactive activities, and frequency of participation in exercises and collaborative tasks.

This is monitored through the execution of various learning activities, including quizzes, reflections, and simulations, all tracked individually within the Moodle platform. The data provides insight into learner consistency and allows the team to identify disengagement patterns, such as low activity or skipped sections.

- **Performance KPIs:** Performance KPIs are used to evaluate student progress and mastery of key learning objectives throughout the training. Specifically, they track individual score improvements over time, the rate of mastery in core competencies, and pass rates across the modules.

In the AI4Ed training programme, these KPIs are applied through quizzes and evaluative exercises embedded in each module. The system monitors not only final results but also how learners evolve as they move through the content. This allows the course designers to assess the effectiveness of AI-integrated instruction in facilitating meaningful learning gains.

- **Adaptive Learning KPIs:** Adaptive Learning KPIs evaluate how effectively the AI system personalizes the learning experience. These indicators monitor the number of personalized learning paths generated, student progress along these paths, and the frequency and type of content adaptations made by the system.

In the AI4Ed training programme, adaptive learning is primarily implemented through the AI-powered chatbot and flexible module navigation. Students can progress at their own pace and revisit content as needed, while the chatbot adjusts its responses based on individual input, helping to reinforce or clarify key concepts.

These KPIs help determine how well the system responds to varied learner profiles and supports differentiated instruction.

- **Retention KPIs:** Retention KPIs focus on monitoring student continuity throughout the course. These indicators include completion rates, retention across modules, and the identification of drop-off points within the digital learning materials.

In the AI4Ed training programme, these KPIs are incorporated to evaluate the ability of AI-based resources to sustain learner engagement and reduce dropout. The system is designed to collect data on learner progression, allowing course designers to analyse disengagement trends and use this information to refine content delivery and structure.

- **Satisfaction KPIs:** Satisfaction KPIs provide insight into the subjective experiences of students using AI-driven educational tools. These indicators measure student satisfaction with AI tutoring systems, collect feedback on the usability of the platform, and evaluate both student and teacher perceptions of the support provided by AI throughout the learning process.

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In the AI4Ed training programme, these KPIs are essential for understanding the level of acceptance and perceived value of AI-enhanced education. Feedback mechanisms integrated into the course allow participants to reflect on their experience with the tools and express how effectively they supported their learning.

6.5 Challenges and improvements

This section is based on feedback from students who completed the AI4Ed training programme. Their comments highlight both strengths and suggestions for future improvements.

Students appreciated the clear and progressive structure, which starts with the basics of AI and moves toward real applications. The course was effective for those new to the subject, while also reinforcing key topics for more experienced users, especially in areas like data language, KPIs, and AI ethics.

The programme's interactive activities and AI model simulation were well received, and the chatbot was highlighted as a helpful tool to clarify doubts and reinforce learning. Overall, the training was seen as engaging and useful.

However, the time required to complete the programme was a common concern. Although valuable, the estimated 22–26 hours were seen as excessive by many participants.

Possible improvements

- Offer different learning paths based on prior knowledge.
- Expand the chatbot's support functions across all modules.
- Include pre-assessments to help personalise the learning path.

Future considerations

Going forward, it will be important to keep the content up to date and explore tools for adaptive learning and real-time feedback. Improving how data is collected and used could also help refine the programme and strengthen its alignment with the KPIs.

With these adjustments, the AI4Ed training programme can become even more flexible, accessible, and impactful for a wider range of learners.

7 Conclusions

The five use cases collectively show that artificial intelligence can be integrated into teaching and learning in a structured, measurable, and iterative manner. Clear data-collection frameworks allowed each partner to track progress, surface challenges, and implement evidence-based improvements. Across the use-cases, common benefits emerged: higher learner engagement through personalised feedback, more granular insight into learning gaps, and reduced administrative workload for instructors. Challenges centred on data quality, technical interoperability, and the need for continuous staff upskilling— all of which were partially mitigated by the Training Program’s modular curriculum. Overall, the results confirm that a combined strategy of targeted pilot implementations and systematic capacity-building is an effective pathway for mainstreaming AI-driven innovation within vocational and higher-education institutions.