SUPSI
University of Applied Sciences and Arts of Southern Switzerland

Designing With

A New Educational Module to Integrate Artificial Intelligence, Machine Learning and Data Visualization in Design Curricula

+ Didactic Guidelines

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Contents

1. Didactic Guidelines: Syntax and Methodology

The didactic guidelines are structured to provide teachers with *Educational Objectives* (EO), *Instructional Activities* (IA) and *Recommendations* (R) for the autonomous implementation of teaching modules on AI in design curricula. This methodology refers to Bloom's Taxonomy, Revised for 21st-Century Learners (Anderson & Krathwohl, 2001) and is tailored to systematically and thoughtfully integrate AI tools into different phases of the design process. Each teaching module or sub-module has a specific educational objective and a set of teaching activities to be carried out to achieve the educational goal.

The *Educational Objectives* refer to the intended results by describing the knowledge and skills students should acquire from the module. Then, the *Instructional Activities* refer to the means by which objectives are accomplished, providing tasks and exercises teachers must prepare and conduct during the module to facilitate student learning. Additionally, *Recommendations* regarding the students' working modalities (individuai or group) and content selection are provided for each module.

1.1 Categories of Objectives

According to Krathwohl and Payne (1971) there are three types of objectives:
1. Global Objectives aim to provide educational vision. They are broadly stated and require one or more years of learning.
   e.g. All students will start school ready to learn.
2. Educational Objectives are effective in planning an educational unit. They break down the global objectives into more specific ones by describing students' behaviour and content topics and requiring weeks or months to learn.
   e.g. The ability to distinguish various types of code language.
3. Instructional Objectives are useful for preparing a lesson. They are even more detailed than the educational ones and refer to specific content areas, requiring a few hours or days to learn.
   e.g. The students learn how to create a consistent dataset to train a machine learning model.

1.2 Categories of Knowledge Dimension

Knowledge can be classified in four dimensions:
a. Factual Knowledge refers to the basic elements students must know to be acquainted with a discipline or solve problems in itterminology and specific details;
b. Conceptual Knowledge, refers to classification, categories, principles and to the interrelationships among the basic elements within a larger structure that enable them to function together.
c. Procedural Knowledge, refers to skills algorithms, techniques and methods of inquiry;
d. Metacognitive Knowledge, refers to a cognitive task, strategies and self-awareness.

a. Factual Knowledge	**Example**
(a.a) Knowledge of terminology	Technical vocabulary, music symbols
(a.b) Knowledge of specific details and elements	Major natural resources, reliable sources of information

b. Conceptual Knowledge	**Example**
(b.a) Knowledge of classifications and categories	Periods of geological time, forms of business ownership
(b.b) Knowledge of principles and generalizations	Pythagorean theorem, law of supply and demand
(b.c) Knowledge of theories, models, and structures	Theory of evolution, structure of congress

c. Procedural Knowledge	**Example**
(c.a) Knowledge of subject-specific skills and algorithms	Skills used in painting with water colors, whole-number division algorithm
(c.b) Knowledge of subject-specific techniques and methods	Interviewing techniques, scientific method
(c.c) Knowledge of criteria for determining when to use appropriate procedures	Criteria used to determine when to apply a procedure involving Newton's second law, criteria used to judge the feasibility of using a particular method to estimate business costs

d. Metacognitive Knowledge	**Example**
(d.a) Strategic knowledge	Knowledge of outlining as a means of capturing the structure of a unit of subject matter in a text book, knowledge of the use of heuristics
(d.b) Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Knowledge of the types of tests particular teachers administer, knowledge of the cognitive demands of different tasks
(d.c) Knowledge of criteria for determining when to use appropriate procedures	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weakness; awareness of one's own knowledge level

1.3 Categories of Cognitive Process Dimension

According to Krathwohl and Payne (1971) the cognitive process dimension comprises six major categories, each associated with specific cognitive processes, totalling 19. These categories, arranged in increasing order of complexity, are:

1. Remember: Involves retrieving knowledge from long-term memory. Specific processes include recognizing and recalling.
2. Understand: It entails constructing meaning from instructional messages (oral, written, graphic). It encompasses interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
3. Apply: About carrying out or using a procedure in a given situation. This includes executing and implementing.
4. Analyze: It involves breaking material into parts and understanding their interrelations and the overall structure or purpose. It includes differentiating, organizing and attributing.
5. Evaluate: It concerns making judgments based on criteria and standards. It encompasses checking and critiquing.
6. Create: It entails combining or reorganizing elements to form a novel, coherent, original or functional whole. It involves generating, planning and producing.

1. Remember	**Example**
(1.1) Recognizing	Recognize the dates of important events in U.S. history
(1.2) Recalling	Recall the dates of important events in U.S. history

2. Understand	**Example**
(2.1) Interpreting	Paraphrase important speeches and documents
(2.2) Exemplifying	Give examples of various artistic painting styles
(2.3) Classifying	Classify observed or described cases of mental disorders
(2.4) Summarizing	Write a short summary of the events portrayed on videotapes
(2.5) Inferring	In learning a foreign language, infer gramrnatical principles from examples
(2.6) Comparing	Compare historical events to contemporary situations
(2.7) Explaining	Explain the causes of important eighteenth-century events in France

3. Apply	**Example**
(3.1) Executing	Divide one whole number by another whole number, both with multiple digits
(3.2) Implementing	Determine in which situations Newton’s second law is appropriate

4. Analyze	**Example**
(4.1) Differentiating	Distinguish between relevant and irrelevant numbers in a mathematical word problem
(4.2) Organizing	Structure evidence in a historical description into evidence for and against a particular historical explanation
(4.3) Attributing	Determine the point of view of the author of an essay in terms of his or her political perspective

5. Evaluate	**Example**
(5.1) Checking	Determine whether a scientist’s conclusions follow from observed data
(5.2) Critiquing	Judge which of two methods is the best way to solve a given problem

6. Create	**Example**
(6.1) Generating	Generate hypotheses to account for an observed phenomenon
(6.2) Planning	Plan a research paper on a given historical topic
(6.3) Producing	Build habitats for certain species for certain purposes

1.4 Building Educational Objectives and Instructional Activities

The cognitive processes and the knowledge dimensions are combined to define the educational objectives and the instructional activities according to the following syntax:

1. **STATEMENT:**
   - Statement [EO] “Student will learn to...”
   - Statement [IA] “Activity intended to...”
2. **VERB:**
   The verb refers to cognitive processes:
   (1) Remember;
   (2) Understand;
   (3) Apply;
   (4) Analyze;
   (5) Evaluate;
   (6) Create.
3. **NOUN:**
   Nouns refer to the knowledge dimension that students are expected to acquire or build:
   (a) Factual Knowledge;
   (b) Conceptual Knowledge;
   (c) Procedural Knowledge;
   (d) Metacognitive Knowledge.

statement + verb + noun

“Student will learn to..” | Cognitive process | Knowledge dimension

e.g. Submodule 1: Getting Familiar W/ Machine Learning

Educational Objectives

{Ml-Obj}
Students will learn to | train a Machine Learning model | to create design artefacts

Instructional Activities

{Ml-Act.1}
Activity intended to | provide students | with vocabulary knowledge of ML

{Ml-Act.2}
Activity intended to | provide students | with basic functionality of ML

{Ml-Act.3}
Activity intended to | provide students | with practical examples of ML applied to design

{Ml-Act.4}
Activity intended to | explain | the procedure of training a simplified ML model

{Ml-Act.4.1}
Activity intended to | set or align | with a design goal

{Ml-Act.4.2}
Activity intended to | introduce students | to familiarising, collecting or creating data

{Ml-Act.4.3}
Activity intended to | provide students | a step-by-step tool tutorial, such as RunwayML

{Ml-Act.5}
Activity intended to | allow students | to individually train a simplified ML model for a design goal

{Ml-Act.6}
Activity intended to | provide students | with a structured template for process and results documentation

{Ml-Act.6}
Activity intended to | make students | explaining and questioning the process

1.5 The Framework of Bloom’s Taxonomy Table

The Bloom’s Taxonomy table (Fig. 1) is comprised of rows and columns that represent the categories of knowledge and cognitive processes, respectively. Educational Objectives and Instructional Activities, whether explicit or implicit, involve knowledge and cognitive processes that can be classified within the taxonomy and placed in the corresponding intersection cell. Once an objective has been placed in a specific cell of the taxonomy table, teachers can systematically address the problem of helping students achieve that objective by identifying instructional activities.

Knowledge dimension	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge						
(b) Conceptual Knowledge						
(c) Procedural Knowledge						
(d) Metacognitive Knowledge						

Fig. 1 Bloom Taxonomy Table. Redesigned for *Designing With* project.

An example using the Machine Learning teaching module and the related Educational Objectives and Instructional Activities presented in the previous section 1.4 is provided below (Fig. 2).

Knowledge dimension	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge		{ML-Act.1}				
(b) Conceptual Knowledge		{ML-Act.2} {ML-Act.3}				
(c) Procedural Knowledge		{ML-Act.4} {ML-Act.4.1, 4.2, 4.3}	{ML-Act.5} {ML-Obj}			
(d) Metacognitive Knowledge				{ML-Act.6}	{ML-Act.7}	

Fig. 2 Sub-Module 1: ‘Getting Familiar’ with Machine Learning. Educational Objectives and Instructional Activities arranged into the Bloom Taxonomy Table.

2. Didactic Guidelines in Practice

Two teaching modules are proposed as a practical example of a didactic activity aimed at introducing Artificial Intelligence (AI), Machine Learning (ML) and Data Visualisation (DV) to multidisciplinary design students. The first module, ‘Getting Familiar’, aims to provide basic theoretical and practical skills of ML, GenAI and DV, in three different sub-modules specific to each discipline.

These sub-modules provide an introduction to literacy and guided practical exercises with AI tools. The second module, ‘Get in Depth’, focuses on guiding students in developing and practising a methodology for designing with AI.

2.1 Teaching Activity Infrastructure

The didactic guidelines are based on the following modular infrastructure which is composed of two main modules and their relative sub-modules (Fig. 3). The first modul, 'Getting Familiar', combines the disciplines of Machine Learning, Generative Artificial Intelligence, and Data Visualization and it is intended to provide basic literacy, guided tutorials, and hands-on experiences. The second module supports students in selecting and employing AI, ML, and DV tools for the design process, addressing a defined project brief to foster the acquisition of a method in designing with AI.

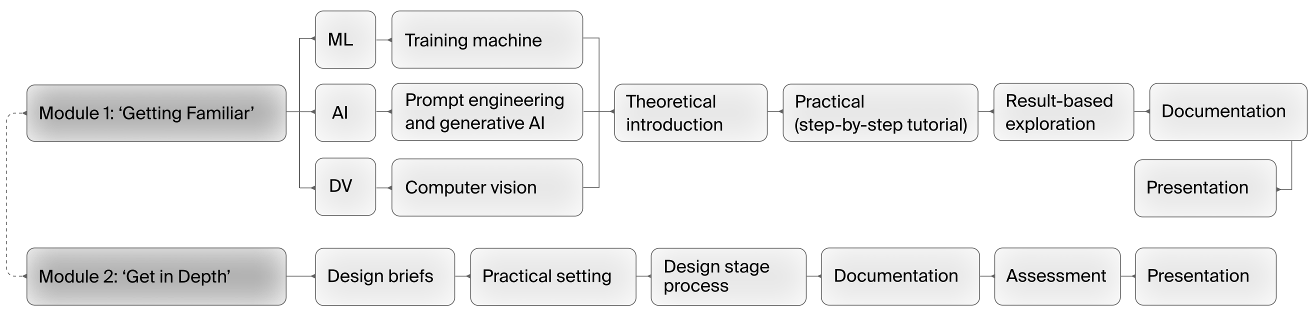

Fig. 3 *Designing With* Didactic Guidelines Teaching Infrastructure.

The three sub-modules in module 1: 'Getting Familiar' present the same teaching activities infrastructure. The infrastructure always organises the teaching activities by moving from a theoretical to a practical learning level. First, a basic literacy introduction is given, followed by an overview of project case studies. Then, a practical step-by-step tutorial in which students are introduced to the use of data and software is provided. Finally, students are invited to familiarise themselves with the methodology through a result-based exploration and a structured documentation of the process and results (Fig. 4).

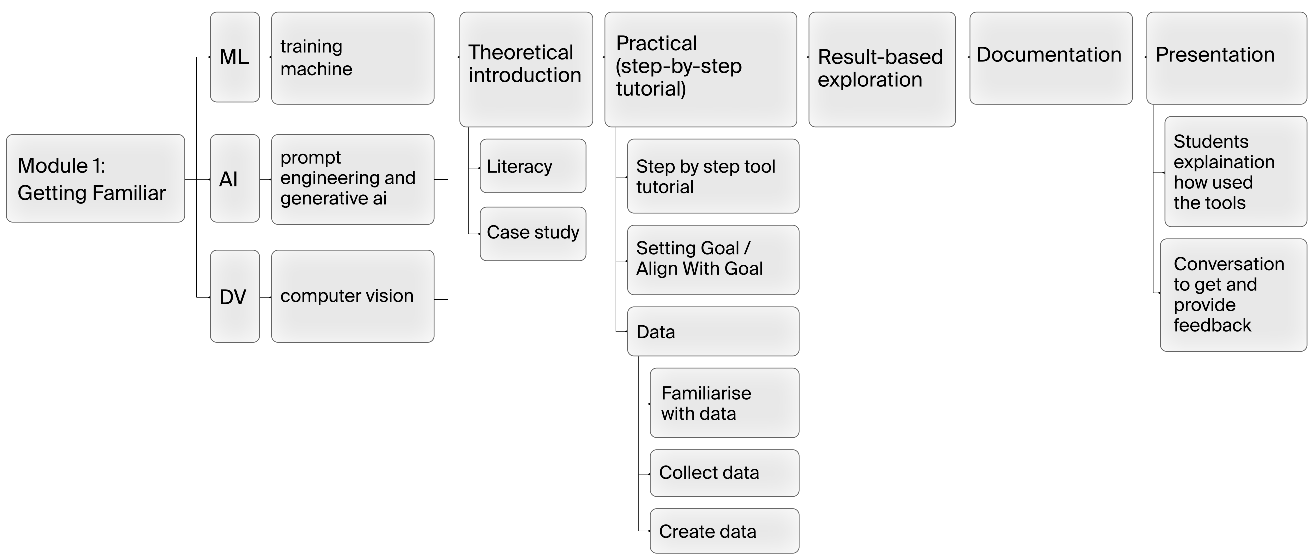

Fig. 4 Teaching Infrastructure of the module 1: 'Getting Familiar'.

The teaching activity infrastructure of module 2: 'Get in Depth' presents an entirely hands-on learning approach. Students are first provided with a design challenge to answer by experimenting with the use of AI tools in the different stages of the design process. Then, AI tools and design stages are introduced through the Designing With Interactive Framework [link]. Throughout the design activity, students are asked to document their process to encourage the acquisition of the method of designing with AI.
Furthermore, to guide students in structuring the design process and to provide technical support in using the tools, two rounds of review are offered by tutors. Finally, an evaluation phase is foreseen to improve the teaching module and to allow the students to self-assess the knowledge acquired (Fig. 5).

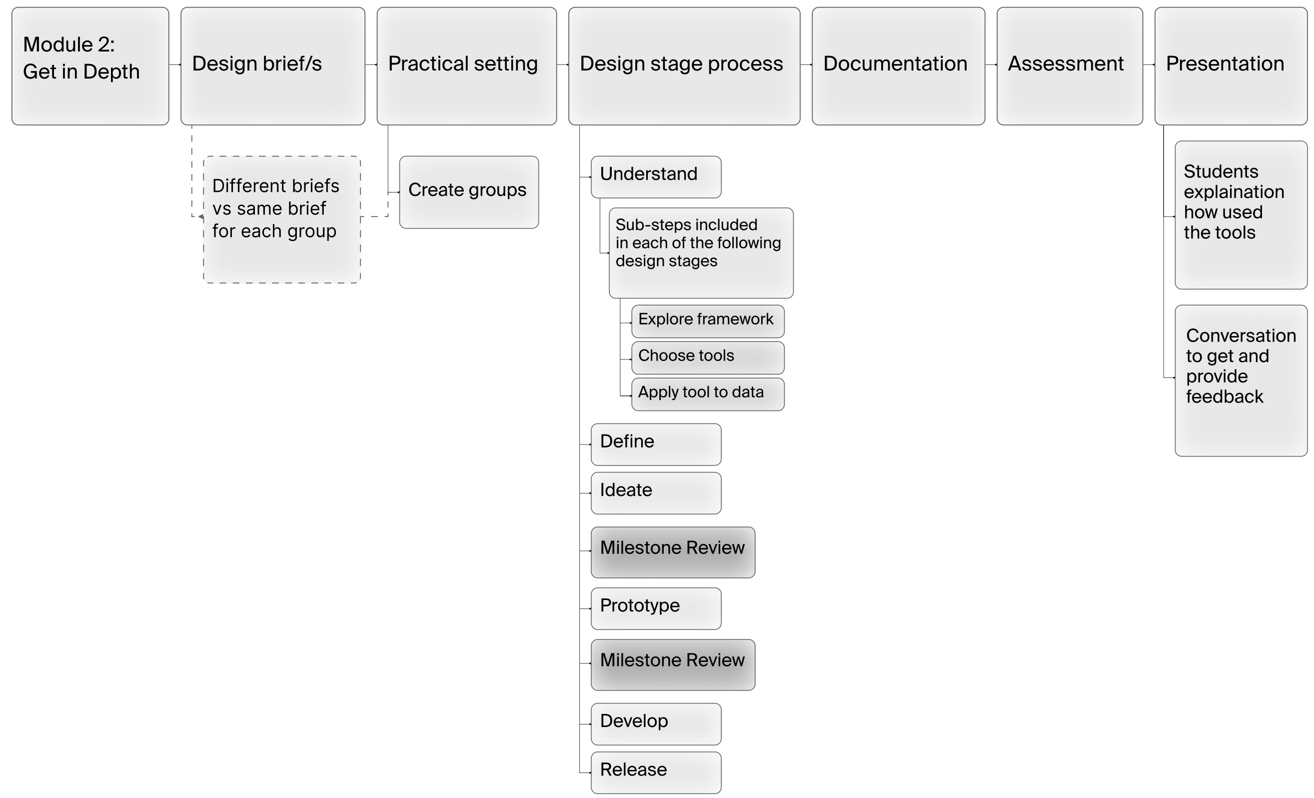

Fig. 5 Teaching Infrastructure of the module 1: 'Get in Depth'.

3. Module 1: Getting Familiar

This module teaches students to employ AI to train, generate, analyse, and visualise data for specific design purposes {Module 1-Obj} (Fig. 6). The module is organised into three sub-modules to get familiar with a specific discipline: Machine Learning (ML), Generative AI (Gen AI) and Data Visualisation (DV). Each sub-module is intended to provide basic literacy, guided tutorials of tools, hands-on experience and documentation practices of results. To promote the development of personal skills, students are suggested to work individually.

Teachers can arrange the duration of each activity based on the level of in-depth study required. Sub-modules are not strictly related to each other. The application of all of them is not mandatory, teachers can make a selection based on needs and interests. The structure of the sub-modules is not designed based on the tool mentioned in the guideline. For a more complete list of tools, refer to the Designing With framework [link].

Educational Objectives

{MOD1-Obj}

Students will learn to | employ AI to train, generate, analyse and visualise data | for specific design purposes

Instructional Activities

{MOD1-Act.1}

Activity intended to | provide students | with vocabulary knowledge of AI

{MOD1-Act.2}

Activity intended to | provide students | with basic functionality of AI

{MOD1-Act.3}

Activity intended to | provide students | with practical examples of AI applied to design

{MOD1-Act.4}

Activity intended to | explain | the procedure of train, generate, analyse and visualise data with AI

{MOD1-Act.4.1}

Activity intended to | introduce students | to familiarising, collecting or creating data

{MOD1-Act.4.2}

Activity intended to | set or align | with a design goal

{MOD1-Act.4.3}

Activity intended to | provide students | a step-by-step tool tutorial, such as RunwayML, Dall-E, Vision API

{MOD1-Act.5}

Activity intended to | allow students | to individually train, generate, analyse and visualise data with AI

{MOD1-Act.6}

Activity intended to | provide students | with a structured template for process and results documentation

{MOD1-Act.7}

Activity intended to | make students | explaining and questioning the process

Module 1: Getting Familiar	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge		{MOD1-Act.1}				
(b) Conceptual Knowledge		{MOD1-Act.2} {MOD1-Act.3}				
(c) Procedural Knowledge		{MOD1-Act.4} {MOD1-Act.4.1, 4.2, 4.3}	{MOD1-Act.5} {MOD1-Obj}			
(d) Metacognitive Knowledge				{MOD1-Act.6}	{MOD1-Act.7}	

Fig. 6 Module 1: 'Getting Familiar'. Educational Objectives and Instructional Activities according to the Bloom Taxonomy Table.

3.1 Sub-module 1: Getting familiar with Machine Learning (ML)

This sub-module teaches students to train simplified ML models to create design artefacts {ML-Obj}. Students develop procedural knowledge through practical guided activities (e.g. RunwayML step-by-step tool tutorials) and they are asked to apply the acquired procedure to a familiar task (e.g. creating a logo). Students are first provided with a basic literacy of ML including technical vocabulary {ML-Act1} and primary functionalities {ML-Act2}. This activity is meant to promote factual and conceptual knowledge by teaching the basic elements of the discipline and their interrelationship to explain the functionality of ML tools. Once basic literacy is introduced, specific case studies are provided to contextualise the application of ML within the design practice {ML-Act3}. At this point, the teaching moves from a theoretical to a procedural level. In this direction, students are first introduced to a guided tutorial {ML-Act4.3} on how to use an ML tool (e.g. RunwayML) starting from setting a design goal {ML-Act4.1} and creating their dataset {ML-Act4.2}. Then, to familiarise themselves with the procedure, students individually apply what they learned by training an ML model aligned with the design goal {ML-Act5}. Lastly, moving the focus to meta-cognitive knowledge, students are asked to analyse and document the process by breaking down the steps and selecting the relevant results {ML-Act6}. This activity aims to create awareness and knowledge of cognition. To foster participation and sharing of results, students are asked to present their work and question others {ML-Act7} (Fig. 7).

Educational Objectives

{ML-Obj}
Students will learn to | train a Machine Learning model | for a specific design purpose

Instructional Activities

{ML-Act.1}
Activity intended to | provide students | with vocabulary knowledge of ML

{ML-Act.2}
Activity intended to | provide students | with basic functionality of ML

{ML-Act.3}
Activity intended to | provide students | with practical examples of ML applied to design

{ML-Act.4}
Activity intended to | explain | training a simplified ML model

{ML-Act.4.1}
Activity intended to | set or align | with a design goal

{ML-Act.4.2}
Activity intended to | introduce students | to familiarising, collecting or creating data

{ML-Act.4.3}
Activity intended to | provide students | a step-by-step tool tutorial, such as RunwayML

{ML-Act.5}
Activity intended to | allow students | to individually train a simplified MLmodel for a design goal

{ML-Act.6}
Activity intended to | provide students | with a structured template for process and results documentation

{ML-Act.7}
Activity intended to | make students | explaining and questioning the process

Sub-module 1: Getting familiar with ML	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge		{ML-Act.1}				
(b) Conceptual Knowledge		{ML-Act.2} {ML-Act.3}				
(c) Procedural Knowledge		{ML-Act.4} {ML-Act.4.1, 4.2, 4.3}	{ML-Act.5} {ML-Obj}			
(d) Metacognitive Knowledge				{ML-Act.6}	{ML-Act.7}	

Fig. 7 Sub-Module 1: 'Getting Familiar' with Machine Learning. Educational Objectives and Instructional Activities arranged into the Bloom Taxonomy Table.

3.2 Sub-module 2: Getting familiar with Generative AI (genAI)

Students are first provided with a basic literacy of AI including technical vocabulary {GenAI-Act1} and primary functionalities {GenAI-Act2}. This activity is meant to promote factual and conceptual knowledge by teaching the basic elements of the discipline and their interrelationship to explain the functionality of AI tools. Once basic literacy is introduced, specific case studies are provided to contextualise the application of AI within the design practice {GenAI-Act3}. At this point, the teaching moves from a theoretical to a procedural level. In this direction, students are first introduced to a guided tutorial {GenAI-Act4.3} on how to use a Generative AI tool (e.g. Midjourney) starting from setting a design goal {GenAI-Act4.1} and experimenting with relative prompts {GenAI-Act4.2} Then, to familiarise themselves with the procedure, students individually apply what they learned by refining selected prompts and generating content based on the design goal {GenAI-Act5}. Lastly, moving the focus to meta-cognitive knowledge, students are asked to analyse and document the process by breaking down the steps and selecting the relevant results {GenAI-Act6}. This activity aims to create awareness and knowledge of cognition. To foster participation and sharing of results, students are asked to present their work and question others {GenAI-Act7}.

Educational Objectives

{GenAI-Obj}

Students will learn to | generate contents with GenAI tools | to create design artifacts

Instructional Activities

{GenAI-Act.1}

Activity intended to | provide students | with vocabulary knowledge of GenAI

{GenAI-Act.2}

Activity intended to | provide students | with basic functionality of GenAI

{GenAI-Act.3}

Activity intended to | provide students | with practical examples of GenAI applied to design

{GenAI-Act.4}

Activity intended to | explain | the procedure of generating contents with GenAI

{GenAI-Act.4.1}

Activity intended to | set or align | with a design goal

{GenAI-Act.4.2}

Activity intended to | introduce students | to familiarising, collecting or creating prompts (data)

{GenAI-Act.4.3}

Activity intended to | provide students | a step-by-step tool tutorial, such as Dall-E or Midjoruney

{GenAI-Act.5}

Activity intended to | allow students | to individually generate contents with GenAI for a design goal

{GenAI-Act.6}

Activity intended to | provide students | with a structured template for process and results documentation

{GenAI-Act.7}

Activity intended to | make students | explaining and questioning the process

Sub-module 2: Getting familiar with GenAI	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge		{GenAI-Act.1}				
(b) Conceptual Knowledge		{GenAI-Act.2} {GenAI-Act.3}				
(c) Procedural Knowledge		{GenAI-Act.4} {GenAI-Act.4.1, 4.2, 4.3}	{GenAI-Act.5} {GenAI-Obj}			
(d) Metacognitive Knowledge				{GenAI-Act.6}	{GenAI-Act.7}	

Fig. 8 Sub-Module 1: 'Getting Familiar' with Generative AI. Educational Objectives and Instructional Activities arranged into the Bloom Taxonomy Table.

3.3 Sub-module 2: Getting familiar with Data Visualisation (DV)

This sub-module teaches students to apply Computer Vision (CV) algorithms to analyse and visualise data {DV-Obj}. Students develop procedural knowledge through practical guided activities and they are asked to apply the acquired procedure to a familiar task (e.g. creating an infographic). Students are first provided with a basic literacy of CV algorithms and DV techniques including technical vocabulary {DV-Act1} and primary functionalities {DV-Act2}. This activity is meant to promote factual and conceptual knowledge by teaching the basic elements of the disciplines (CV and DV) and their interrelationship in analysing and visualising complex phenomena (Omena, 2021). Once basic literacy is introduced, specific case studies are provided to contextualise the application of CV within the design research {DV-Act3}. At this point, the teaching moves from a theoretical to a procedural level.

In this direction, students are first introduced to a guided tutorial {DV-Act4.3} on how to analyse data with CV algorithms (e.g. Meme Spector) and visualise the results (e.g. Gephi) starting from setting a research question (DV-Act4.1) and collecting and organising data related to the phenomena {DV-Act4.2}. Then, to familiarise themselves with the procedure, students individually apply what they learned by investigating the dataset to answer the research question {DV-Act5}. Lastly, moving the focus to meta-cognitive knowledge, students are asked to document the process by breaking down the steps and selecting the relevant results {DV-Act6}. This activity aims to create awareness and knowledge of cognition. To foster participation and sharing of results, students are asked to present their work and question others {DV-Act7} (Fig. 9).

Educational Objectives

{DV-Obj}
Students will learn to | apply Computer Vision algorithms | for analyse and visualise data

Instructional Activities

{DV-Act.1}
Activity intended to | provide students | with vocabulary knowledge of CV and DV

{DV-Act.2}
Activity intended to | provide students | with basic functionality of CV algorithms and DV techniques

{DV-Act.3}
Activity intended to | provide students | with practical examples of CV applied to design research

{DV-Act.4}
Activity intended to | explain | the procedure of analysing data with CV algorithms

{DV-Act.4.1}
Activity intended to | introduce students | to familiarising, collecting or creating prompts (data)

{DV-Act.4.2}
Activity intended to | set or align | with a research question

{DV-Act.4.3}
Activity intended to | provide students | a step-by-step tool tutorial, such as Memespector, Gephi

{DV-Act.5}
Activity intended to | allow students | to individually analyse data with computer vision for a research goal

{DV-Act.6}
Activity intended to | provide students | with a structured template for process and results documentation

{DV-Act.7}
Activity intended to | make students | explaining and questioning the process

Sub-module 3: Getting familiar with DV	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge		{DV-Act.1}				
(b) Conceptual Knowledge		{DV-Act.2} {DV-Act.3}				
(c) Procedural Knowledge		{DV-Act.4} {DV-Act.4.1, 4.2, 4.3}	{DV-Act.5} {DV-Obj}			
(d) Metacognitive Knowledge				{DV-Act.6}	{DV-Act.7}	

Fig. 9 Sub-Module 1: 'Getting Familiar' with Data Visualisation. Educational Objectives and Instructional Activities arranged into the Bloom Taxonomy Table.

4. Module 2: Get In-depth

To face this module, students need some basic knowledge of the disciplines involved and some practice of tools. For this reason, the selection of tools provided to students within this module depends on the skills acquired during the first module or prior knowledge. To define the set of tools suitable, refer to the Designing With Framework [link]. Working in groups (5-6 people) is recommended for this module, as collaboration facilitates addressing complex challenges. Additionally, a multidisciplinary approach incentivises different perspectives to emerge.

Students are first provided with a design challenge to drive the activity {MOD2-Act 1}. The design challenge provides a macro area for students to experiment with tools based on specific research questions and tasks. Examples of these challenges are *designing for climate change* and ***designing for twin cities***. A detailed description is available from the Designing With Workshop repository [link].

To help students understand the challenge, case studies are provided. Working on challenges contributes to developing a knowledge dimension as students are asked to understand the interrelationship of basic elements (acquired in Module 1) and make them function together within a larger structure. Once the context is set, tools are introduced through the Designing With Framework {MOD2-Act 2}. The framework aims to introduce students to exploring tools of AI/ML/DV, understanding their capabilities, and applying them within a design process. Additionally, the framework promotes a data-based approach, bringing students closer to a design practice led by data input and output. The data-based approach is useful, especially in promoting the method of inquiry, which is part of the procedural knowledge dimension developed within this activity. Fostering the exploration of tools through the framework aims to infuse in students a method of design with AI.

During the process, students are asked to document this method. For this purpose, a structured template [example] is introduced {MOD2-Act 3}. While in Module 1 documentation is one of the final activities, for the Module 2, keeping track of the steps, tools and choices at each of the design phases is encouraged to foster the acquisition of the method. During these activities, supervision from tutors and experts in the field is useful for choosing {MOD2-Act4} and properly applying AI tools {MOD2-Act5} for specific tasks defined based on the initial challenge. Two rounds of revisions are planned: the first one {MOD2-Act4} aims to support students in choosing the appropriate tools and refining the design concept; while the second one {MOD2-Act5} focuses on providing technical support in using the tools, as this second revision comes later when students are supposed to have the concept already defined and move to the prototyping and implementing phase. To allow teachers to assess the activities and future implementation of the module, students are asked for feedback. This activity contributes to creating awareness and knowledge of cognition. Lastly, to foster participation and sharing of results, students are asked to present their work and question others during a public presentation {MOD2-Act 7} (Fig. 10).

Module 2: Get In-depth	Cognitive process dimension					
	(1) Remember	(2) Understand	(3) Apply	(4) Analyze	(5) Evaluate	(6) Create
(a) Factual Knowledge						
(b) Conceptual Knowledge		{MOD2-Act1}				
(c) Procedural Knowledge			{MOD2-Act2}	{MOD2-Act3}	{MOD2-Act4} {MOD2-Act5}	
(d) Metacognitive Knowledge				{MOD2-Act6}	{MOD2-Act7}	{MOD2-Obj}

Fig. 10 Module 2: 'Get In-depth'. Educational Objectives and Instructional Activities arranged into the Bloom Taxonomy Table.

Educational Objectives

{MOD2-Obj}

Students will learn to | choose and apply AI/ML/DV tools | for specific activities of the design process

Instructional Activities

{Act.1}

Activity intended to | provide students | with a design challenge

{Act.2}

Activity intended to | support students | in understanding, exploring and using the Framework

{Act.3}

Activity intended to | provide students | with a structured template for process and results documentation

{Act.4}

Activity intended to | supervise students | in choosing AI tools for specific design phases

{Act.5}

Activity intended to | supervise students | in applying AI tools for specific design phases

{Act.6}

Activity intended to | ask students | feedback on the teaching module

{Act.7}

Activity intended to | make students | explaining and questioning the process and results

5. Conclusion

The didactic guidelines aim to provide teachers with detailed instructions on how to implement teaching modules on AI, Ml and DV in design curricula. The need to develop teaching resources arises from the need to equip the next generation of designers with the necessary knowledge and skills for the creative application of emerging technologies in design, preparing them for the ever-evolving demands of the design industry.
The methodology used to structure the guidelines refers to Bloom's Taxonomy, Revised for 21st-Century Learners (Anderson & Krathwohl, 2001), and is based on the individuation of a specific educational objective and a set of instructional activities for each teaching module. The guidelines consist of two teaching modules, 'Getting Familiar' and 'Get in Depth'. The first one, 'Getting Familiar' aims to provide fundamental theoretical and practical skills in Machine Learning, Generative Artificial Intelligence, and Data Visualisation.
These skills are divided into three discipline-specific sub-modules, allowing teachers to choose the complete module or the sub-module that best suits their needs. The second one, 'Getting Depth' aims to guide students in developing and practising a methodology for designing with AI during the stages of a design process. The methodology refers to the framework developed during the project. These guidelines have been tested and validated during the 'Designing With: AI + ML + DV' workshop with multidisciplinary students and teachers from different fields of design, architecture and engineering. The questionnaires and the results achieved by the students prove the comprehension, effectiveness and potential of the didactic framework.

6. References

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