FROM COMPONENTS TO POSSIBILITIES: THE STORY BEHIND THE AI-VET KIT

Artificial intelligence becomes easier to understand when learners can move beyond theory and begin building, testing and improving something of their own. This principle guided the development of the AI-VET Kit: a practical educational resource created to help VET teachers and students explore artificial intelligence, computer vision, robotics, programming, the Internet of Things and technology-supported sustainability.

The kit did not emerge from a single decision or from the work of one organisation. It was the result of a collaborative and incremental process involving the technologically oriented members of the AI-VET partnership, including universities, vocational education institutions and technology specialists. Each partner brought a different perspective: academic knowledge, technical expertise, classroom experience and an understanding of the challenges faced by VET teachers and learners.

The partnership also drew upon lessons learned through previous European projects. Earlier experiences had demonstrated that an effective educational kit must be more than a collection of electronic parts. Its components need to work together, support different levels of experience and allow teachers to move gradually from introductory activities to more ambitious applications. The AI-VET Kit was therefore refined as a flexible system that could support both guided training and independent experimentation.

A KIT DESIGNED AROUND LEARNING

The selection process began by considering what teachers and students should be able to achieve. The partnership wanted learners to develop programming skills, connect and control sensors, collect environmental data, explore computer vision, build robotic systems and understand how intelligent technologies can contribute to real sustainability challenges.
At the same time, the kit had to remain accessible to people with different levels of technical experience.

The components were therefore assessed according to several complementary criteria: educational usefulness, reliability, affordability, availability, ease of replacement, software compatibility, power requirements, physical integration and the possibility of reusing the same equipment across multiple projects.



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At the centre of the kit, the partnership selected the **Raspberry Pi 5**, provided in both 4 GB and 8 GB configurations. This was a particularly important decision. Unlike a basic microcontroller, the Raspberry Pi provides a complete Linux-based computing environment in a compact format. Teachers and students can use it to learn Python, work with hardware through its GPIO connections, process information from sensors and run more demanding applications involving cameras, computer vision and AI models.

The Raspberry Pi 5 also offers a strong educational ecosystem, extensive documentation and broad community support. These characteristics reduce the barriers encountered by beginners while providing enough processing capacity for more advanced users. The two memory configurations allow the kit to support both introductory exercises and projects requiring greater computational resources.

FROM PROCESSING INFORMATION TO INTERACTING WITH THE WORLD

The **ESP32-S3 module** was included as a complementary platform. While the Raspberry Pi can act as the central computer of a project, the ESP32 introduces learners to microcontroller programming, real-time operations and low-power wireless communication. Its built-in Wi-Fi and Bluetooth capabilities make it particularly useful for IoT projects in which devices collect information and communicate with other systems.

The **Raspberry Pi Camera Modules V2 and V3** created the foundation for computer-vision activities. Through these cameras, learners could move from simple image capture to projects involving object detection, visual monitoring and automated decision-making. Including more than one camera model also allowed different levels of resolution, field of view and project complexity to be explored.

Environmental and proximity sensors gave the kit the ability to observe the physical world. The **DHT11 temperature and humidity sensors** support environmental monitoring and data-collection activities. The **HC-SR04P ultrasonic sensors** can measure distance and support obstacle-detection or robotic-navigation projects. The adjustable **LDR light sensors** allow learners to explore smart lighting, energy efficiency and systems that react automatically to changing environmental conditions.

The kit also needed to act upon the information it collected. For this reason, it included **SG90 microservos**, **L298N motor drivers** and **two-wheel robotic chassis**. Together, these components allow learners to transform software instructions into physical movement, supporting projects such as automated windows, mobile robots, steering mechanisms and responsive systems.



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Visual feedback was another important consideration. Compact OLED displays enable projects to present sensor readings, messages and system information clearly. Programmable WS2812 LED strips, together with standard LEDs in different colours, allow data and system states to be represented visually. This is especially valuable in educational environments, where learners benefit from being able to immediately see the result of a change in their code.

Finally, breadboards, jumper wires, resistors, buttons, memory cards, power supplies, camera cables and protective Raspberry Pi cases ensured that the main devices could actually be assembled and used. Although these smaller elements may attract less attention, they are essential to creating a complete and reusable learning environment.

BEHIND THE FINISHED KIT











Once the component selection had been completed, the development process entered a detailed preparation stage. Materials had to be received, counted, separated and grouped into consistent sets. Connections, power requirements and compatibility between the different platforms were reviewed, while the supporting accessories required for practical classroom use were checked against the kit inventory.

Representative configurations were then assembled to validate how the components worked together. These tests ranged from introductory activities, such as controlling LEDs and servo motors, to projects using light and ultrasonic sensors, OLED displays, programmable LED strips and camera modules. This practical validation also helped connect the hardware with the training materials, ensuring that teachers would receive not only equipment but also a structured route into using it. The training handbook consequently guides users through Raspberry Pi setup, Python programming and a progression of hands-on projects.

The result was not simply a box of electronics. It was a coherent learning system designed to encourage experimentation, collaboration and problem-solving. Teachers could begin with guided activities, while students could progressively combine components to create original solutions addressing areas such as environmental monitoring, intelligent automation, robotics and energy efficiency.
At the conclusion of this development phase, the AI-VET Kits were ready for the next stage of their journey. Their distribution to project partners and participating schools would bring the equipment into real learning environments, where teachers and students could test its possibilities, contribute their own ideas and transform individual components into meaningful projects.

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