STEAMCITY - CONNECTED LEARNING

AI AT THE SERVICE OF THE CITY

Orientation guide for secondary school teachers AI and learning territories

Co-funded by the European Union

In the experimental approach promoted by SteamCity, artificial intelligence occupies a unique position that makes it a fertile field of investigation for learning territories. Unlike traditional approaches that consider AI as a complex technical tool reserved for specialists or a black box, SteamCity proposes to approach it as a set of accessible tools allowing students to question their immediate environment and develop concrete solutions to sustainable development issues. This approach is based on a fundamental characteristic of AI: its ability to reveal invisible patterns in data. Whether analyzing the biodiversity of a neighborhood by automatically recognizing birdsong, optimizing the management of urban green spaces, or understanding autonomous mobility, AI allows students to transform their daily environment into an experimental laboratory to better understand the issues while becoming increasingly familiar with the potential and limits of AI.

This direct experimental dimension distinguishes the SteamCity approach by offering students the opportunity to become actors in understanding and improving their environment.

The integration of tools and protocols related to Artificial Intelligence in SteamCity is thus in line with the logic of learning territories by providing students with the means to collect, analyze and interpret real data from their urban environment. This approach transforms learning about AI into a scientific investigation where students develop technical skills while contributing to a better understanding of territorial issues. This document presents SteamCity's educational orientations in the field of Artificial Intelligence and guides teachers in choosing the experimental protocols best suited to their educational objectives and the specificities of their disciplines.

Artificial intelligence is playing an increasing role in the management of cities and territories.

From intelligent transportation systems to optimized energy grids, environmental monitoring and urban planning, AI requires citizen ownership, especially for generations evolving in these augmented environments.

To demystify this complexity, it is important to distinguish between the main technological approaches of current AI. Supervised classification makes it possible to automatically identify and categorize urban elements from data, whether for sorting waste or classifying vegetation. Image recognition automates infrastructure identification, urban quality monitoring, or green space tracking. Sound recognition opens up new perspectives for analyzing the urban acoustic environment, from biodiversity monitoring to noise pollution assessment. Conversational agents and large language models, popularized by tools like ChatGPT, illustrate another dimension of AI. These technologies make it possible to process and analyze vast corpora of textual data on urban policies, citizen feedback, or territorial studies, offering students new ways to query and synthesize the information available about their environment.

SteamCity proposes to approach AI not as an abstract and anxiety-inducing concept, but as a set of concrete tools to analyze, understand, and act on territorial issues. This approach allows students to develop their scientific, technological, and civic skills, while discovering the potential and limitations of these emerging technologies.

EDUCATIONAL CHALLENGES OF AI IN STEAM EDUCATION

The integration of artificial intelligence into STEAM education meets educational objectives that revolve around the development of specific technical, analytical and civic skills.

As part of the bird song recognition protocol, for example, students acquire concrete skills in audio data processing: they learn to manipulate sound files, extract spectrograms, clean up their recordings by removing urban background noise, and then build labeled databases associating each sound sequence with the corresponding species. This approach leads them to use programming tools for audio analysis, while developing their data visualization skills to represent the acoustic characteristics of each species.

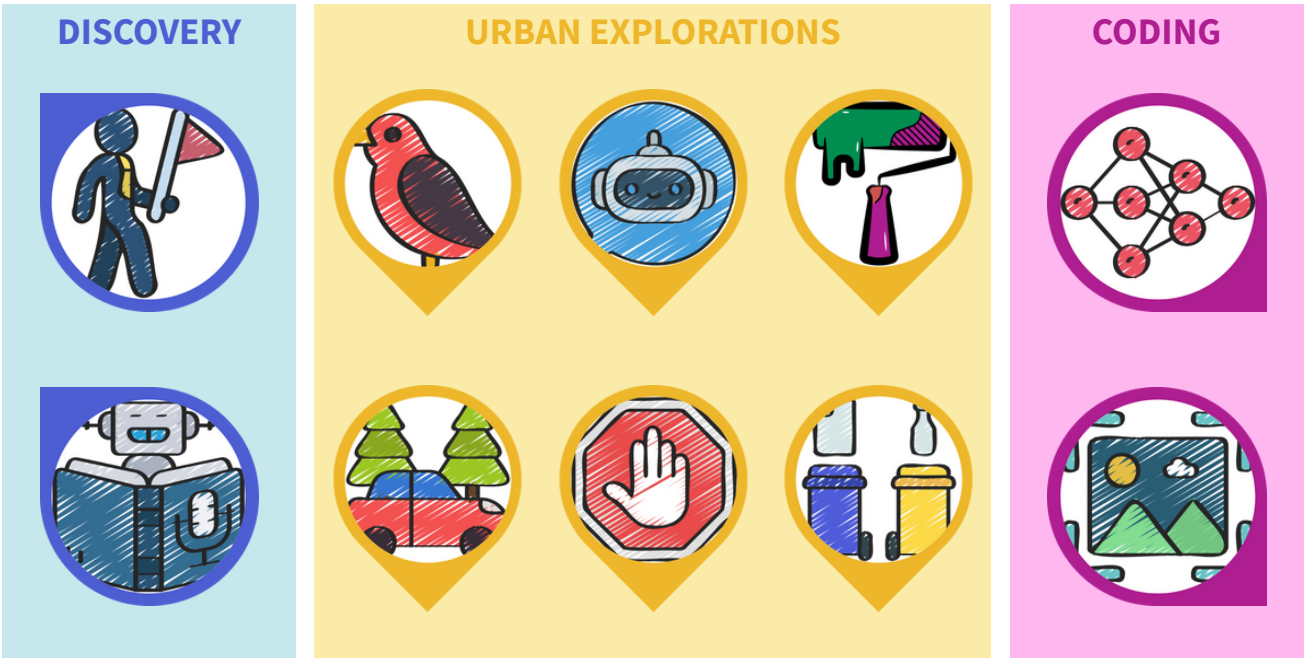
Critical thinking is developed through concrete situations evaluating algorithm performance. When students test their bird recognition model, they discover that their system confuses certain species with similar songs or that it performs poorly on recordings made in acoustic environments different from those of the training. This experience leads them to question the representativeness of their training sample: have they collected enough recordings of each species? Does their data reflect the diversity of urban contexts? How should a recognition rate of 75% for a given species be interpreted?

Interdisciplinarity finds authentic applications in SteamCity protocols where disciplinary boundaries naturally blur. The project to optimize an urban green wall simultaneously mobilizes biology to understand the physiological needs of plants (photosynthesis, mineral nutrition), physics to analyze environmental parameters (light, temperature, humidity), mathematics to model the relationships between these variables and optimize control algorithms, technology to program the sensors and actuators of the automated system, and geography to analyze the impact of these installations on the urban heat island. Students thus discover how AI can orchestrate the convergence of these different fields of knowledge to produce creative solutions and open up avenues of scientific exploration.

The scientific investigation approach is enriched by AI through specific methodological steps that students experience concretely. In the image recognition protocol applied to the analysis of urban vegetation, students begin by formulating a problem adapted to machine learning: "How can we automatically identify the different types of vegetation present in our neighborhood from photos?" They then build a collection protocol by defining the shooting conditions (altitude, angle, brightness), create a dataset by manually photographing and labeling several dozen images, and then train a classification model using accessible machine learning platforms such as Google Teachable Machine or Vittascience's Adacraft. Analyzing the results leads them to interpret confusion matrices, identify the most difficult vegetation categories to distinguish, and suggest improvements to their protocol. This concrete experience in scientific modeling prepares them for real-life research methods while giving them the critical tools to evaluate the AI systems they will encounter in their daily urban environment.

ARCHITECTURE OF THE AI APPROACH IN STEAMCITY

The integration of artificial intelligence in SteamCity is organized around three experimental courses composed of 8 activity proposals (some derived from SteamCity protocols and others focusing on technical skills) designed according to a coherent educational progression: from conceptual discovery to autonomous territorial experimentation.



Discovery and awareness course

The first course is an exploration phase designed to familiarize students with the fundamental concepts and concrete applications of artificial intelligence in their daily environment.

"Discovering AI in the City through DataWalk" offers an immersive territorial approach through an exploratory urban walk. Students identify on-site equipment and infrastructure that use or could benefit from AI to improve the quality of urban life: adaptive traffic lights, intelligent transport systems, interactive information terminals, environmental sensors. This contextual discovery anchors learning in direct observation of the territory and reveals the discreet omnipresence of AI in the urban environment.

"Understanding the Fundamentals of Bio-Inspired Learning" introduces the mechanisms of reinforcement learning by drawing parallels with human learning. This approach allows students to intuitively understand how AI algorithms learn through trial and error, drawing on their own learning experience. This conceptual foundation facilitates subsequent understanding of the processes by which AI models are trained.

Experimental territorial exploration course

The territorial exploration course engages students in authentic scientific investigations that mobilize AI to analyze and act on concrete environmental issues in their territory.

"AI and Biodiversity - Exploring Birdsong" is a scientific experiment using sound recognition to assess urban biodiversity. Students develop a rigorous approach to collecting acoustic data, build a learning base of bird song recordings, train an automatic recognition model, and then analyze variations in biodiversity across the urban areas studied. This investigation combines scientific rigor and technological innovation to produce original data on the local urban ecosystem.

"AI and Inclusion - Creating a Chatbot for Urban Accessibility" introduces students to conversational technologies by asking them to design a virtual assistant using major language models to respond to requests for accessible urban exploration. This experience combines technical discovery of LLMs and reflection on the accessibility of urban services, while developing user interface design skills.

"AI and Greening - Designing Adapted Green Walls" guides students through the design of an urban green wall by leveraging the capabilities of large language models to identify plant species adapted to the specific constraints of the implementation site. Students use AI as an advanced document search tool to cross-reference local climate data, soil characteristics, light exposure, and the ecological properties of candidate species. This approach illustrates how AI can support informed decision-making in sustainable urban development projects.

"AI and Decision-Making - Arbitrating Urban Issues" introduces students to decision tree methods applied to the identification of complex urban issues. This transparent algorithmic approach allows students to explicitly understand the classification criteria used and to question the relevance of the selected variables. This experience particularly develops critical thinking regarding automated decision support systems used in urban policies.

"AI for Tomorrow - Creating Future Road Signs" addresses the challenges of traffic sign recognition by autonomous vehicles and engages students in the design of new signs optimized to avoid ambiguities in interpretation by AI models. Students first analyze the recognition errors made by current systems, identify confusing visual features (similarities in shape, color, lighting conditions), and then propose redesigned signage designs for autonomous traffic. This experience concretely illustrates the interaction between artificial intelligence and urban infrastructure, while developing critical thinking on the adaptation of the urban environment to emerging technologies.

"AI and Waste - Automatically Sorting Waste" engages students in an image recognition project applied to automated waste sorting. Students create a photographic waste dataset, train a supervised classification model, and then evaluate its performance and limitations. This hands-on AI development experience reveals the challenges of data quality, algorithmic bias, and the real-world applicability of automated solutions in urban management.

Technical course: AI coding basics

A cross-curricular technical course complements this approach to AI by offering two practical activity sheets focused on mastering Vittascience tools. These technical skills provide the coding foundation needed for many of the project's other courses and educational resources.

The first sheet, "Creating and Training Your AI Model," guides students through the complete design of a machine learning model, from defining the problem to evaluating performance, including creating the dataset and setting up the training parameters. This technical skill is used in several territorial exploration experiments.

The second sheet, "Using Image Recognition," offers a practical approach to using computer vision models using Vittascience's Adacraft programming platform. This foundational skill allows students to develop their own visual analysis tools for various investigations.

These two technical skills constitute a cross-disciplinary methodological foundation which enriches all SteamCity courses by providing students with the concrete tools necessary to implement their territorial investigation ideas.

RECOMMENDATIONS FOR EDUCATIONAL GUIDANCE

The choice of courses depends on several factors that teachers must consider to optimize the educational impact of their interventions. The students' level of technical training is a first determining criterion. Discovery courses are particularly suitable for classes without specific computer science prerequisites, while technical approaches require a more solid foundation in programming and mathematics.

The teaching discipline also guides the choice of experiments. Life and earth science teachers will find natural connections to their curricula in biodiversity and vegetation courses, while technology teachers can focus on the technical aspects of model development. Mathematics teachers will discover concrete applications of statistical and probabilistic concepts in analyzing algorithm performance.

Available time necessarily influences the selection of courses. Discovery experiences can be integrated into short sequences, while exploratory projects require a greater time investment, compatible with interdisciplinary projects or interdisciplinary practical teaching.

The technical equipment available at the institution is another factor to consider. Some courses require specific IT resources or access to online platforms, while others can be adapted to more technically constrained environments.

PERSPECTIVES FOR EVOLUTION AND ADAPTATION

The integration of AI into SteamCity presents a major strategic particularity: its tools and methods are designed to transversely enrich all of the project's experiences, well beyond the only courses specifically dedicated to artificial intelligence.

This modular approach allows teachers to gradually integrate AI tools into their territorial investigations, regardless of the preferred field of study.

The major language models, introduced in the chatbot and greening courses, constitute a cross-disciplinary tool to enrich the documentary research phase of all SteamCity experiences. Whether studying urban mobility issues, analyzing territorial governance, or exploring energy questions, students can use the LLMs to effectively interrogate scientific literature, synthesize local regulatory data, or explore feedback from other territories facing similar challenges. This approach transforms the traditional documentary phase into an interactive investigation that allows students to gradually refine their understanding of the issues studied.

LLMs also offer innovative perspectives to support the critical analysis of experimental results. Students can submit their preliminary conclusions to an initial automated analysis that identifies points of attention, suggests complementary angles of interpretation, or points out possible inconsistencies in their reasoning. This automated critical confrontation does not replace the pedagogical support of the teacher, but constitutes a methodological safety net that helps students ensure that they have not omitted any obvious elements in their investigative approach.

The technical tools for image classification and recognition developed in specialized courses find applications in many other areas of territorial experimentation. An investigation into urban biodiversity can be enriched by automatic recognition techniques to process larger volumes of photographic data. An exploration of the quality of urban housing can integrate image classification tools to automatically analyze the state of buildings or identify areas of urban degradation. Mobility study courses can use image recognition to automate the counting of different modes of transport or analyze the temporal evolution of the occupation of public space.

This approach also allows teachers to offer differentiated in-depth courses based on their students' interests and skills. Some groups may simply use existing AI tools to enrich their investigations, while others may engage in the development of technical solutions adapted to their specific problems. This pedagogical flexibility respects the diversity of learning profiles while maintaining the requirement for a rigorous scientific approach.

The evolution of AI integration relies on feedback from teachers to identify the most common cross-curricular needs and develop new, appropriate tools. This collaborative approach transforms teachers into co-designers of educational resources, ensuring that the proposed tools match the realities on the ground and promoting the appropriation of technological innovations to serve learning territories.

CONCLUSION

The integration of artificial intelligence into SteamCity offers an educational approach that transforms learning about AI into a scientific investigation rooted in territorial issues.

Through its courses, it offers teachers a structured progression that leads students from the conceptual discovery of machine learning mechanisms to the technical mastery of classification and recognition tools, through concrete experimentation on urban environmental issues.

This approach is distinguished by its dual educational ambition: to develop specific technical skills in data processing, programming, and modeling, while also training critical thinking in the face of the algorithms that shape territorial decisions. Students do not simply use AI as a "black box," but understand its mechanisms, identify its biases, and evaluate its limitations through concrete experiments conducted in their own territory.

The cross-disciplinary dimension of AI integration is a major asset for the entire SteamCity project. The tools developed in the courses—from large language models for document research to classification techniques for territorial data analysis—can enrich all the investigations carried out in the other areas of the project. This modular approach increases the possibilities for experimentation while respecting the diversity of educational contexts and student skills.

By transforming the territory into an experimental laboratory where AI becomes an accessible scientific investigation tool, the integration of artificial intelligence in SteamCity prepares students to become enlightened citizens capable of understanding, questioning and using artificial intelligence technologies to analyze and improve their urban environment.

This training thus fully contributes to the emergence of truly learning territories where technology serves citizen investigation in the service of sustainable development.