INTRODUCTION TO THE USE, INTEREST AND EDUCATIONAL IMPACT OF MODELING

Model the city to help students understand its issues and contextualize their learning

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INTRODUCTION

Models—whether of a location, an installation, an environment, or even a concept—are long-standing tools for representing reality. They show reliefs and shapes, interactions and complexity, at a scale that allows the observer to have a global, overarching view and adopt different angles of observation.

For example, a model of a neighborhood allows for the simultaneous visualization of buildings, green spaces, traffic routes, and their complex interconnections—the hierarchy of routes and points of friction between pedestrians and vehicles. Similarly, a model of the circulatory system reveals the complexity of vascular branching, diameter variations, and cross-flows that a flat diagram could not show, while a model of an industrial production line makes visible the complexity of material flows, temporal interdependencies between stations, and potential bottlenecks.

This work on complexity is essential. Indeed, models are often used as an intermediate step between a uniform vision and a multidisciplinary vision of the object of study, for example in the context of a place, as a tool for moving from the plan or map to a complete vision of the environment, reliefs and forms of occupation of space, but also emotions and interactions. The transition to this more complex vision makes it possible to make issues that seem invisible visible. And thus to understand their spatial relationship, their role in the organization of the collective, in our country, in the city.

For example, a model of a neighborhood can reveal how the position of a school in relation to public transport influences the daily journeys of families, or how the location of green spaces creates green continuities and social links between different residential blocks - issues of collective organization that remain abstract on a map.

Building a model also facilitates the transition from lived space to designed space (Godin, 2008) by allowing the remobilization of reality, from observation - what students see every day when they cross their neighborhoods - to position themselves in a designer role - students must reflect on their observations to transcribe them faithfully or sensibly in their modeled tool. This approach makes it possible to understand and tame the complexity of the territory through the active positioning of the student.

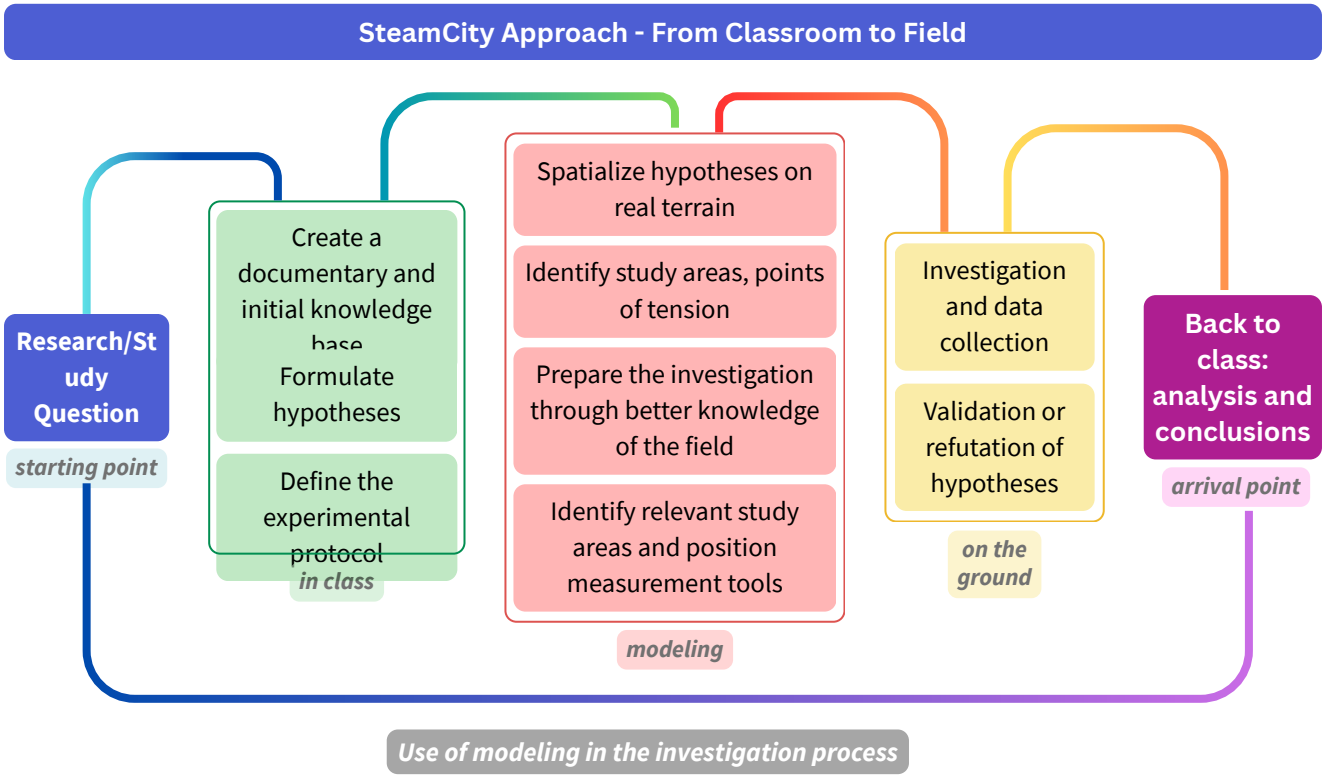
In concrete terms, students who walk along a shopping street every day will be able, by building a model, to become aware of the layout of the shop fronts, the width of the sidewalks, the obstacles to pedestrian traffic, and to suggest thoughtful improvements based on their experience of the place.

The model is now a widespread tool in education: in science to make complex systems visible, in geography to make visible the state of reality and the possible future of the environment. In SteamCity, the objective is to link these two uses. In the service of a more integrated, broader, more complex education about territories and the environment, and radically anchored in scientific rigor and questioning.

OUR APPROACH IN STEAMCITY

Within SteamCity, the modeling phase is a link between learning concepts within the classroom and the project's ambition to push students outside the classroom to contextualize their knowledge. Modeling makes this relationship easier and more understandable, while allowing them to manipulate the territory in a new way, to reflect and organize their ideas.

The modeling stage also involves a spatial memorization issue - understanding and grasping the territory before being propelled there - but also an educational one, by offering a reassuring stage, without major risk, of active situational simulation.



Use of modeling in the investigation process

Using the model in an active investigation phase is also a way to stimulate dialogue (Buyck et al., 2016; Romero et al., 2017). It provides a concrete support for discussion to compare perspectives and develop each person's representations of their environment, which makes it far from trivial in the investigative pedagogical approach. In particular, it makes it possible to highlight the interdisciplinarity proposed in the SteamCity protocols. The model mobilizes scientific and technological teaching, as well as geographical, civic and historical teaching - understanding the evolution of the field of study.

In addition, confirming the desire to integrate the arts and humanities as components of science learning and as tools to stimulate students' interest, the model is a tool based on creativity, collaboration, the artistic approach and personal expression. The modeling phase is a time dedicated to students to express and explore their emotions in the face of their daily lives.

Beyond the real representation of their living environment, the model can be used to identify areas of friction, places where students feel exposed, those creating feelings of well-being or stress, fears and risks. Exploring these emotional issues through a rigorous and scientific approach allows students to take ownership of the experimental process and give it new perspectives.

THE MODEL, THE CITY AND EDUCATION IN TERRITORIES

The SteamCity project aims to connect scientific learning with current urban and societal issues to understand how each student can impact their living environment. Within this overall objective, the vision of the territory and the links with risk education are central. The project allows for work on the concepts of vulnerability, both those of territories and those of the citizens who occupy them.

Risk education - What are we talking about? - Excerpt from the Eduscol platform

In a context of increasing occurrence and intensity of major events linked to climate change, the control of natural and technological risks requires an effort to reduce vulnerability and improve the resilience of populations and the educational institution. In accordance with the principles of Law No. 2004-811 of August 13, 2004 on the modernization of civil security, the School has, among its missions, that of developing security education to strengthen the resilience of the population in the face of major events.

The prevention of major risks is one of its thematic axes. Major risks refer to technological hazards (industrial and nuclear accidents) and natural hazards (floods, storms, earthquakes, avalanches, etc.) likely to affect territories and populations.

Major risks vary from one territory to another. Taking into account local specificities is a key element in the diagnosis and analysis of risks as close as possible to the reality of the territories (floods, avalanches, seismic risk, etc.).

https://eduscol.education.fr/3691/eduquer-et-informer-sur-les-risques-majeurs#:~:text=L'%C3%A9ducation%20aux%20risques%20majeurs,adopter%20en%20cas%20de%20crise

Risk education must involve students' perception and awareness of these risks. This awareness is built through experience, through shared representations within the "class" group in which each student evolves. Knowledge of the vulnerabilities of one's territory thus traces the personal observations, uses and direct experiences of individuals (Tanner, 2010).

It is therefore necessary to anchor risk education in a local context, close to the reality of learners. The territory becomes a fully-fledged axis of learning, a pedagogical support which ensures geographical and social anchoring, and encourages the positioning of students as active citizens (Blanc-Maximin and Floro, 2017; Barthes et al., 2019).

But the learning process shouldn't make the content anxiety-inducing for those who experience it. It is in this sense that SteamCity offers a platform that is both rigorous and fundamentally fun for working on territorial issues. Through the use of the model, students engage in their work of raising awareness of their environment, through a creative, engaging, and positive approach.

The model thus makes it possible to account for local specificities, whether in terms of spaces, resources or actors, and to teach in the territories, through concrete and contextualized activities (Dussaux, 2017).

The experiment within SteamCity illustrates this dynamic. The use of models demonstrates the learning of the territory. Whether or not students can go into the field, implementing this phase will ensure that they acquire knowledge of the local context.

HOW TO BRING OUT THE MODEL AND FOR WHAT USES

Creating a model is not a purely technical or artistic activity. It is a tool for reflection and exploration that allows students to account for their representations of their territory. Within the framework of SteamCity and the associated investigation protocols, it also serves to make visible and question the hypotheses generated to understand their research questions before confronting them with the field.

The emergence of the model within the class must therefore reflect this learning process of reflection, be problematized and brought as a tool at the service of investigation.

Bring the model to class

The first step in starting a model—whether made of LEGO®, modeling clay, cardboard, or even flat, on an improved map—is to question students' initial representations of their territory. To achieve this step, stimulate discussion in class. Organize a session of everyday stories, where each student shares an anecdote, a moment of life in their neighborhood. Use mind mapping tools to compare points of view and stories. Have them draw their living environment, or a dynamic moment, a journey, an interaction. These initial supports will reveal their preconceptions of the territory, its vulnerabilities, and their priorities as residents of these places.

The transition from these representations to a collective model will emerge from the confrontation of these ideas so that collectively, the students choose: the reference territory, the one that makes sense for the collective, the selection of materials to represent their ideas.

Perhaps a cardboard model can help visualize a territory in a very realistic way.
If the students' goal is rather to visualize emotions, sensitive mapping is sufficient.
If their modeling desire focuses on spatial interactions, using LEGO® is relevant.

Once the variables and components of the model have been defined, the students will be able to distribute the construction tasks: divide the work by type of action (create a plan, look for materials, assemble them), by geographical areas, by topographical elements, by infrastructure, by devices, etc. This distribution of tasks will promote individual skills and make each student responsible for collective success.

Examples of models that can be created within the framework of SteamCity
(each is the subject of an associated methodological sheet)

Model type	Description	Educational relevance
3D model (Lego, cardboard, paper, etc.)	Material construction with simple volumes (cardboard, paper, light wood), modular blocks and project stages. Use of bricks to model structures and their interactions.	Represent a territory realistically: relief, waterways, infrastructure. Structure a collaborative project, experiment with iteration and collective management. Visualize spatial interactions, test scenarios.
Road traffic model	Flat representation of the territory used as a testing ground. Can be used with a robotic agent.	Simulate movements, obstacles, protection or evacuation strategies.
Sensitive mapping	Individual cards transformed into a collective artistic representation.	Express emotions, perceptions and feelings related to the territory and risks.

The use of the model in the investigation stages

Once completed, the model is used in the SteamCity experimental protocols as a link between the questioning and hypothesis formulation phase carried out within the class and the possibility of validating these hypotheses in the field. By offering a simplified version of the territory, it allows the protocol to be rigorously tested through the following axes:

From the classroom to the field: the role of the model in a scientific investigation protocol

Stage	Role of the model	Contributions for students	Example*
Spatialize hypotheses on real terrain	The model places the hypotheses on a tangible representation: waterways, reliefs, inhabited areas, infrastructures. It immediately shows the effects of the choices.	Students situate their ideas within a constrained space. They connect geography, science, and technology with their experiences.	The model locates noise sources, flows, and screens. It translates hypotheses into visible paths and provides an understanding of nighttime propagation.
Identify study areas and points of tension	The model highlights sensitive areas: floodplains, fragile banks, unstable slopes, exposed buildings. Tensions between use and constraint appear.	Students see that risks are localized. They prioritize observation and identify strategic points.	The model reveals stress points (traffic, industries, etc.) and refuge areas. It helps choose measurement sites and distinguish between structural and usage factors.
Prepare the investigation through better knowledge of the field	The model requires maps, aerial photographs, witness accounts, and historical data. This data is integrated into the model.	Students move from a general overview to a detailed analysis. Hypotheses gain credibility. The model serves as a rehearsal.	It structures the night protocol: variables, constants, slots. Biases (weather, wind, events) are anticipated.
Position measurement tools and strengthen analysis	The model simulates the installation of instruments: markers, stations, sensors, structures. The placements are discussed and tested.	Students connect space and instrumentation. They justify each position and understand what the data proves, reinforcing rigor.	The model maps sensor placement and noise paths. It ensures consistent distances and heights for reproducible collection.

**creation of a protocol on the impact of urban noise on sleep*