# Space Representation and Gender Differences: A Flipped Approach to Geography Teaching

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## Abstract

According to recent literature, men and women do not process spatial information in the same way (Berthoz, 2009). The origin of these differences is not known, but experimental evidences demonstrate a huge variety of strategies the representation of space according to sex, context, purpose to reach, education, age. Our assumption is that the different behaviors between genders is important in studying geography, in particular in use of maps. Using maps, if concurrent with navigation, implies a transformation from the egocentric perspective to the geocentric perspective, which is one of the aspects in which gender-related behaviors mainly differ.
This peculiar problem is inscribed, in Italy, in a broader framework that sees an educational emergency linked to the study of geography. This emergency arises from the reduction in the number of hours dedicated to the discipline and the distance between the theoretical dimension of human geography and the need for practical activities that make teaching effective.
The Flipped Classroom model provides a complementarity among the logics of problem solving, learning-by-doing, and reflective learning: activity is at the center of didactics, learning is experienced in the first person, matures through the execution of a task and is finally remodeled through a discussion, and a teacher-guided correction. The expert knowledge of the teacher is fully profitable to the extent that he is questioned by the student, involved in solving problems, called to give his point of view in the discussion of a case.
This article proposes some teaching activities, based on the flipped classroom, which were designed and developed keeping in mind gender differences, providing a series of equivalent teaching materials that matched the different cognitive strategies.

**Keywords:** *Spatial information processing, Gender, Flipped Learning;*

## Introduction

DiSalle indicates how the topic of space constitutes a common thread, an uninterrupted debate from Newton to Einstein:

"…when Newton appeals to absolute space, he does not advance any theses about the ontology of space-time. Rather the postulation of absolute space and time is inspired by empirical reasoning about motion. This theme unites Newton with later physicists: At the very least, we can identify a common metaphysical principle uniting general relativity with special relativity and Newton's theory: space-time is an objective geometrical structure that expresses itself in the phenomena of motion."[1]

The philosophical debate on the ontology of space, in extreme synthesis, has been incardinated on two specular positions: an idea of absolute space, according to which space and time exist independently of objects and object relations (or, more radically, based on to which space and time exist), and an idea of relative space, whereby the existence of space and time is linked to objects and relations between objects (or, more radically, for which space and time do not exist at all) ( DiSalle, 2006).
The Kantian position, which saw space and time as a priori frameworks, was the object of the subsequent elaborations of Poincaré and Einstein
During the nineteenth and twentieth century the Kantian conception, both from the philosophical point of view and above all on the objective bases of the new scientific discoveries, was literally demolished.
The recent discoveries in the field of neuroscience have definitively established the indissolubility of the space-mind-body triad.
Neuroscientific investigation does not take space as a category, but frames it from the point of view of brain activity

"Dans le traitement de l'espace, le problème pour le cerveau, c'est la multiplicité des espaces. Il n y a pas «l'espace », il y a une multiplicité formidable d'espaces. Deuxièmement, percevoir l'espace n'équivaut pas à percevoir la géométrie, mais à percevoir un mouvement." [2]
The brain, in this perspective, is very far from the idea of a computer of the stimuli coming from the senses, but it represents a "creator of worlds", a "reality emulator".
"Our reality emulator acts primarily as the prerequisite for coordinated, directed motricity; it does so by generating a predictive image of an event to come that causes the creature to react or behave accordingly" [3].
The basis of this discourse is the flipping of the perception-action paradigm
"We base on our action, and not on representation, our conception of the organism's activity. Perception does not represent the world as it is, but the structure in the Umwelt. [...] There is no perception of the world that does not refer in any way to the acting body"[4].

As for the difference between the genders in space representation, the assumption is that the different behavior between genders is not a variable that intervenes only during the acquisition of the skills being investigated, but that represents a structural difference, and persists into adulthood.
Berthoz summarizes: "there are anatomical and neuroendocrinal bases for gender differences […], but it is now accepted that, whatever the origin (nature or nurture) of these differences, men and women do not process spatial information, for instance, in the same way"[5].
For travel memory, women tend to adopt more egocentric and sequential strategies. Berthoz suggests that this is related to their preference for what can be verbally mediated. In other words, women prefer a verbal description of travel, which is of a sequential nature. This is probably due to the cerebral lateralization process.
Men, on the other hand, prefer more allocentrics strategies. In general, males are statistically more efficient in mental rotation tasks, such as changing perspective by reading a map. Some studies point out that the mental representation of large environments in males contains more "metric" information in men than in women, while females relied more on information about the actual references in the environment during navigation.
On the whole, variation between men and women tends to be smaller than deviations within each sex, but very large differences between the groups do exist—in men's high level of visualspatial targeting ability, for one [6].
The evidence that emerges with certainty from diverse studies is, however, that of a huge variety of strategies that differ according to sex, context, purpose to reach, education, age, and profession.
Our assumption is that the different behaviors between genders is important in studying geography, in particular in use of maps. Using maps, if concurrent with navigation, implies a transformation from the egocentric perspective to the geocentric perspective, which is one of the aspects in which gender-related behaviors mainly differ.
This peculiar problem is inscribed, in Italy, in a broader framework that sees an educational emergency linked to the study of geography. This emergency arises from the reduction in the number of hours dedicated to the discipline and the distance between the theoretical dimension.
Our assumption is that Flipped Classroom Model could provide a teaching approach which can fit gender peculiarities in geography learning.

## Flipped Learning

The Flipped Lesson is "flipped" because it reverses precisely the usual order of the didactics: traditionally you get the information with a front lesson and then study at home; in the Flipped Lesson, at least in the inevitable simplification that followed the dissemination process, a student studied at home before, and works in class with the teacher at a later time. The accent, in short, has fallen on reversing work time at home / work at school. The meaning we propose here is closer to the methodology of the Episodes of Situated Learning. To be overturned are not primarily the times and the relationship between home and school; The subject of flipping is the didactic actions: what does the teacher do and what the pupils do.
According to the synthetic and effective reconstruction elaborated by Piercesare Rivoltella [7], the idea of a "flipped" methodology is focused in the 90's by Eric Mazur [8], at Harvard University addresses it to explain the function of the computer in the learning process; in the following years it is being revived and developed in several contributions that now speak of "inverted instruction" and "inverted classroom" [9], "classroom flip" [10] becoming a a slogan ("Flip your classroom!") and entering common use.

The concept of Flipping Learning today is used to decode one of the possible uses of Blended Instruction, the use of technologies to make available to students the material they need to practice pre-learning before confronting the teacher.
In Flipped Lesson you get the information freely exploring different materials pre-selected by the teacher, and you are confronted later with the teacher. The sequencing of an articulated Flipped Learning Object is scanned in three phases:

- an exploratory moment in which the teacher starts curiosity about the new topic through a stimulus and gives students the opportunity to satisfy this curiosity through free text exploration (text, videos, images, audio, maps, games) pre- selected;
- an operational moment in which the information obtained by the student in the first phase is useful in supporting the production of an artifact through work in small groups;
- a final debriefing time in which the artifact processed at the second moment is subjected to critical review by presentation and sharing.

Approaching Geography through experience (i.e., orienteering practice, map reading) involves a re.thimnking of the restructuring / metacognitive moment management: the nature of the object of the operational stage, indeed, is not an artifact, but a performance.

## From artifact to performance: orienteering as teaching strategy

Golden, Levy and Vohra provides a detailed definition of activities and procedures to which is called the athlete who takes part in an orienteering event:
"Orienteering is an outdoor sport that is usually played in heavily forested areas. Located in the forest are a number of "control points" each with an associated score. Competitors armed with compass and map are required to visit a subset of the control points from the start point (node 1) so as to maximize their total score and return to the end point (node n) within a prescribed amount of time" [11]
Given the type of activity, it is easy to imagine how a scientific approach to orienteering involves a wide variety of fields of knowledge (cartography, geography, medicine, sport sciences, education, psychology, neuroscience) which are sometimes regarded as distant from each other.
National Guidelines for the kindergarten and the first cycle of education, among learning objectives that students should achieve by the third year of secondary school, mention the ability to orient in the natural environment through the reading and decoding of maps.
The selection of the route, in fact, is clearly one of the success factors in orienteering: "There is no doubt that good route selection and proper execution of the five techniques along your route are keys to success in orienteering" [12].
In the practice of orienteering are involved not only the cognitive processes linked to the spatial navigation, but also the "combined task (as well as subtasks) of map reading and navigation" [13].
These tasks are not discrete and separate moments, but represent operations that are managed simultaneously by the brain of the athlete.
The contribution of neuroscience in the investigation of this specific field of study is filling a gap due to the hybrid nature of the research. This gap had already been identified and reported years ago. Robben, in 2004, emphasized how "research into cognitive processes in map reading has been conducted primarily in the fields of psychology and cartography. […] Cognitive studies and spatial ability measures have been conducted for more than 100 years by psychologists and for more than 30 years by cartographers. However, while some studies provide insight into the cognitive processes and strategies associated with specific map-reading tasks, many of these tasks, strategies, and processes have yet to be identified and, possibly more importantly, understood" [13].
Orienteering can represent the ubi consistam of the operational stage in a flipped model to geography, and can allow different performances respecting different gender-based cognitive strategies. The logics of problem solving, learning-by-doing, and reflective learning is complemented and supported in the flipped approach: activity is at the center of didactics, learning is experienced in the first person, matures through the execution of a task and is finally remodeled through a discussion, and a teacher-guided correction. The expert knowledge of the teacher is, in fact, fully profitable to the extent that he is questioned by the student, involved in solving problems, called to give his point of view in the discussion of a case ([7].

## Conclusion

Orienteering involves directly and primarily cognitive processes that are crucial in the acquisition of the ability to take the perspective of others.
Cognitive processes involved in peculiar orienteering activities (map reading, route selecting, spatial thinking) are involved in the management of intersubjective relationship. In essence, the skills involved in reading maps and in developing strategies for spatial navigation are skills that allow us to see the world from different points of view, abandoning the egocentric perspective, and are therefore involved in educational inclusion-oriented paths.

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