Chapter 9
Citizen Observatories as Advanced Learning Environments

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ABSTRACT

Citizen Observatories are the technological platforms where a diverse range of tools are developed, such as web portals, smartphone apps, electronic devices, that allow the development of citizen science projects, particularly those with the principal objective of large scale participation of the people, covering large geographical areas and long periods of time. These new observatories integrate the latest Information and Communication Technologies (ICT) to connect the citizens digitally, improve their observational capabilities and provide information flows. The concept of Citizen Observatories offers great possibilities as an educational experience, precisely due to the opportunities offered by the participation of the people, with different levels and roles and therefore, it is assumed in terms of active collaboration of the citizens, in shared processes of knowledge creation. This is especially clear when we pay attention to the complexity of the challenges education must face today, within the framework of a society of knowledge like ours.

WHAT ARE CITIZEN OBSERVATORIES?

Citizen science promotes public participation in the collection of large quantities of observations of a very diverse nature (from the identification of new stars or comets to the detection of cancerous cells and the presence of invasive species, to mention a few examples). These observations provide data in a wide variety of settings and during long periods of time. Citizen science projects have had notable
success in the advancement of scientific knowledge and the contributions of the people are providing large quantities of data in different scientific disciplines. An essential requirement for the functioning of citizen science is the participation of the people, in an extensive and sustained manner. Citizen Observatories are the research infrastructures (i.e. the technological platforms where a diverse range of tools are developed such as web portals, smartphone apps, electronic devices) that allow the development of citizen science projects, particularly those with the principal objective of large scale participation of the people, covering large geographical areas and long periods of time. These new observatories integrate the latest information and communication technologies (ICT) to connect the citizens digitally, improve their observational capabilities and provide information flows.

The Citizen Observatories therefore offer an environment where people can participate in citizen science projects. According to an original idea by Arnstein (1969) different levels of participation can be defined, considering to the social and cognitive involvement of the people. In an adaptation of this idea, within the context of citizen science, Haklay (2011) defined the hierarchy of participation with four levels of social and cognitive involvement:

- **Crowdsourcing:** At this level, people generate information passively with little cognitive involvement. For example, people are invited to wear a sensor for a time, after which it is returned to the organisers of the experiment. The information generated is subsequently analysed by specialists in the subjects being studied.

- **Distributed Intelligence:** At this level, the central resources of the project are the cognitive abilities of the people. Most current citizen science projects fall within this level. The people who participate often receive training, which may be in person or using didactic resources accessible on the web. People who can provide information through observations made or through the interpretation of existing information (for example, validating observations made by others).

- **Participative Citizen Science:** This level is characterised by the problem being defined by the community itself. In some cases, it may be derived from an evolution of the projects from the previous level, when the people that have participated have acquired sufficient expertise in the collection and analysis of data, as well as the ability to think up new questions to solve.

- **Collaborative (or Extreme) Citizen Science:** This is the most integrated level where the people participate at all levels. It is not only possible to think up new questions, like at the previous level, but the people can also participate in the design of the methods for acquiring the observations and analysing the information.

Aside from the levels of participation, the Citizen Observatories also offer an environment where the people can collaborate with different roles of participation (see Figure 1):

- **Makers:** These are people with abilities and interests in the technological field. In this role, the people participate by designing new observation instruments and tools, often with low-cost material that is easy to acquire, promoting the concept of *Do-It-Yourself* (DIY).

- **Observers:** These are the people who provide observations, either using existing technology or technology designed by the makers.

- **Analysers:** In this role, the people participate by interpreting or validating existing information. With this analysis it is possible to improve the quality of the information provided by the observers.