	Advantages
General	• Developers get to know users; they learn profoundly about user abilities, use purposes, and life circumstances • Prevent and reduce problems of communication and misunderstanding between developers and users • Users offer a source of new ideas
Development process	• Valuable user input • Address users' lack of awareness of their own requirements and their inability to outline these reliably • Support developers to identify, describe, and fully recognize user requirements • Avoid undesirable developments
Afterwards	• Guarantee that the application aligns with user needs/demands and that it delivers a good user experience (focusing, for example, on accessibility, usability, utility, compatibility, and desirability) • Increase user knowledge and acceptance of the application • Ensure that the implemented product really meets the needs of the user group

Table 11. *Selected advantages of participatory design (Hennig and Vogler 2016).*

education and training opportunities. It is widely accepted that such measures to strengthen spatial literacy are equally important as providing accessible applications (Hennig et al. 2013).

PARTICIPATORY DESIGN

The methods used in the AccessibleMap and senTOUR projects—literature and internet review, user survey, AoSS, and stakeholder involvement (Figure 1)—are well-recognized in software engineering and requirements engineering. But, applying them might not be enough to gain a profound understanding of users. Reasons include communication problems between users and developers (misunderstandings, use of different vocabulary, etc.), users' lack of awareness of their own needs, and users' lack of ability to reliably describe their requirements (Firesmith 2007; Hennig and Vogler 2016). Direct and active cooperation with future users in the application development process can be seen as a remedy to these shortcomings, using the approach of participatory design.

Participatory design is defined as a process that aims at involving representatives of future users in the design and development process of a system or product. This can occur in different ways and with varying intensity (Baek et al. 2007). A distinction is made between weak and strong participatory design: in weak participatory design, even though user input is solicited throughout the entire development process, decision making is largely undertaken by the developers. In strong participatory design, the users take part in decision making. Detailed information on participatory design can be found in the literature (see, for example, Enerson 2013; Mazzone and Read 2005; Steen et al. 2007).

Several advantages of participatory design are laid out in Table 11. Because users are experts in their own requirements, participatory design exposes user needs and skills (as tacit knowledge: aspects usually not known to developers) and brings them into the development process. This helps to generate applications that better adhere to users' aims (Muller and Druin 2012; Steen et al. 2007), which is particularly relevant for the development of web maps that address laypersons and/or special needs users such as disabled people, the elderly, and children. Tsou (2003) stresses that the developers of web maps are challenged with meeting the needs of non-experts, who are a lot more diverse and unfamiliar to the developers than are traditional GIS users. Hennig and Vogler (2016) further explain that special needs users, including visually impaired users, are even more unknown to web map developers. Thus, the participatory design approach can play a critical role in the development of accessible web maps.

CONCLUSION AND OUTLOOK

The use of web maps is as important for the visually impaired as it is for sighted people, and sometimes it is even more important. Having access to spatial information regarding unknown areas allows them to plan and prepare trips in advance; this can lead to a more independent life. Since accessible web maps enable everyone to benefit from