Cities 27 (2010) 172–181

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

Viewpoint

An assessment of Public Participation GIS and Web 2.0 technologies in urban planning practice in Canela, Brazil

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ARTICLE INFO

Article history:
Received 28 May 2009
Received in revised form 3 September 2009
Accepted 12 November 2009
Available online 18 February 2010

Keywords:
GIS, PPGIS
Public participation
Urban planning
Web 2.0
Geospatial data

ABSTRACT

Recent advances in Geographic Information Systems (GIS) and Web 2.0 technologies provide new ways of creating sophisticated Web applications that strengthen social interactions based on comments on online maps, which have the potential to improve Public Participation GIS (PPGIS) practices. In this paper, we address this promising approach to analyze the impact of collaborative Web 2.0 tools applied to PPGIS applications in urban planning actions. We develop a Web 2.0 PPGIS application through free, easy-to-use tools, which consist of a Web mapping service, with eligible geospatial data layers, where users explore and comment. A database stores the contributions in a format supported by GIS. We also set up a prototype version in Canela (Brazil), to test its usability. The results showed that it is a valuable approach for engaging the public. It could promote communication among users and decision makers in a more interactive and straightforward way. Besides, it is easy to set up and understandable by non-experts. The Web 2.0 PPGIS may serve as a social tool for any spatially-related issue involving community members in any context.

Introduction

Urban planning handles problems of the built, natural, and social environments, where a wide range of features have to be balanced against each other to reach solutions (Webber and Rittel, 1973). Undoubtedly, key players in urban planning are the inhabitants, who know the reality and the problems around them better than anyone else. Citizens' knowledge provides a rich source of updated information that helps to improve the quality of the analysis, leading to different solutions than when using traditional forms of data. Nevertheless, involving members of society in planning decisions affecting their lives is a recent trend, principally influenced by legislation. For instance, the United Nations Local Agenda 21[1] program enshrines the practice in its principles; and the Aarhus Convention[2] established that sustainable development can only be achieved by involving stakeholders.

However, public participation for urban planning decisions is not a straightforward process. It deals with problems that co-evolve, with an infinite number of solutions (Webber and Rittel, 1973; Tang et al., 2005). Besides, the complexity and interdisciplinary characteristics of all studies needed to produce an urban analysis demand up-to-date tools and methods to represent space and its inherent relations. As most urban studies data are found in map forms, visualization capacity, employing mapping services, found in Web 2.0 tools, and the capacity to model multiple outcomes of GIS, are critical (Elwood, 2006).

As a result of the use of GIS capabilities by the public, the term Public Participation GIS (PPGIS) has emerged (Nyerges et al., 1997). Rather than using these in a traditional way, as for spatial analysis, geospatial capabilities are used for production of maps and spatial stories that help to characterize the local space (Elwood, 2006). Since traditional participation methods received some criticism, based on the limited ability to sufficiently engage the public, to provide useful data, and to promote an exchange of ideas (Forrester et al., 1999; van den Brink et al., 2007), PPGIS can be perceived as a technological evolution enabling more interactive methods.

PPGIS projects are though still limited in their ability to communicate, organize, and reflect user participation (Carver, 2001). According to Steinmann et al. (2004), although up-to-date research efforts are concentrating in new technologies around the Web (Rinner et al., 2008; Sidlar and Rinner, 2009), the reality is that exchange platforms are exceptions. Also, Hanzl (2007) states that

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[1] List of actions to be taken nationally and locally for a sustainable development: http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm.

[2] The UNECE (United Nations Economic Commission for Europe) convention on access to information, public participation in decision-making and access to justice in environmental matters on June 1998 in the Danish city of Aarhus: http://www.unece.org/env/pp/.

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doi:10.1016/j.cities.2009.11.008

most of the examples described in the literature are still experimental: they corroborate available technical possibilities but do not apply to real participatory planning actions.

Recent changes in how people are using new information technologies for their own interest (Castells, 2001) are reflected in an increasing volume of user-generated geospatial content, available for everyone (Goodchild, 2007; Hudson-Smith and Crooks, 2008; Turner, 2006). This poses new challenges in PPGIS applications. Centralized, top-down approaches dominated by institutions, politicians, and technicians are not suitable anymore. New perspectives are thus required that enable a bottom-up decision making strategy, building on effective participation and communication among experts and non-experts. Therefore, the issues addressed in this paper are twofold:

- Enhancing effective participation and communication among experts and non-experts via an easy-to-use and interactive exchange platform.
- Exploiting the local knowledge and user-generated content to enrich urban planning actions, though the use of Internet and Web 2.0 collaborative tools.

In this paper, we combine principles of public participation, urban planning, PPGIS, and Web 2.0 tools to, first, develop a Web 2.0 PPGIS prototype, and, second, to evaluate its usability in a real-world case study of Canela, Brazil. We first outline the background ideas and technologies used in our project and describe related works. Then, the case study is presented. The following two sections describe the prototype implementation and assess the usability test. Finally, we close with lessons learned from the project, and future work recommendations.

Web 2.0 and the programmable Web

Web 2.0 (O'Reilly, 2005) is shifting the Web to turn it into a participatory platform, in which people not only consume content (via downloading) but also contribute and produce new content (via uploading). Web 2.0 ideas (Vossen and Hagemann, 2007) incorporate new techniques (tagging, social networks, blogs, wikis, mashups), which are breaking the barriers between users and data-providers, by creating new and useful links among them (Hudson-Smith and Crooks, 2008).

Although Web 2.0 technologies are enabling innovative, collaborative, and easy-to-use services and applications, embedding participatory practices into existing institutional organizations still needs plenty of effort. As van den Brink et al. (2007) have stated there is high resistance, lack of qualifications and variable interest by participants that together act as entry barriers. Then, "useful links" are defined here as the ability to connect official and informal information. Users are more proactive in creating Web 2.0 spatial content themselves. Neogeography (Turner, 2006) and Voluntary GIS (Goodchild, 2007) show the successful user-created-content map applications (Haklay and Weber, 2008). Therefore, paying attention to Web 2.0 techniques is essential to collaborative decision-making.

Apart from a participatory platform, the Web is also becoming a programmable platform (Programmable Web, 2009). Today, most Web 2.0 services offer programmatic access by lightweight application programming interfaces (APIs). These publicly-available APIs (around 1.500 according to Programmable Web, 2009) allow programmers to easily combine services and resources from remote sources into so-called mashups that meet specific user needs. Various Web 2.0 technologies are available today to set up mashup applications. The ones enabling our prototype focus on three conditions: they support rapid development, are easy-to-learn, and are free or open source. Online web mapping services are essential to visualize and inspect the geospatial data across a map. Microsoft, Google, and Yahoo! are some examples of online mapping tools. We decided to use Google Maps because it provides an easy-to-use, well-documented API (Google, 2009). In short, this API enables AJAX (Asynchronous JavaScript and XML) to build more interactive, advanced Web applications.

Related work: collaborative geographic applications

A key aspect in collaborative geographic applications is the interoperability between geospatial data and tools available on the Internet to users wanting to build up their content. Table 1 shows a comparison of some relevant examples, which vary from simple geospatial data visualization portals to more interactive systems.

London Profiler (London Profiler, 2009) is an example of a geovisualization portal that delivers geospatial data online, which pictures London neighborhood data through Google Maps services and GMapCreator (GMapCreator, 2009). It allows users to select the desired layer by distinct classes or to overlay a KML file URL (though opinion sharing is not supported). Hackney (Map Hackney, 2009), a London borough, displays various maps by topics. Users may provide their opinions by e-mail, but are not georeferenced on a map-based discussion. Orange County Interactive Mapping (Orange County Interactive Mapping, 2009), from the city of Orlando, Florida, allows participants to attach a map, where they can sketch it to the e-mail message. These two examples primitively allow two-way flows of information.

Virtual Slaithewaite, one of the first online applications for participatory urban planning (Kingston et al., 2000), allows citizens to zoom and pan, to select features, to get information about it, and to add their comments. Any features selected provide a free-form typing text box. As comments are not organized or related to each other, tracking discussions over time is not though supported. The Argumentation Map prototype (Keßler et al., 2005) developed solutions for georeferencing comments. It makes geographic references in discussions and uses them for linking text messages to maps. Later, Sidlar and Rinner (2007) and Sidlar and Rinner (2009) have conducted usability and utility tests on the prototype. Finally, WikiMapia (WikiMapia, 2009), a collaborative Web mapping strategy, combines Google Maps and Wiki, where any user can add a place mark to any location and provide information. Registered users can also check certain areas and send personal messages to one another. Besides, users can vote for or against other users' contributions as a means of data trust.

Despite these efforts and projects, except for the Argumentation Map prototype and subsequent works, the use of Web 2.0 services is still limited to delivering collaborative applications (Rinner et al., 2008). In general, users can post comments on a map, but user-friendly map-based citizen's opinion and interactive discussion is still not widely supported. We expect to engage more citizens in local actions for urban planning by using the emerging technologies for web-based collaborative social networks (missing in most of the early applications).

To characterize the usability of Web 2.0 and GIS technologies in practice, we have assessed the impacts of the Web 2.0 PPGIS prototype in the following real-world case study.

Case study: local participation for urban planning in Canela

In January 2009, the first version of the prototype was presented to potential users in Canela, Brazil (see evaluation text). Brazil encourages public participation via legislation. Existing projects range from public participation meetings, such as Participa-

Table 1
Application's tools comparison (adopted from Steinmann et al., 2004 and Tang et al., 2005).

Tool	Pro	Cons	Application
Geovisualization	Makes spatial data available	Does not support opinion sharing	London profiler
E-mail feedback	Allows opinion sharing	E-mail can be ambiguous and does not enable exchange of spatial data	Map Hackney
E-mail plus map with sketches	Transfer spatial content	Does not support transparent exchange of comments: other users do not see	Orange county interactive mapping
Georeferenced comments	Clear comment geographical location	Comments are not organized or related to one another. No idea on the evolution	Virtual Slaithewaite
Online forum + georeferenced comments	Transparent exchange of comments	Map as user interface to the comments, when is not organizing it	Argumentation map
Collaborative	Allows user input and two-way flow of information	Data trust and accuracy	WikiMapia

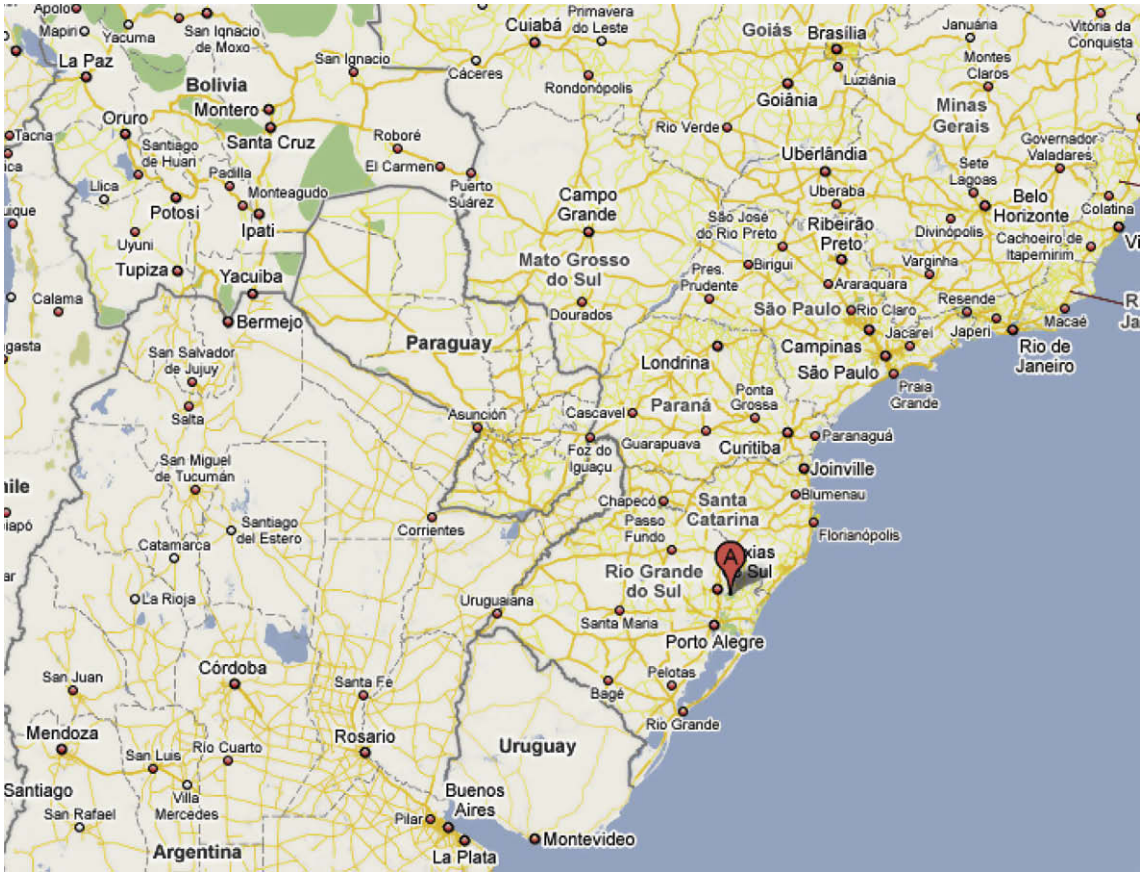

Fig. 1. Canela localization (Google maps).

tory Budgeting[3] to Internet portals that deliver information such as the SOS Mata Atlântica.[4] But few are using GIS and Web 2.0 tools simultaneously.

By giving emphasis to the housing question and aiming to mobilize municipalities to deal with social problems, Brazilian Federal Law determined the need to build Social Housing Plans with public participation. Thus, the city of Canela developed its Local Plan in 2008, using traditional participation methods such as public meetings and mapping workshops.

Canela is a famous tourist city that receives more than 1,800,000 visitors each year. It is located in the southern most state of Brazil, Rio Grande do Sul (Fig. 1), and has around 40.000 inhabitants. This status imposes high pressure on urban planning decisions, as it has the potential to create conflicts between all parties involved in the land use. Since Canela has just developed the Plan, it provides us with an excellent institutional context to carry out the experiment.

Web 2.0 PPGIS prototype

Design considerations

The prototype objective is to enable users to communicate easily and dynamically about their interests, based on georeferenced maps. The maps may act as integrated interfaces for both officially spatial referenced data and user contributions to the discussion of certain problems at a given location. Citizens normally use GIS tools and maps to better understand spatial effects of proposed projects, evaluate alternatives, and create new solutions (Jankowski, 2009). Above all, they need to identify the locations of interest based on different types of data that link user mental maps and

[3] The first full participatory budgeting process, where citizens decide how to assign part of the municipal budget, was developed in the city of Porto Alegre (http://www.pbh.gov.br/redebrasileiraop/) in 1989. Nowadays more than 300 cities around the world apply it: http://www.citymayors.com/finance/participatory_budget.html.

[4] Displays spatial data about Brazilian Atlantic Forest: http://mapas.sosma.org.br/.

Table 2
List of principles, goals and interactivities (adopted from Tang et al., 2005).

Principle		Goal	Interactivities
Information distribution	Experts	Promote the practice	Add layers and information. Use the user created content for spatial analysis
	Non-experts	Public engagement	Visualize mapping service, geospatial data layers, and other information
Solutions through participation		Increase participation	Map-based commenting tool
Transparency		Store, organize and display the evolution	Store and organize contributions at a database to use in GIS environments
Consensus building		Support two-way flow of information	Send comments and see others comments

Table 3
Eligible geospatial data.

Planning topic	Feature	Source	Year
Community facilities	Point	Aerial photograph	1991
Economy and tourism	Point	Canela database[a]	2008
Infrastructure and services	Polygon and line	IBGE[b] and Canela database[a]	2000
Urban planning	Polygon	Canela database[a]	2008
Housing	Polygon	IBGE[b]	2000

[a] Built digitalizing the aerial photograph and updating it with data collected during the studies for the Local Social Housing Plan.
[b] Brazilian Institute of Geography and Statistics: http://www.ibge.gov.br/english/.

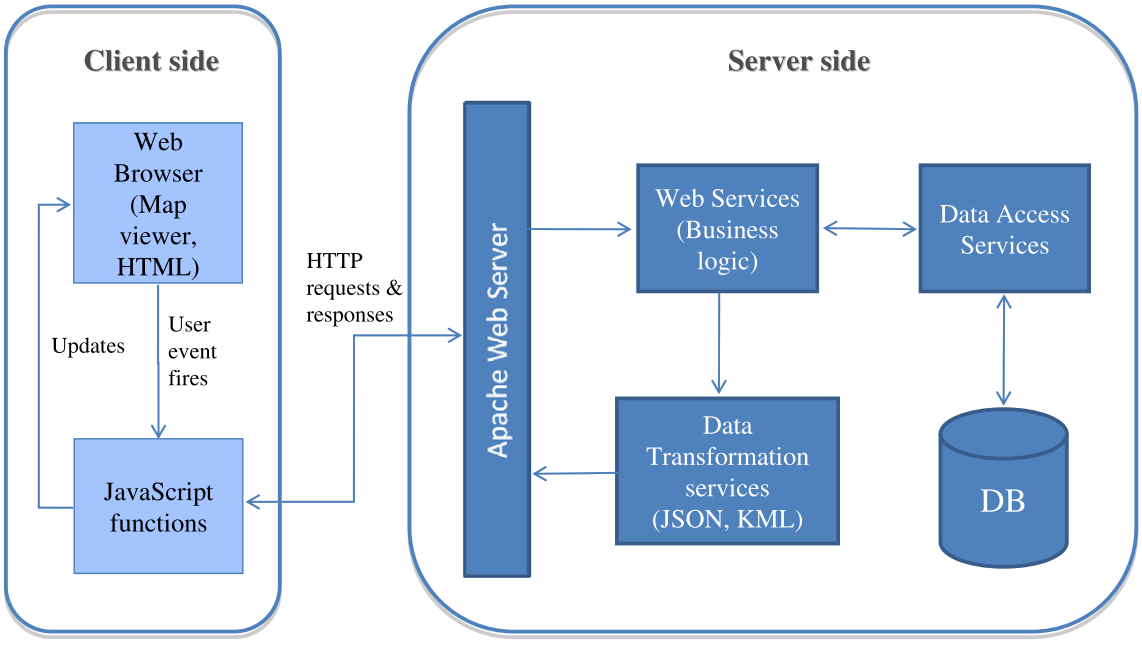

Fig. 2. Web 2.0 PPGIS architecture.

system maps (Elwood, 2006). For these reasons, accuracy in these maps is not a required feature, what is important is efficiently reflecting how they are identified with the locations and areas of interest (emotions and comments).

The key is to find the balance between interactivity and visualization capacities necessary to create an innovative user-friendly tool. Interactivity implies enabling users to have high communication levels with the system (Steinmann et al., 2004). Visualization refers to mechanisms of representing spatial data so they are unambiguously understood (Wood et al., 2007). Table 2 presents a list of principles, goals and proposed interactivities, according to the concrete case of Canela. Nevertheless, the first functionalities presented can grow according to specific needs. As stated in the theory of social software (Nielsen, 2008), users define what they want from an application with the experience of use.

Data source

Participants contribute to the discussion according to relevant urban planning topics by eligible layers. These data are from the Canela Social Housing Plan studies. Table 3 lists the planning topics and its feature, source and year. As with many other applications,[5] Google Maps API uses a KML format to represent and display geospatial data on the Web. Source data came in various formats that were unified to KML, using a Shp2kml[6] converting tool. This was not always automatic, and reference system transformations from South American Datum 1969 (SAD 69) used in Brazil, to World Geographic

[5] Examples: Google Earth, ArcGIS, PhotoShop, AutoCAD, Flickr, Yahoo! Pipes, and Open Layers.
[6] It transforms ESRI shape files to KML files http://www.zonums.com/shp2kml.

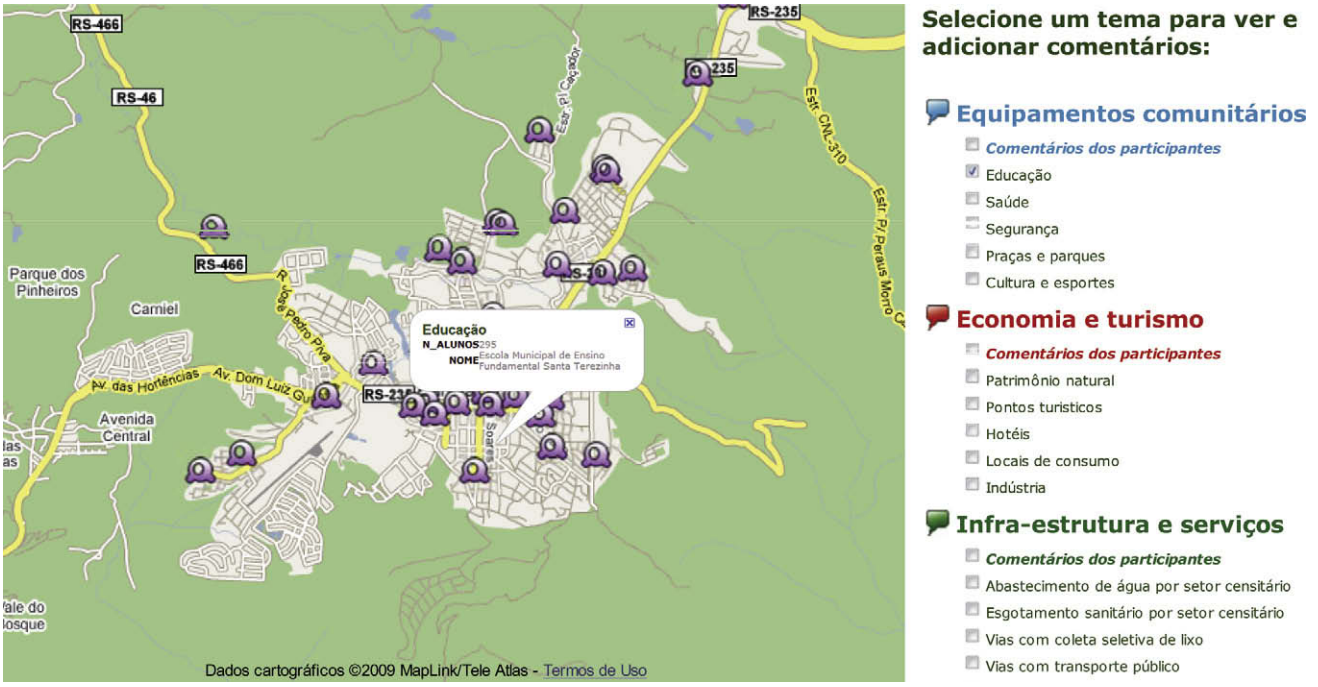

Fig. 3. Points out information about education and the urban planning topics by color.

System 1984 (WGS 84) used in Google Maps, were necessary. To improve the readability of the data, other preprocessing tasks, such as simplifying details and reclassifying were also carried out when necessary.

Architecture and components

Fig. 2 outlines the overall architecture of the Web 2.0 PPGIS prototype. Technically, the prototype is composed of several services running both at the client and server side. At the server side, data access services provide an abstraction layer to interact with a MySQL database that stores and delivers base geospatial layers and user's markers. Also the data transformation services (a set of PHP scripts) treat such server-side data in any suitable format (XML, HTML, JSON and KML) before sending them to client-side units.

JSON format has been the encoding of choice in this project because it fits nicely with client-side components implemented in most JavaScript languages. At the client's side, participants need a simple Web browser to interact with the prototype. User interface and interactivity is performed by some AJAX functions that manage server communications and user interface generation in response to the user's actions. Spatial data visualization is managed by embedding a mapping viewer in the browser, based largely on the standard functionalities of Google Maps API.

System description

The present Web 2.0 PPGIS prototype (http://geoportal.dlsi.uji.es/pgis/) promotes participation by using different ways to interact with the system. In the simple case, the prototype allows users to explore urban planning information with the eligible geospatial layers and satellite imagery. For instance, the education layer pinpoints icons for all city educational places on the map. Clicking on an icon provides information about that school (name, number of students). The commenting tool allows users to enter their opinion by selecting an icon whose color identifies a planning topic and placing it on the map (Fig. 3). Thus, comments refer to georeferenced objects from eligible geospatial layers. Furthermore, users can label the comments as suggestions, questions, complaints, comments in favor or against (Fig. 4).

User comments are treated as common geospatial layers with associated features (coordinates, zoom level, active layers, date, label and so on), as geospatial data in a Spatial Data Infrastructure (SDI). The resulting user-generated content layer yields extra benefits for decision makers because such layers can be easily shared, reused, and analyzed (Hudson-Smith et al., 2009). In this way, opinion exchanges are fostered by allowing users to inspect comments for the same thread introduced by other participants; similarly, to browse all comments that refer to one or several topics. This may also be meant for future spatial and pattern analysis tasks by technicians (Fig. 5).

Evaluation test

This section explains the evaluation criteria and the strategy used to conduct the evaluation text.

Evaluation criteria

PPGIS studies have been criticized for stressing more technological aspects rather than usability (Craig et al., 2002; Steinmann et al., 2004). Usability is a part of the Human Computer Interaction discipline, which refer to evaluating whether an application works and has met its design goals according to the user's needs (Nielsen, 1993). Usability testing with real users involves watching target users or existing users of a system interact with it by performing a set of real or representative tasks.

Recent studies have been devoted to analyzing how best to study the use of PPGIS applications from the user perspective. Steinmann et al. (2004) conducted a qualitative expert analysis evaluating 12 applications. Haklay and Tobon (2003) explained from three workshops how usability evaluation may contribute to PPGIS research. Sidlar and Rinner (2007) employed a quasi-naturalistic case study on the usability test of the Argumentation Map.

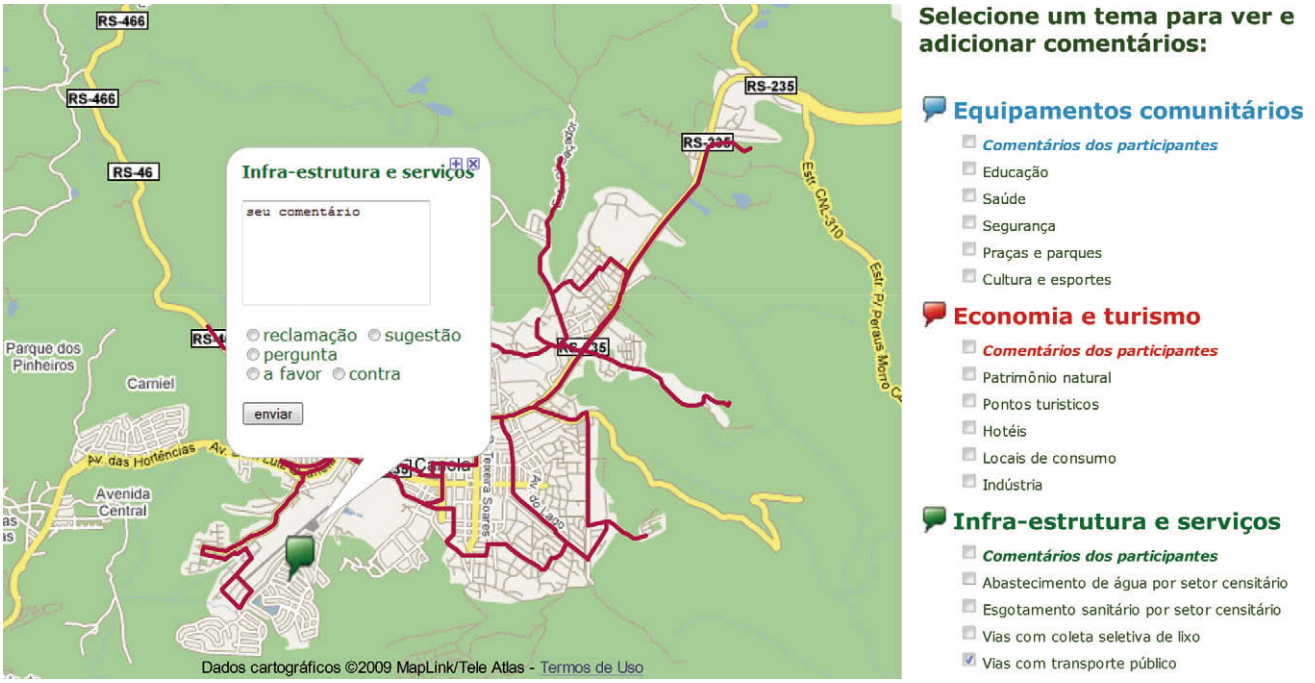

Fig. 4. Free text comment window and label choices.

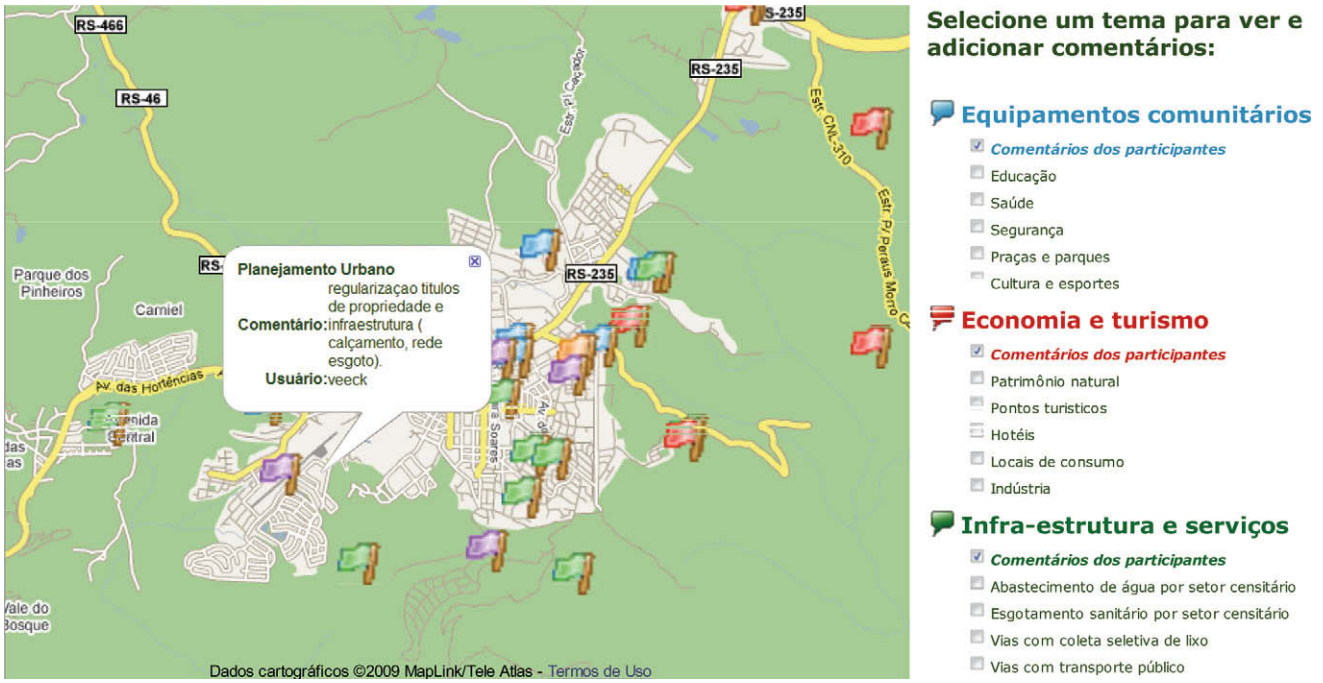

Fig. 5. Viewing user comments.

Zhao and Coleman (2007) developed a design guideline for PPGIS application evaluation. All of these studies propose usability frameworks for PPGIS but the last two, Sidlar and Rinner (2007) and Zhao and Coleman (2007), perform an extensive discussion of literature and propose similar sets of indicators. As both have demonstrated valid frameworks, the criteria chosen for evaluating the level of user success for our prototype is a combination of the common criteria of these two proposals:

1. *Cost of entry*: includes the price of the tools and components needed to run or access the prototype.
2. *Intended users*: background of the different users. Includes features such as the involvement in using similar software and educational level.
3. *Ease of use*: do users find the application easy-to-use. It is reflected both by direct observations taken from the person who conducted the test – in the levels of speed, completeness and correctness in the user's test performance – and from the specific questions from the evaluation questionnaire.
4. *Satisfaction*: degree of emotion the user credits. Satisfaction is determined qualitatively via the opinion reported through the evaluation questionnaire.

Table 4
Questionnaire.

Do you agree with these statements? ( ) yes ( ) no
1. I found the platform easy-to-use and to understand
2. I think that people in general would be able to use a platform like this easily
3. I would like to use this platform often to give my opinion
4. I think that people in general would like to use a platform like this
5. I found the information interesting and important
6. I think this platform can strengthen public participation in decision making
7. I think all municipalities should have a platform like this available for the community
Please answer:
8. What did you like more and what did you not?
9. Do you think this platform could be useful for Canela? What for?
10. What do you think is missing?
11. What do you think could be improved?

5. *Usefulness*: can be understood as the degree to which the application would enhance user tasks. This criterion is difficult to measure, so besides direct questions we propose open questions in the evaluation questionnaire to better collect user's impressions (see Table 4).

Practical strategy

To evaluate the Web 2.0 PPGIS prototype, a workshop was held in the city of Canela from 12 to 15 January 2009. This was possible thanks to Simmlab from UFRGS[7] that had developed the Social Housing Plan. Simmlab put the authors in contact with the municipality administrators who, being aware of the proposal via the university's recommendation letter, allowed and supported the test with a physical space and an Internet connection.[8]

Because of time constraints, we did not expect many participants, just the minimum necessary for the analysis.[9] Potential users received e-mail invitations to join the test, collecting a list of 30 attendants of the participation meetings of the Social Housing Plan. Additionally, these people forwarded e-mails to friends, and as the experiment took place at the City Hall, it attracted curious passers-by. Thus, participants were mainly people from the Canela municipality, stakeholders involved with the Social Housing Plan, and their acquaintances.

Even though Canela had just finished developing the Social Housing Plan, we decided not to focus on any specific question, as the layers organization already encourage selected urban planning topics. Without a clear definition of what information participants should report, we expected them to discuss planning issues that concerned them.

Each volunteer set an appointment to perform the test individually. A computer with Internet access was provided with the prototype already running. Firstly, participants reported their familiarity with Internet and GIS with the objective to identify a participant's background. A person with urban planning and GIS experience conducted the activity. The test task was to send at least one comment to the system. To complete the task, initially they had to log in providing a user name, password, e-mail, sex, age, profession and neighborhood. Then users were free to explore information layers, select topics, and find places on the map to enter a text message with the commenting tool. Neither video nor sound was recorded, to offer a more natural environment. Nevertheless, participants were encouraged to think aloud while using the prototype.

The test consisted of three parts: introduction, practical test, and questionnaire. At the introduction the promoter briefly explained the test's objectives, the interface, its functionalities, and encouraged users to use the prototype. In the second part, time spent was counted down while users performed the task. Meanwhile, the observer took notes on major difficulties and satisfaction demonstrated. Only when asked to did the observer help or provide hints. Users could interact for as long as they needed. Last, they answered a questionnaire with seven direct questions and four open questions (Table 4). The direct questions considered topics related to the ease-of-use, satisfaction and usefulness. The free answering questions serve mainly to analyze the usefulness of its functionalities and tools for future improvements.

Results and discussion

All urban planning topics received relevant comments. They refer to city problems that would not be visible from traditional forms of data, and give voice to particular opinions that could not be considered in the decision making, simply because there is no opportunity. Mostly users classified the comments as suggestions, with 28 labels, while nine were labeled as complaints and four as in favor. Table 5 exemplifies some of the observations.

In reporting the results towards the evaluation criteria, although we use specific questions to discuss each criterion, some could have served to measure more than one criterion, as question 5 for satisfaction and usefulness. So the results should also be understood as a whole, since the questions are qualitative and interrelated. Table 6 shows the summary results for the direct questions, followed by the evaluation criteria discussion.

Cost of entry

The prototype was performed using open source software and components, which support the open source software potential in building novel, usable applications at no cost. In this sense, from the client perspective, the cost of entry is almost non-existent, since a computer with an Internet connection is enough. From the developer perspective, it is easy to set up, given that programming only took a few hours.

Intended users

Twenty two volunteers took part in the test, 11 male and 11 female, with an average age of 41.3 years old, ranging from 24 to 58 years old. They posted 41 comments in total. The average number of comments by user was 1.38, median 1, and maximum 11. The average time users spent interacting was 14.28 minutes, minimum 5, and maximum 31 minutes (Table 7). The differences in maximum and minimum number of comments and time spent are visible through the diversity in users' interest to participate and ability to deal with Internet and GIS. Participants were mostly graduates. Only 9 out of 22 had experience with GIS. Regarding the user neighborhoods, there is a diverse spatial distribution, which also led to comments that were spatially scattered throughout the city map. Statistically, this sample can be considered representative, given that similar studies took smaller responses as representative (Harrison and Haklay, 2002).

[7] Simmlab – Laboratory for simulation and modeling in architecture and town planning: http://www.simmlab.ufrgs.br/index.html. From UFRGS – Federal University of Rio Grande do Sul: http://www.ufrgs.br/ufrgs/.

[8] News of the experiment at a local radio station: http://www.gramadofm.com.br/eventos/16.01.09+-+Canela+%C3%A9+tema+de+mestrado/127/.

[9] Some website usability engineers believe that between five and eight users are all that is needed to detect approximately 85% of the problems present in using a website (Zhao and Coleman, 2007).

Table 5
Examples of participant's comments.

Planning topic	No. of entries	Example	Label
Community facilities	8	Improve the main square use; the fountains are not active	Suggestion
		This neighborhood needs urgently a leisure area; children are playing on the streets	Suggestion
Economy and tourism	14	Location of the future International Airport of Canela, in environmental license	Suggestion
		Please, improve the access to the Morro Pelado, Queimado and Dedão parks	Suggestion
Housing	2	I believe this construction should be in another area; having minded the number of water sources that exists there, it is necessary to preserve those nascent	Complain
Infrastructure and services	13	Public transport should have more time alternative to the main bus station	Suggestion
		Trash collection does not attend Santo Antönio Street	Complain
Urban planning	4	The streets at the Palace Hotel Neighborhood need maintenance urgently	Complain
		Solve the green area invasion in the Santa Marta Neighborhood	Suggestion

Table 6
Direct questions summary.

Question	Yes		No	
	No.	%	No.	%
1. I found the platform easy-to-use and to understand	19	86	3	14
2. I think that people in general would be able to use a platform like this easily	15	68	7	32
3. I would like to use this platform often to give my opinion	20	91	2	9
4. I think that people in general would like to use a platform like this	16	73	6	27
5. I found the information interesting and important	22	100	0	0
6. I think this platform can strengthen public participation in decision making	22	100	0	0
7. I think all municipalities should have a platform like this available for the community	21	95	1	5

Table 7
Participation statistics.

Sex		Profession		Neighborhood	
Male	11	Civil servant	8	No informed	6
Female	11	Architect	5	Center	5
Total	22	Engineer	3	Vila Maggi	4
Age		Politician	2	São Lucas	2
Average	41.36	Accountant	1	Vila do Cedro	2
Median	42.5	Administrator	1	São João	1
Maximum	58	Retired	1	Palace Hotel	1
Minimum	24	Doctor	1	Loteamento central	1

Ease of use

Most users found the Web application easy-to-use. Answers from question 1 – *I found the platform easy-to-use and to understand* – resulted in 86% yes. In other words, just three out of 22 participants had difficulties when using it, including one that asked for a tutorial. Hence, besides some technical drawbacks and consequential improvements needed on this early version (see lessons learned), it achieved a good level of operational simplicity.

However, when asked if other people would be able to use it easily, in question 2, there is not the same consensus, only 68% said yes. This is not to say users seem averse to the application, but rather they seem worried about the Internet access and the population's wealth and education skills, as one user mentioned in question 8 (Table 8, comment 13): "*...Internet access may be a problem to others, I suggest implementation of public Internet point*". Although, we believe Internet access may no longer be a problem, as newer and cheaper forms of connection appear every day.

Satisfaction

The response to question 3 – *I would like to use this platform often to give my opinion* – shows that participants enjoyed the application: 91% said yes. Question 4, though, shows participants were not so sure about others, only 73% answered yes. This reveals concerns, essentially, on the interest others would have in participating. We consider that future improvements as the discussion forum, pictures and others social networks tools would make the platform even more attractive to users.

Besides the observer notes on users' verbalizations while doing the test, they were asked what they liked most and what they did not like, in question 8, shown in Table 8. On average, users mentioned satisfaction with the ease of use, information available and interactivity. In one user's words: "*Easy discussion and open information to citizens, projects the city on the Web, without cost to the user*".

Usefulness

Everybody answered yes to question 5 – *I found the information interesting and important* – and, significantly, to question 6 – *I think this platform can strengthen public participation in decision making*. Further, question 7 – *I think all municipalities should have a platform like this available for the community* – was 95% affirmative. This allows us to affirm that the Web 2.0 PPGIS has potential to strengthen participatory urban planning.

Usefulness was also measured in open question 9 – *Do you think this platform could be useful for Canela? What for?* – shown in Table 9. Overall all of the answers are positive, pointing out the use for communication channels, administration surveying, or connection to the citizens with government. Two users specifically said it could strengthen public participation in decision making.

Moreover, the answers to open questions 10 – *What do you think is missing?* – and 11 – *What do you think could be improved?* – provided hints on future functionalities for the production phase. Some improvements reported were the inclusion of other topics of interest (tourist information, street lighting) and advanced features such as place pictures, tools to measure distance and chat rooms to increase open communication. Other comments refer to the lack of use of documentation, demanding online tutorials and guides. This aspect demonstrates participant interest in the application.

Lessons learned

Non-GIS participants normally needed a great level of detail (zoom) and spent some time on finding and identifying places of

Table 8
Question 8 – What did you like more and what did you not?

1	With the street names it is easy to locate
2	I liked everything
3	The easy access
4	Open public information
5	Solutions for the control of the city
6	–
7	The ease of use
8	I liked everything, interesting and complete
9	–
10	I liked everything in general and would not add anything at the moment
11	In this first contact I did not found anything difficult or that I disliked
12	It is easy and quick of use
13	Easy discussion and open information to citizens, projects the city in the Web, without cost to the user. As Internet access may be a problem to others, I suggest implementation of public Internet points
14	The easy access and accurate information
15	Easy access to information. But I think is lacking clarity in the ways to use it
16	–
17	It is easy to understand
18	The contributions could be able to help the public administrator apply the capital in the right places and prioritize issues
19	I liked much the map and the satellite image
20	I liked the interactivity idea
21	The ease of use
22	–

Table 9
Question 9 – Do you think this platform could be useful for Canela? What for?

1	Yes, it is good
2	Yes, because of the information available
3	It would be the eyes of the municipal administration
4	It could increase participation and the responsibility of the community in the decision making
5	Yes, for administrative checking
6	Quick and efficient communication channel for problems detection
7	For participation with suggestions and opinions, modern channel of communication and information, for administrators to have feedback of the actions and evaluate new ways
8	With the information available is possible to evaluate the most problematic points
9	–
10	Yes, the user would have real participation in the problems of the city
11	In the tourist attractiveness divulgation, where the visitor would have the necessary information for a good stay in the city
12	A way for the administration to hear the community and if possible does planning according to the suggestions
13	Up-to-date information and connection to the citizens, to receive suggestions, denunciations
14	Yes, city details easy access
15	To suggest easily and to evaluate, open channel of communication more efficient
16	Yes
17	Yes, if well revealed the community would be able to engage
18	Public administration would have community input with more efficiency to be able to do something
19	To define which are the priorities and the best for the city
20	It would improve participation on the decision making
21	Yes to drive decisions
22	–

interest. Visual aids for navigation were useful, such as street names, yet many expressed that they would like to see pictures of places. This supports the idea of using Web 2.0 applications since users increasingly feel confident with more interactive, richer environments that include multimedia resources (videos, audios, pictures). None of them checked all the geospatial layers, but many did check other's comments layers, encouraging open communication among participants. Some users just placed a comment at an arbitrary place. This points out how to interpret, classify and store comments when they do not have a specific geographic location.

From a technological standpoint, participants have provided us real needs, hints, and improvements for future versions. Some problems concerned with user interface aspects, such as changing mouse icons, were detected, which can be solved considering the early version of the prototype. The main drawback, however, is that a comment could not be on top of another icon. When there is a crowded information area, it becomes a problem. This can be solved by implementing a discussion forum on the location.

From a social perspective, the main contribution of the workshop has been to pressure institutional organizations to seriously consider developing tools based on social networking and open communication. The scores show that most participants found the experience positive and demand these kinds of applications as a way to express their opinions on urban planning issues. Furthermore, many authors state that PPGIS projects failed because users still need a greater degree of expertise to deal with it. In general, volunteers started to use the application without major problems, essentially because they were already familiar with web mapping services. The usability level of the Web 2.0 PPGIS prototype satisfied workshop participants. Therefore, we could expect them to play the role of disseminators by sharing the experience with friends and neighbors, as other collaborative applications have been spread almost entirely through word of mouth from users.

Conclusion and future work

This paper's assumption is that PPGIS and Web 2.0 technologies help to develop alternative ways for public participation, engage more people, and encourage open communication between citizens and decision makers. To recognize the ability of these technologies, we developed a Web 2.0 PPGIS application and promoted an evaluation test with citizens, considering that this application is uncommon in urban planning, especially in Brazil.

Practical results show that participants found it easy-to-use, useful for communication, and that it may support participatory urban planning. Comments were relevant to planning issues and users did not have substantial problems in using the tool. Besides, they reflect great satisfaction and excitement about a possible institutional implementation linking to other web sites like local government and local tourist offices. In their opinion, it could improve their participation in decision making. Accordingly, it confirms the potential of Web 2.0 and PPGIS in participatory urban planning.

Further work should focus on exploiting the benefits of user-generated content to better organize the feedback for spatial planning in a useful way. Besides, future research questions may center on trust and reputation issues, and how to deal with user's estimation of location.

The Web 2.0 PPGIS makes urban planning information available to citizens 24/7 in a useful way, different from traditional meetings, where there is minimal chance of interchange and information understanding. It promotes communication among users, and most importantly, vertically – with decision makers – in a more interactive and straightforward way. Essentially, we believe that combining conveniently traditional methods with novel Web 2.0 participatory tools notably strengthens participatory urban planning and will eventually empower the role of citizens.

Acknowledgments

This work has been supported by the European Commission, Erasmus Mundus Programme, M.Sc. in Geospatial Technologies, Project No. 2007-0064. The authors wish to thank Dori Apanewicz for proof-reading the manuscript.

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