Collaborative, Remote, Digital, Virtual, and Mixed Research Methods in Cartography & Geovisualization

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ABSTRACT
During the few decade cartographic products have profited from new technological evolutions. In the first place, Web 2.0 has made it possible for users to contribute to the products, which have also become more mobile. Furthermore, the recent evolutions have also introduced advancements regarding methods and techniques in user research (remote logging, mobile field tests, virtual environments, linking methods and techniques), but many challenges still remain.

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Cartography, user research, methods and techniques

ACM Classification Keywords
User centered design, evaluation/methodology

INTRODUCTION

The basic starting point for this position paper is the article "Cognitive and usability issues in geovisualization" of Slocum et al. [1] and the ICA Research Agenda published in 2009 [2]. The need for usability testing is stressed in the first article (dating from 2001), stating that "comprehensive usability evaluation throughout the lifecycle of map products has been uncommon". During the last 15 year, a giant step forward has been taken in this context, with many important works to cite: e.g.[3-15]

What is more, since 2001 the cartographic products themselves have undergone a tremendous revolution, linked to the rapidly progressing technological possibilities. A trend from static to dynamic maps has been described in the past [16, 17]. Slocum et al. [1] reflected on the questionable effectiveness of map animations and the ICA Research Agenda [2] on the importance of the usability of dynamic and interactive interfaces is stressed.

New roles of maps

The newest evolution - emerging after the establishment of the latest ICA Research Agenda - was already mentioned vaguely in some articles in the past: "universal access" [18] and "collaborative (geo)visualization" [1, 2]. In the ICA Research Agenda it is called a 'hype' and the name 'neo-geography' or 'neo-cartography' emerges with the following associated question: "Would it be possible to bring these often informal data collection processes of Web 2.0 together with the formal world of for instance the National Atlas or Topographic Maps, such that both worlds could benefit and one might even think of update via the people?" This is exactly what has been happening during the past 6 years, creating many possibilities but also many challenges…

New roles of 'map users'

Today, users know they can find almost all geospatial information on the Web. Over the years, an evolution can be noticed in how users interact with it, which has opened the door for many new applications: FOSS, APIs, VGI, UGGC, etc. These developments are also inherently linked to, what is called, the Web 2.0. Consequently, more and more users are able to create cartographic products. A wide variety of information (meteo data, crisis information, twitter data, pictures, etc.) can be combined creating mashup maps: e.g. [19-22]. However, these map makers are not all experts in cartography, nor in informatics. During the past few years, a number of critical reviews have been published on these new cartographic evolutions, or neogeography maps [23, 24]. Furthermore, there is still some debate regarding the effectiveness of dynamic and interactive display in general [25-28].

REACHING THE DIGITAL CROWD

In order to evaluate the usability of these new cartographic products, it is of utmost importance to get in touch with the users. The same technological advancements that have fed the evolutions of cartographic products can be used to evaluate them. Web 2.0 has made it possible to extend the possibilities of, for example, questionnaires drastically: drawing elements on maps, sketching maps digitally, dragging and dropping objects on maps, real time online discussions and contributions, collaborative approaches, etc. In the end, feedback regarding the products can be gathered as VGI. Nevertheless, questionnaires and direct feedback do not always suffice when going to the UCD-lifecycle.

Logging data

User logging is not a new methodology as it has been extensively used for many decades in User Centered Design (UCD) to gather quantitative data from end users who execute a certain task on a certain product: e.g. [29-33]. Through user logging, we can discover, e.g., where users are clicking in an interface, how often certain button combinations are used, whether certain menu items can be found and when the user action occurs. Van Drunen, et al.

[34], for example, recorded user actions as an indication of user workload while performing a Web-based task.

Logging how users interact with an online application can be done in a lab-setting, but also over the internet. The latter has the potential of reaching a vast amount of users, who are employing the product in their most natural environment. With self-constructed tools [35] or tools like Google Analytics [36] and, Hotjar [37], actions of users anywhere on the globe can be registered and subsequently analyzed, even without their knowledge. Nevertheless, these tools are designed for 'regular' website, not taking geospatial component of cartographic products into account. This might be overcome by including logging options in the new cartographic products, using for example proxy-servers of mapping API's.

Challenges

User studies that have incorporated the interactive nature of digital cartographic products, are rare [14, 38, 39]. Typically, the interactive nature of maps is approximated; for example, the maps are implemented as a collection of static images or videos [40, 41]. This means that the user actions are predefined - they occur at exactly the same time, with the same parameters - which is more straight forward to compare between participants.

Ideally, under experimental conditions, participants should execute a task on the interactive map as they would normally do so, without restrictions on their behaviors or on the interactivity levels and the tested display. On the other hand, an ecologically valid approach with interactive maps would introduce severe challenges to the internal validity of the experiments. The experimenter has no control on a number of critical (potentially cofounding) factors, such as the characteristics of the screen (e.g. color settings, dimensions, resolution), the tasks the participant executes, the environment (lightning conditions, distracting elements), user characteristics (age, gender, expertise), etc.

Furthermore, remote logging of user actions is not a valid option for many methods or techniques in usability engineering: e.g. thinking aloud, eye tracking. However, with the rapid technological advancements, more remote possibilities might arise, which makes it easier to target a larger test group. Eye tracking and recognition of facial expressions through the webcam (as proposed by EyeSee [42]) are examples in this context.

Another delicate problem with logging and tracking people – possibly without their knowledge – is the privacy issue. When do you intrude privacy? Only when the identity of the person is known? But this latter can often be obtained by taking additional steps (although this is in most cases not the intention of the researchers)?

GOING MOBILE AND VIRTUAL

In [18] the success of paper maps is explained: "the fact that it is truly mobile and assists the user 'in the field' where it is highly valued". This holds also true for mobile applications. In the ICA Research Agenda [2], the small screens of the mobile applications are mentioned as a limiting factor. On these mobile devices the current position of the user is integrated in a wide range of location based services. During the last decade, many devices that are used to do user research have equally found their way to mobile alternatives, so they can be applied in the field (tablets, smartphones, wireless microphones, eye trackers, small cameras, etc.).

The challenge in evaluating these systems is thus not only related to the small screens, but mainly to the complex, ever changing environment in which the user operates. Since researchers cannot control the environment (other people, sounds, weather conditions, etc.) it is nearly impossible to compare data across participants who did test in the field [43].

This latter challenge can be tackled with other new developments in the field of virtual environments. These systems were also mentioned in [18] and [2], but have gone a tremendous evolution since to more affordable and small sized systems. The real life environment can be simulated in a lab setting, where tests with mobile devices can be conducted in a controlled (and safe) setting. Examples which have recently surfaced are the Oculus Rift [44] and Google Cardboard [45].

LINKING AND INTEGRATING TECHNIQUES

Combining multiple techniques during user research has many advantages: complementary and overlapping data can be recorded. This way we can obtain a larger picture of multiple factors that interact and validate the findings. This mixed methods approach was named 'convergent methods' in [1]. However, combining multiple methods is typically associated with a lab-setting.

The challenge in using this type of setting is, firstly, how to let these systems communicate with each other (different hard- and software) and secondly the different types of recordings (e.g. sampling rates) that need to be linked to each other. Finally, in the stage of the analyses the recordings need to be explained separately but also in combination with the other findings.

CONCLUSION

To conclude we can state that during the last 5 -10 years, evolutions in cartographic products have been identified in several fields, which also bring along new challenges. Nevertheless, these same evolutions can be integrated in the methods and techniques for user research to evaluate the new applications and systems. Unfortunately, the systems will often come first (without thorough evaluation) and the methods to evaluate them afterwards.

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