

# Comparing a Mobile Nature Guide and a Paper Guidebook in the Field

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## ABSTRACT

The variety of mobile guide systems continues to grow but to date there has been little research done comparing the mobile guide systems of various application domains to one of their ancestors, the paper-based guidebook. This paper presents a field study testing a mobile nature guide against a paper guidebook for a guided nature tour.

## Keywords

Evaluation, field study, mobile guide systems, mobile nature guides, paper-based guidebook

## 1. INTRODUCTION

Corresponding to the hype of mobile technologies, mobile guide systems are being developed for an ever increasing number of application domains [2]. This trend is nurtured by the promises of new and better services for the user which will make it easier to deal with new tasks or grant a more enjoyable and interesting experience. Being still a relatively young field, research on human computer interaction with mobile devices including mobile guides is still focusing on producing new solutions while reflecting less on the methodology and on the efficient application of devices in the respective application domains [7].

Even though a variety of mobile guide systems in the domains of tourism and exhibition guides relate to traditional paper guidebooks as metaphor [4], there have only been a few studies directly comparing these two types of guides, mostly focusing on the map part of the systems [5], [8].

The Mobile Nature Guide system (MobiNaG) has been designed for the application in environmental tourism and communication [3]. Similar to tourism in general Mobile Nature Guides mimic traditional media used by environmental education and communication institutions with the paper guidebook or brochure

as one of the common media used in natural areas [6]. However these institutions, such as visitors centers and agencies traditionally have to operate on small budgets [6]. Thus even though they are willing to embrace mobile technologies in order to provide better interpretive services [1], they are keen to get proof of the promised benefits over traditional methods before investing in mobile devices, potentially need network infrastructure and software.

This paper presents a comparison of a mobile nature guide system with traditional interpretive media. As part of the study the MobiNaG system was tested against a traditional paper-based brochure, by comparing the performance of the users with regard to their navigational performance as well as utilization of the content provided by the guide media.

## 2. EVALUATION DESIGN

As part of the MobiNaG project a remedial evaluation of the Mobile Nature Guide prototype was conducted at the test site for the project. The study sight is a floodplain conservation area along the River Rhine, southwest of Karlsruhe, Germany. The visitor center to this conservation site, the Naturschutzzentrum Karlsruhe-Rappenwört is located in the area and constitutes a crucial infrastructure and partner institution for the project. Since it is a major objective of the MobiNaG project to evaluate the effective application of mobile guide systems in the environmental education and communication domain compared to traditional forms of environmental communication, the evaluation was designed as a field study. According to [7] field studies are characterized by taking place in “the real world” under realistic conditions, drawing upon qualitative as well as quantitative approaches. A combination of an ethnographic field study and a field experiment was conducted attempting to maintain a high degree of realism with regard to the application domain. Consequently a Mobile Nature Guide should be tested in the field as the conditions given in natural areas cannot be realistically replicated in the lab [3]. Thus the decision was made to accept the limitations to experimental control in favor of a high amount of realism.

### 2.1 Media

Initially a self-guided nature tour through the flood-plain conservation area was designed for the evaluation in collaboration with the Naturschutzzentrum Karlsruhe-Rappenwört. The tour

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was created based on environmental interpretation concepts according to [6]. The tour with the theme “Wooden Helpers” was intended to guide the visitor along an easily accessible 1.5 km trail, starting and ending at the visitor center (see Figure 1). Along the trail 7 natural phenomena in this case extraordinary trees were selected as Points of Interest (POI). At each of the 7 stations the visitors are presented with a brief text and images telling them something about the functions trees fulfill in an ecosystem and which services they perform for man kind. Two types of tours were created adapted to the different target groups. Contents for school classes were mainly kept shorter and easier to comprehend, while the essential information remained the same.

Two types of media were used to perform the tests. The paper-based guidebook was realized as booklet containing 17 pages of texts and color images as well as a fold out paper map of the area (see Figure 1). The route for the tour is highlighted and the map includes references to the stations in the form of a photograph as well as the name of the station and where it can be found in the booklet.

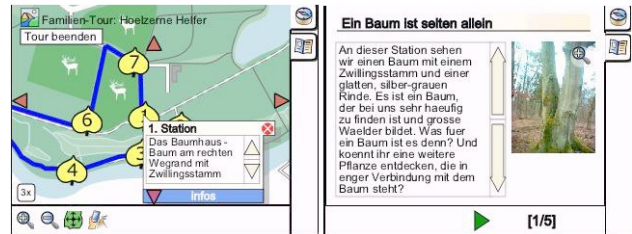


**Figure 1 Paper-based guidebook designed for test tour**

The Mobile Nature Guide (MobiNaG) is a mobile guide system which has been implemented as a C++ application running on a PocketPC-based PDA (in this case a T-Mobile MDAII and a HP iPaq 5450). As positioning technology MobiNaG utilizes GPS. The PDA is connected to an external GPS receiver via Bluetooth. The user-interface (UI) was realized with SVG, which is rendered by a commercial eSVG engine [3]. The MobiNaG systems currently provides the user with two basic services. The Navigation Service displaying a map of the natural area as well as the current position of the user. The trail that should be followed during a guided tour is highlighted and the system tracks and displays the route taken by the user. Furthermore a tour service is included in the MobiNaG, which offers location-based information on the POIs that the user encounters throughout the guided tour.

The information associated with a station is divided into several parts based on an environmental interpretation concept [6]. The user can flip back and forth between these parts using next and previous arrow-buttons. If a content part includes a long text a user has to scroll down to read the entire text. Each content part is completed by an image that can be enlarged and minimized using a magnifying glass icon. The UI was designed drawing upon a guidebook metaphor (see Figure 2) thus, similar to a guidebook

the user can employ the taps on the right hand side of the landscape layout, to flip back and forth between the map view and the tour-information view. In order to protect the mobile device and the GPS receiver unit from weather conditions as well as physical impacts during the test tours, they were enclosed in a transparent casing that the users could wear around their neck.



**Figure 2 UI of Mobile Nature Guide – Map service (left) and Tour-Info service (right)**

Both the paper-based guidebook and the mobile guide contained the same content. Participants of either group had to read the texts. Usually the person carrying the device or the booklet had to read the text out loud for the rest of the group members. With respect to navigating through the tour it should be mentioned, that neither stations nor junctions were equipped with any signage related to the test tour. While the groups using the paper-based guide had to rely on the map and the pictures of the respective trees, the groups using the MobiNaG system were notified by an audio signal, when they penetrated an area approximately 10-15m around a station. The audio signal was accompanied by a message box announcing the station and allowing the user to view more detailed location-based information on the respective POI (see Figure 2). In accordance with the paper map the mobile device did not provide additional navigational cues at intersections.

## 2.2 Participants

All participants were members of the two major target groups of the environmental education institution, families and school children. The target groups had previously been determined during a front-end evaluation at the site [3]. Participants were recruited by an information leaflet as well as a newspaper articles including a call for participation.

Members of the respective target groups usually come to the visitor center in social groups. School children come with their teacher and either take a tour as an entire class or are divided into subgroups. Families, usually consisting of a parent couple and 1-3 children at different ages also typically engage in a guided nature tour together. Thus in order to compare the two media under realistic conditions the test was conducted with groups of visitors instead of individual users. The test with the target group families, was conducted with 18 families, including 35 adults (18 females and 17 males) and 37 children (14 females and 23 males). The participating families were assigned to the two different media. Seven families took the tour with the paper-based guide and 11 families tested the mobile guide system. Next to the families, 5 secondary school classes ranging from grades 5-7 took part in the study. Each class was subdivided into multiple group families, which were then assigned to the different media. The paper-based guide was used by 9 groups, including 36 students (17 females and 19 males). The mobile guide was tested by 8 groups subsuming 33 students (16 females and 17 males).

### 2.3 Methods and Procedure

According to the characterization of field studies by Kjeldskov and Graham [7] it seemed reasonable to combine ethnographic methods and experimental methods, in order to come to an understanding of how the target groups experience a guided nature tour using different types of guide media and at the same time evaluate the performance of the different groups based on quantitative measures.

The Evaluation was conducted during April and May on Sundays for families and during weekdays for school classes. Upon arrival the participating groups were asked to complete a pre-test questionnaire, designed to collect demographic data next to environmental awareness measures. Following the pre-test the groups were assigned to one type of guide, paper-based or mobile and taken to the starting point of the tour. None of the groups received instructions regarding the handling of the guide media. Each group was accompanied by an observer who completed a semi-standardize observation protocol. In this protocol, data was recorded on navigation behaviour, such as the success in locating the stations, as well as the time of arrival and departure at each station. In addition to these measures, navigation decisions at junctions were documented. The accompanying experimenter further surveyed the utilization of content, by recording which content parts were read out loud to the group. Furthermore she or he took notes on social interactions within the group. The observers were instructed to always remain in the background to avoid influencing the group especially with respect to navigation and orientation. The observer however intervened in case a group got seriously lost or the mobile guide system malfunctioned. After completing the tour the group members filled in a post-test questionnaire, again applying a semi-standardized self-completion questionnaire. Apart from questions measuring changes in environmental awareness compared to the pre-test, test users were asked to state their overall satisfaction with the experience and rate the navigational support by the map of the guide.

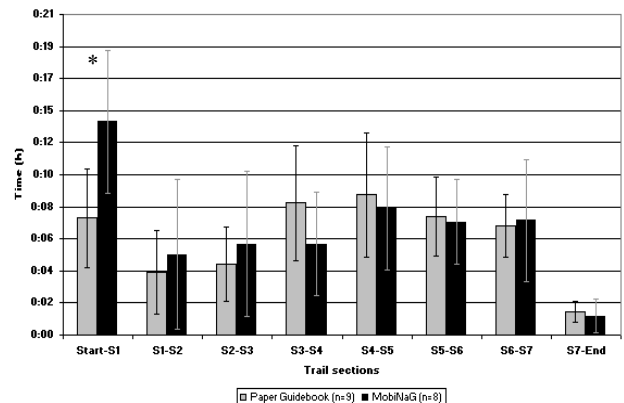
### 3. RESULTS

With respect to the navigational performance using different guide media, the study yields the following results. The sum of successful navigation decisions was calculated for the two types of guides at each navigation decision point, which includes finding the initial direction and taking the correct turns at junctions. A comparison of the percentage of family groups making the correct decision indicates that there is no pronounced difference between the groups using the paper-based guide and the ones using the mobile system. As can be seen in Table 1, there are only two decision points where the paper-based guide groups perform better than the other groups by more than 12 percent. The comparison was based on the performance threshold of 12 percent, as this implies a difference of at least 2 groups (families as well as students). The same is true for students, here the groups using the Mobile Nature Guide appear to perform slightly better. Regarding the tasks of locating stations along the route correctly (without the observer having to intervene), no difference could be determined between the media groups neither for families nor students. It should be added, that families generally were more successful than students.

**Table 1 Number of navigation decision points and located stations at which >12% performed better than other group**

	Paper-based Guide (families)	Mobile Nature Guide (families)	Paper-based Guide (students)	Mobile Nature Guide (students)
Junctions	2	0	3	4
Stations	2	2	3	3

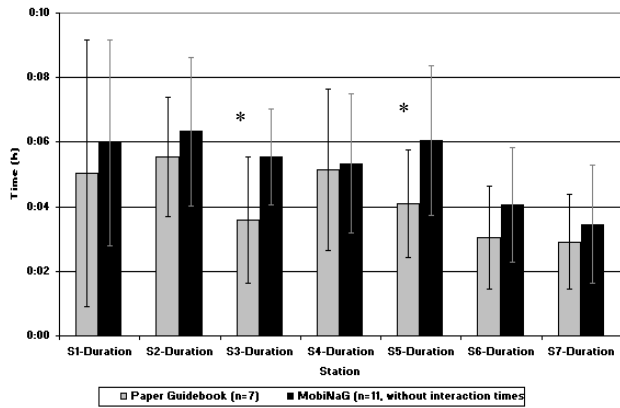
Navigational performance was also further evaluated by measuring the time that the groups spent on the trail sections in between stations, assuming that most of this time was spent walking along the trail and making navigational decisions such as locating the next station. The mean for all groups using the same guide was calculated for each trail section. There appears to be a trend that families using the mobile guide take longer at the first two trail sections. However using a Mann-Whitney U-test, a significant difference ( $p < 0,05$ ) between the media groups could only be found for the trail section between station 1 and 2, where the mobile guide group took more time. For students a similar trend can be observed but a significant difference using the U-test was solely determined for the trail section between the starting point and station 1 (see Figure 3).



**Figure 3 Mean time taken by student groups to navigate trail sections (error bars show standard deviation, \*= significant difference)**

The time spent at each station was recorded as an indicator of the intensity at which the participants engage in the content and proposed environmental education activities. The mean time spent at each station was calculated for the families and students using the paper-based guide as well as for the ones using the mobile guide. What has to be taken into account though when comparing the time spent at a station is that the groups visiting a station with the mobile guide, will not only take the time to read and explore the natural phenomenon but also to interact with the device. This interaction time includes activities like scrolling and moving between pages but also time taken by the system to load station data. The interaction time was determined for the two test tours by timing 4 testers during a “walkthrough” solely navigating through the tour without actually reading the content. The mean interaction time was then subtracted from the mean time spent at the stations by the mobile guide groups. Nonetheless the families as well as students using the Mobile Nature Guide tend to spend

slightly more time at almost every station (see Figure 4). However a significant difference ( $p < 0.05$ ) based on a U-test was only determined for two of the seven stations for families as well as for student groups.



**Figure 4 Mean time spent at stations by families (error bars indicate standard deviation; \*=significant difference)**

With regard to the utilization of content the results of recording which content parts were actually read by the participants yield the following results presented in Table 2. Comparing families, the groups using the Mobile Nature Guide read slightly more of the content. Taking a look at the student groups this difference is more evident as 14 of the 37 content parts were read by more of the groups using the mobile guide. Again it should be noted that families generally performed better than students with regard to reading the content parts.

**Table 2 Number of content parts at which >12% performed better than other group**

	Paper-based Guide (families)	Mobile Nature Guide (families)	Paper-based Guide (students)	Mobile Nature Guide (students)
No. of parts	5	7	8	14

As has been shown above, no obvious difference could be found concerning the success rate of navigational tasks. Taking this into consideration, it is striking that when asked in the post test, if the map helped them to find the route and the stations there is a difference in the answers given by the family groups. Of the families that used the paper-based guide 92% answered “Yes, the map was helpful” and only 8% of the participating individuals felt that it was “only partially helpful”. Among the families guided by the mobile system only 65% answered with “Yes” whereas 22% felt that it was only partially helpful 9% stated that it was not helpful at all. This difference is not as pronounced between the student groups as 67% of the paper-based guide group marked “yes” and 30% stated that it was only partially helpful, 75% of the mobile guide users said “yes” and it was only partially helpful for about 17% of this group. Less than 5 % of both groups meant that it was not helpful at all. In the post-test the participants were further asked how they felt right after completing the tour. Multiple answers could be marked in this case. Members of the

families utilizing the paper-based guide stated to 92% that they were content and relaxed comparing to 68 % of the mobile guide users. Equally in both groups 32 % marked that they were motivated and inspired following this experience. About 20 % though of the group using the Mobile Nature Guide stated, that they were either frustrated and annoyed or bored, this was not the case for any of the paper-based guide users. Also the majority of both of student groups described their emotional state after the tour as “content and relaxed”. In that case there is no difference between the paper-based guide group and the mobile device group. Still there is a difference between the groups when it comes to the “motivated and inspired” category. Of the mobile guide users 45 % marked that they were motivated and inspired, whereas only 22% of the other group gave the same answer. In addition considerably more of the paper guidebook participants (25%) than the mobile guide group members (13 %) noted that they were bored.

#### 4. DISCUSSION

The objective of this study was to test a mobile nature guide system against a paper-based guide traditionally used in this domain, in order to detect differences in navigational performance as well as the user’s engagement with the content of the provided tour and overall satisfaction with the guided tour experience. Based on the results of this field study no obvious difference in navigational performance could be determined between groups (families or students) using a paper-based guide and groups using a mobile guide. These findings contradict to some extent the results of other studies in the literature like [5], where electronic pedestrian navigation aids could increase the navigational performance of users compared to a paper map. It needs to be taken into consideration though, that the MobiNaG system does at the time not offer any additional navigational support apart from a position indicator and basic instructions to locate a close-by station. A major difference to other studies is based on the fact, that the MobiNaG system is employed in natural areas which commonly lack additional navigational cues like signs or prominent buildings and thus make the navigation tasks generally more difficult for participants.

The trend that can be observed with regard to the mean time spent in between stations leads to the assumption that the groups using the mobile guide system go through an initial period of familiarization with the electronic device and the guide application. As the participants did not receive instructions on how to use the mobile guide they apparently took more time getting acquainted with the interface and the device in general. This familiarization effect apparently lasts for about one to two stations and trail section.

Overall the study shows that there is a difference in the usage of the device by the two different target groups. In the family groups the parents usually have more experience when it comes to navigating in natural areas thus they are generally more successful making navigational decisions and locating the stations. And apparently they also tend to rate the support of a traditional paper-based map higher than that of an electronic map in the mobile guide. Furthermore the parents typically initiated the participation in the study in order to expose their children to an environmental education experience. Hence usually parents were highly motivated to learn more about the natural phenomena

which could explain that families generally read more of the content parts. What is striking is that students using the mobile guide seem to not only spend some more time at the stations but also appear to read more of the content parts. There could be two possible explanations for this result. On one hand this may be related to the interaction modalities of the MobiNaG Tour service. Once the students entered the information related to a station they are more or less directed through all content parts until they exit the station information again. The students using the paper guidebook on the other hand can more easily skip whole parts of the information. Furthermore this result could indicate a stronger motivational effect that the mobile guide system has on the students, which is supported by the finding that more mobile guide student users than paper guidebook student users reported to feel motivated and inspired after completing the tour. This may of course be attributed to the general fascination of children of this age group with technical and especially mobile device of all kinds. Nevertheless this could make the Mobile Nature Guide an interesting tool for environmental education institutions that could help to motivate more students to participate in environmental education experiences and eventually learn more about their natural environment. Thus this is an important aspect, which should be subject to further investigation.

The mobile guide system as well as the study design certainly have a number of limitations, that may restrict the generalizeability of results. One of the crucial issues is the lack of experimental control in a field study and the fact that a lot of additional factors can have an influence on the results, as it has been stressed by [5], [7]. One of these additional factors immanent to the study design is for instance related to the experimenter conducting the observations. Ideally each group should be monitored by the same observer, but mainly due to time constrains this was not a feasible option. Especially student groups of one class had to be tested in parallel sessions. Also in order to constrain the change in appearance of the natural environment it was attempted to keep the entire study period as short as possible. As a consequence this study was carried out by 7 different observers, of whom each was briefed on the methodology prior to the study and collected data on a standardized protocol form. Nevertheless this resulted in some variability of the collected data and some protocols could not be included in the analysis due to missing data entries. Which for instance led to unequal numbers of families in the two media groups.

## 5. CONCLUSIONS AND FUTURE WORK

Based on the results of the study no pronounced overall difference in the performance of user groups participating in a guided nature tour with a paper-based guide or a mobile guide was found. Nonetheless this study yielded a number of interesting findings. It could be observed, that groups using the mobile guide generally appear to take longer during the first part of the tour and thus seem to go through an initial period familiarization with the application. It can further be concluded, that families tend to be more successful than student groups, when it comes to navigational decisions and locating stations. In addition it is striking, that parents using a paper-based guide are likely to rate the support by the map higher than those employing the mobile guide with an electronic map. Another important finding

especially with respect to the environmental education domain is, that there appears to be a strong motivational effect on children using the mobile guide system.

However, it should be taken into account, that these are the first results of a more extensive field study. In a next step it is planned to include additional factors such as environmental conditions and especially social interactions in the analysis of the data. Furthermore another comparative study is planned, which will be aimed at testing a mobile nature guide against a human tour guide or environmental interpreter.

## 6. ACKNOWLEDGEMENTS

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