

USABILITY TESTING: USING 'THINK ALOUD' METHOD IN TESTING CARTOGRAPHIC PRODUCT

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ABSTRACT

In this paper, review and research is made on usability testing in the Geo-information environment, as used in modern digital cartographic visualization. Modern Cartography is more than the presentations of geographical information in a map form. Nowadays, it is seen as Geo-visualization, involving the visual exploration of data by an individual scientist as well as the final presentation to a more general public. The increasing use of the Internet and multi-media to disseminate geographical information place their own specific demands on visualization techniques. As a result of these, there is the need to test the efficiency, effectiveness and satisfaction of a visualization tool for the final consumer. The test method in which the paper seeks to address is the 'think aloud' method. The paper addresses how usability testing was conducted using the 'think aloud' method in testing a prototype application developed for real estate agents in visualizing buildings in 3D environment (using Virtual Reality).

Keywords: 'Think aloud' method, Usability testing, Geo-information, Visualization

INTRODUCTION

For a product or prototype to be used by target users, one needs to test for its efficiency, effectiveness and satisfaction. This makes the product user-friendly and productive, for users to use, thereby avoiding the idea of supply-oriented approach of disseminating Geo-information products to demand-oriented approach (Quaye-Ballard, 2003). The testing ensures that participants evaluate the product before it reaches the

final consumer. With reference to Andrienko *et al* (2002), 'for a visualization tool to be effective users expects: to know the purpose of the visualization tool; to have training; education of the visualization tool; a simple interface. Adding, users expect to understand the purpose of the visualization tool and learn more on how to use them'.

The research was conducted by developing a three-dimensional (3D) map in a virtual environ-

ment for real estate agents. This will help their clients visualize properties they have for sale in 3D. Developing this prototype required a test in order to determine its efficiency, effectiveness and satisfaction. As a result, the 'think aloud' research method was adopted. However, this method was further researched into to determine its usefulness in the Geo-visualization environment.

The 'think aloud' method

As indicated earlier, the method adopted for this research for the usability testing is the 'think aloud' method. According to Rubin (1994), 'the 'think aloud' method for usability testing is a simple technique intended to capture what the participants are thinking while working. To implement this technique, one has to let the participant provide a running commentary of their thought process by thinking aloud while performing the tasks of the test. This allows participants to express their confusion, frustrations and their delight'. In this research, there is the need to know from users what the map display looks like, whether the map can be used for the tasks given, whether it meets their expectation, and whether the information supplied by the map is what they need. The mixture of performances and preference for the above mentioned needs led to the choice for the 'think aloud' method. According to Rubin (1994), 'the 'think aloud' method is an excellent way to unravel cognitive processes taking place in the mind of the users'. Other reasons for the choice of the 'think aloud' method are explained below with its setbacks (Rubin, 1994; van Elzakker, 1999).

Advantages of the 'think aloud' method

- With the 'think aloud' method, participants are able to capture preference and performance information simultaneously, rather than having to remember to ask questions about preferences later.
- With the 'think aloud' method, there is no problem of memorising the thought that came up as the thoughts are expressed immediately.

- One receives early clues about misconception and confusion of participants before it manifests incorrect behaviour. These early clues help one to anticipate and trace the source of problems.
- The method can help participants to focus and concentrate. Participants fall into the rhythm of working and expressing their views throughout the test.
- 'Think aloud' method leads to valid and most complete data on cognitive processes

Disadvantages of the 'think aloud' method

- With the 'think aloud' method, participants may find the technique unnatural and distracting because the 'think aloud' method may be different from their own style of learning. If the participant is not an analytical learner, he or she may severely feel inhibited.
- 'Think aloud' method slows the taught process, thus increasing mindfulness.
- 'Think aloud' is a very time-consuming technique. It is not only the data collection that takes time but particularly the coding and analysis of the verbal protocols. The analysis of the resulting protocols is often difficult and tedious.
- Using the 'think aloud' method, participants may find it difficult to translate their thoughts into words.

Design of the 'think aloud' method

This section illustrates how the 'think aloud' method was designed. The design was based on the objective of the usability testing (that is, evaluating the efficiency, effectiveness and satisfaction of a prototype). Based on this objective, the testing was broken down into tasks and questionnaire. The tasks comprised of trial and testing sessions. The trial session involved a simple application of a 3D virtual environment. This is introduced to help participants to familiarise with the user interface before testing the prototype,

because the objective of the usability testing was not to test the software interface, but rather the concepts behind the design of the prototype.

The testing session comprised of pre-defined tasks for the participants to perform whilst 'think aloud', followed by a questionnaire. The questionnaire comprised of structured questions, which were answered by participants by ticking their choice of answer on a paper whilst 'think aloud', to explain their choice of answer. The structure of the questionnaire is as follows:

- **Satisfaction**, which is the complete fulfilment of a need or want. These questions were used to determine the participants' satisfaction after testing the prototype (Figure 1). For instance, whether the prototype gives enough information about the property a client is interested to buy; whether the prototype appeals to users in buying a property; and how users feel about the application.

- **Effectiveness**, which is the extent to which goals are achieved. This question was used to find out whether the prototype is user friendly.

- **Efficiency**, which is the mental effort put into reaching goals. These questions were used to find out if the prototype is time consuming in visualizing property.

Implementation of the 'think aloud' method is described in the next section.

Implementation of the 'think aloud' method

Implementing the usability testing (that is, the 'think aloud' method), practising real estate agents and non-real estate agents were asked for their participatory interest. Real estate agents were involved to determine their interest in the prototype, as the prototype was designed for them. Non-real estate agents were assumed to be buyers of properties (that is, clients of real estate

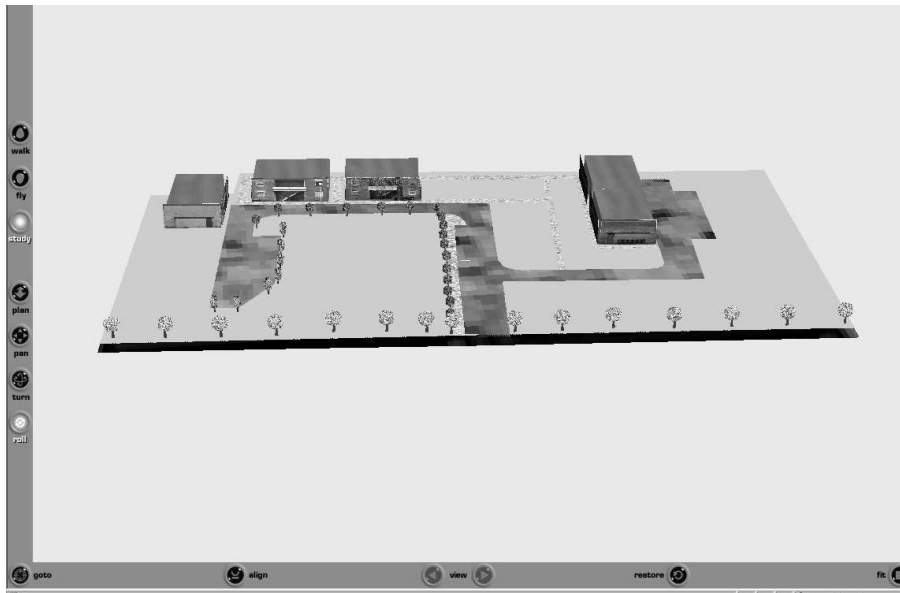


Fig. 1: The designed prototype for the testing

agents), since most of them are in the position of buying a house, or one way or the other, have acquired a house. In all, ten participants participated, comprising one real estate agent and nine non-real estate agents.

Diagrammatic description of the set-up using the 'think aloud' method is shown below (Figure 2), where there were no disturbances from the outside environment. The participants were first all introduced to objective of the test and the trial session. This was then followed by explanations on how to perform the tasks and answer the questionnaire. Participants were given a brief and concise demonstration on how the interface works. Later, participants were left alone to perform the test whilst they were being timed. For the questionnaire session, a sample of the traditional way of using pictures by real estate agents to inform clients about property was also made available. This was to allow for comparison to be made between the prototype and the traditional way of visualizing property. Five minutes was allotted for familiarization during the trial session and ten minutes for the testing session for which the seven tasks were given to the participants to perform by the 'think aloud' method. Another ten minutes was allotted for answering the questionnaire so as to determine the satisfaction, efficiency and effectiveness of the designed prototype.

Analysis and conclusion from pre-defined tasks and questionnaire

For the tasks, participants were able to go through all the seven tasks by using the tools embedded provided by the Cortona plug-in for web browser (that is, the Internet Explorer). These tools are the study, plan, pan, turn, roll, restore, align and the fit buttons. Participants were able to identify properties within the application, even the type of property (that is, property built for the old age). In due of this identification, some participants said the property was not to their liking if they were to buy. The participants identified the front, the left, the right and the back views of the properties, although there were difficulties in using the buttons to navigate through the virtual environment. Some participants claimed some views show no image. Others also claimed the speed of the interface was too much, although they could adjust the speed of movement. However, the following were easily identified: adjacent properties, entrances to properties, the road linking properties and parking lots. Viewing the whole environment in which the properties were located was very easy to be accomplished by the participant. With the difficulties in using the application, some participants suggested that the application should in the first place be used by real estate agents to demonstrate properties to their clients

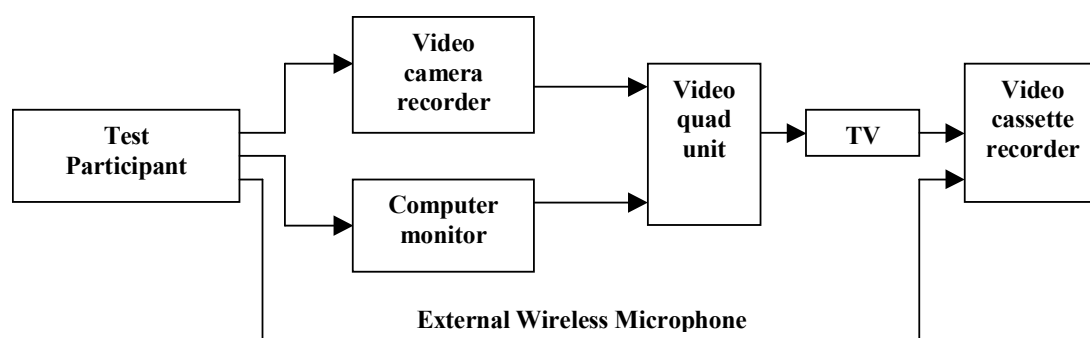


Fig. 2: Mechanism for acquiring user feedback using the 'think aloud' method (Adapted from: Redido-Cusi, 2002).

Table 1: Answers from the participants

Questions	Totally Agree	Partially Agree	Neither Agree Nor Disagree	Partially Disagree	Totally Disagree
On Satisfaction					
1. The look of property identified is appealing.	1	5	3	1	nothing
2. The way in which the property is currently represented in the system is very satisfactory (i.e. visualization of property is realistic and detailed enough)	2	5	2	1	nothing
3. The way property is presented in this application is worth of use for visualizing property you wish to be informed about.	5	3	1	1	nothing
4. The application is a good medium of informing you about a property offered for sale	1	4	3	2	nothing
5. Comparing the two systems of visualizing properties, this application looks more appealing.	2	2	5	1	nothing
6. Comparing the two systems of visualizing properties, this application gives realistic view of the environment.	2	5	nothing	1	2
On Effectiveness					
1. Navigating into the system for visualizing property and its surroundings using this application is easy to use (i.e. the application does not involve effort).	nothing	3	2	4	1
On Efficiency					
1. Visualizing property and its surroundings is skilful in terms of time (i.e. the application does not involve much time in visualizing property).	3	6	nothing	1	nothing
2. The mental effort in identifying and visualizing properties using this application is efficient in terms of time.	1	7	1	1	nothing

rather than allowing clients to operate it themselves.

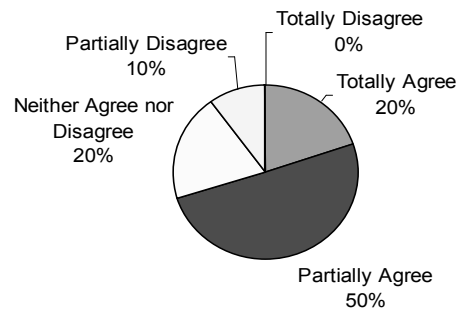
The results obtained from the questionnaire (Table 1) were analysed as follows:

- For Satisfaction: 50 % of participants partially agreed that the look of property using

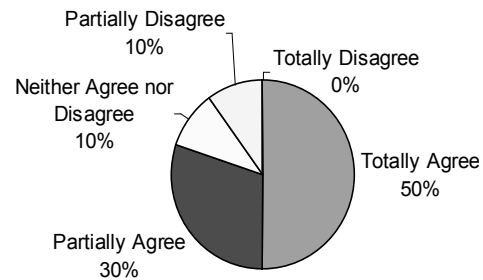
the prototype was appealing and very satisfactory; 50 % of participants totally agreed that the prototype was good for visualizing property; 40 % partially agreed that the application was a good medium of informing property offered for sale; 50% partially agreed that the application gave a realistic view of

the environment as compare to traditional way of showing pictures. However, 50 % neither agreed nor disagreed that the properties represented in the prototype was more appealing as compared with the traditional way of visualizing property. Explaining these higher percentages (Figure 3) from the protocols by the participants in the 'think aloud' method, the techniques behind the application was very pleasing for visualizing properties and their surroundings although it did not inform them about the cost of the property. The traditional method contains much textual information about the cost. Adding, there was too much simulation (artificial objects such as trees) within the prototype. Also, the prototype gives a visual impression about the property and its environment one is interested to buy. An example given by a participant was the purchase of a house without having the opportunity of seeing the environment in which the property was located. The participants concluded that the application was satisfactory in terms of use, realistic representation of the environment and inform clients about a property offered for sale. However, it is not satisfactory in informing clients about the cost of the property.

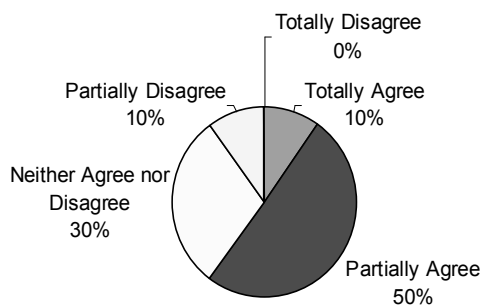
Question Two



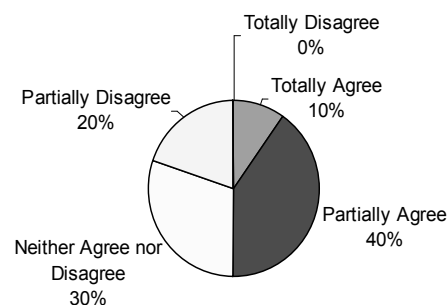
Question Three



Question One



Question Four



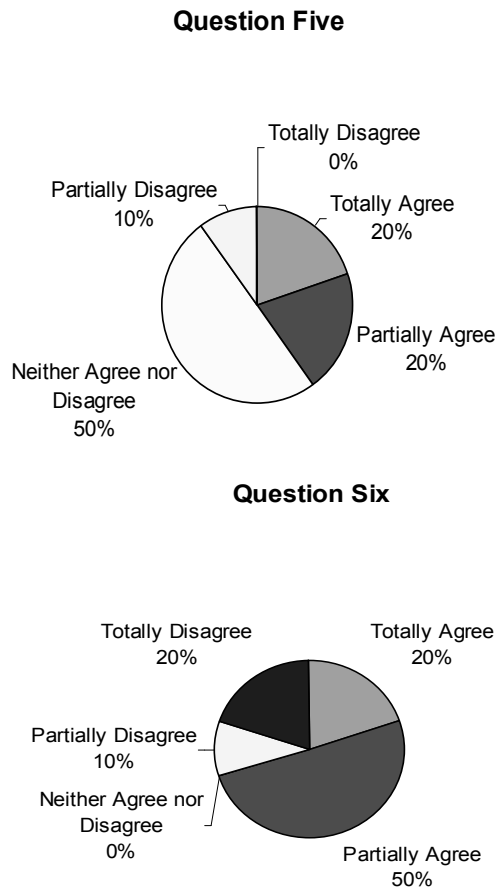


Fig. 3: Answers based on satisfaction visualized using pie chart

- For effectiveness: 40 % of the participants partially disagreed to the question that navigating into the systems for visualizing property and its surroundings was easy. This higher percentage (Figure 4) can be explained from the protocols by the participants in the 'think aloud' method. That is, most of the participants were not conversant with virtual reality interface due to the way they interact with the application. Some participants were lost in the virtual environment. Hence, navi-

gating into the system seems very difficult. Some claimed with more practice it will be

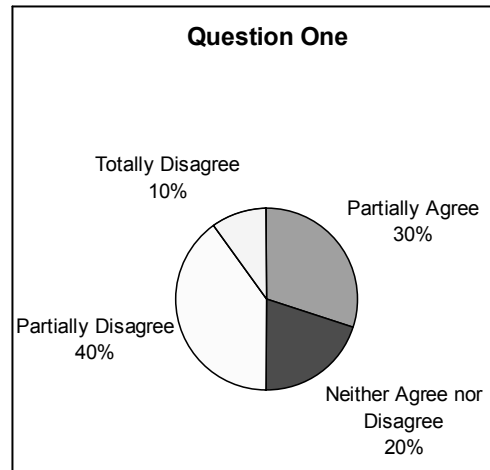


Fig. 4: Answers based on effectiveness visualized using pie chart

very easy to use. Adding, the buttons have too much functionality for use. In conclusion, the prototype is effective for participants who are conversant with virtual interface, but not for those who are not familiar with virtual interface.

- For efficiency: 60 % of the participants partially agreed that the application did not involve much time in visualizing property; and 70% of the participants partially agreed that the mental effort in identifying and visualizing properties using the prototype was efficient in terms of time. Explaining these higher percentages (Figure 5) from the protocols by the participants in the 'think aloud' method, properties were easily identified without difficulty with more elaborate description of the type of property participants were visualizing. The conclusion drawn from this test was that the application is efficient in terms of the time required to identify property and its surroundings, although the virtual navigation was problematic for participants.

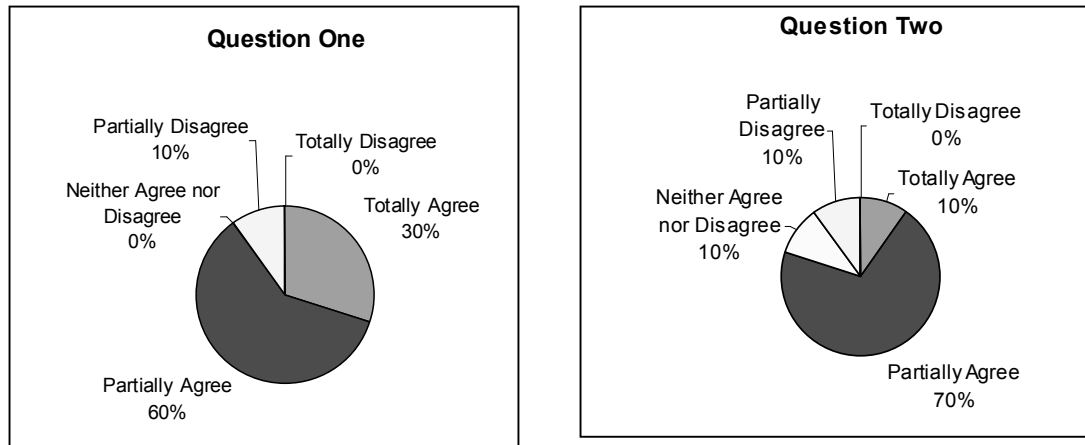


Fig. 5: Answers based on efficiency visualized using pie chart

In all, participants claimed the application is good for representing the environment. Clients could easily have a look at the surroundings as compared to the traditional approach of using pictures. Participants were able to grasp the concept of identifying property and its surrounding within the application without physical identification on the field. The real estate agent think the prototype is not necessary as it will best be suitable for visualizing commercial (bigger) properties rather than domestic (smaller) properties.

Recommendations from the participants in the 'think aloud' method

The following is a summary of improvements recommended for the prototype by the participants during testing and questionnaire sessions:

1. The applications' functionality should be reduced. This is because each button of the interface has too many functionality. Participants claim this problem makes the application difficult to use.
2. Well descriptive buttons such as pan and zoom should be used. Also there is the need for 'go into' tool for viewing the inside of the property (building).
3. The need for 'clickable' tools to display textual information (that is, an access to attribute data). The real estate agent claimed the clients need information about the cost of the property. Hence, the need to provide a mechanism such that a click on the property would display information about the cost of the property.
4. Use of joysticks in replace of the mouse to allow for effective use and navigation within the application.
5. A map of the area showing where the property is located should also be made available. Also, linking the application to cadastral map such that, a click on the parcel boundary on display will activate the application to view the environment in which the property could be identified.
6. An interesting area posed by the real estate agent is that: the application could be developed for newly developed area as well as large commercial properties and not only for domestic properties.
7. For suggestion one above, it was a problem with the browser employed as well as the familiarity with the use of desktop virtual reality. The other suggestions raised by the

participants were not implemented because of time constraints.

CONCLUSION

The 'think aloud' method proved to be a useful usability-testing tool to improve the design of the prototype as well as determining the satisfaction, efficiency and effectiveness of the prototype. Feedback from participants using 'think aloud' proved helpful, for further development of the prototype. The 'think aloud' method although tedious to implement, proved successful in determining the cognitive reasoning of participants about the prototype.

From the protocols of the 'think aloud' method, it was discovered that the real estate agent think the prototype was not necessary. A suggestion was that the prototype would be best use for visualizing commercial (bigger) properties rather than domestic (smaller) properties. This shows that the demands of the clients of real estate agents in visualizing property are not considered by the real estate agents rather the sale of properties by using 'feelings' of the clients.

A conclusion drawn from the usability testing for the prototype is that the application is satisfactory in terms of use, realistic representation of the environment as well as informing clients about a property offered for sale. In addition, the application is efficient in terms of the time required to identify property and its surroundings. Also, the application is effective for participants who are conversant with virtual interface.

In summary, the usability test illustrates the significance of the 'think aloud' method in testing Geo-information application for the final user. Without the test, it will be assumed that the final product is good for the clients of the real estate agents. In other words, the prototype was tested to determine the demands the clients of the real estate agents. This demand-oriented approach is what the Geo-information scientist is interested in, whereby efficiency, effectiveness and satisfaction of the product will be evaluated.

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