Exploring Games and Gameplay as a Means of Accessing and Using Geographical Information

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Gaming computers are now as powerful as their office/industry counterparts, or, in some cases, even more powerful. Gaming strategies and games could provide an innovative means for accessing geographical information, including geographical information accessed via the Web.

This paper reports on research undertaken to ascertain the usefulness of implementing a "games" interface for accessing geographical information. Three simple prototype packages were built and subsequently tested to see if access to information via a different interface would enhance information provided to users from a selected user group profile – the "Nintendo" group of users. Ormeling (1993) has identified this group as those users who have been exposed to computer games and thus potentially prefer access to computer-delivered information via this type of interface. The use of the prototypes was compared with the use of a conventional paper map for the same area and evaluations were completed to ascertain:

- *The general operability of the products;*
- *Whether users preferred other metaphor approaches to traditional map interfaces;*
- *Whether 3D graphic interfaces are preferable to 2D interfaces; and*
- *Whether this type of product provides a better "picture" of reality.*

It was found that generally users preferred interactive multimedia to using conventional maps. They found that it would be easier for users who were not competent computer users to use a game-like control, and that the cognitive load was generally easier with a 3D interface, compared to a 2D interface.

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Furthermore, it was possible to conclude that this type of product provided a better understanding of a real place than a conventional map.

This paper provides a background to the research, information about how the research was conducted, results from the evaluations and propositions for further research.

Keywords: geographical knowledge, information access, interfaces, cartography, multimedia

A new generation of geographical information users, the so-called Nintendo generation (Ormeling 1993), has emerged. This generation of users was not brought up on television alone. They are computer-savvy and attuned to navigating and using games interfaces, games controllers and to working with games strategies. They are mostly under 35 years of age and male (Clickz.com 2004b) and their focus on the use of technology for information and entertainment is different from that of their parents and grandparents. Half of this new user population prefers to play games rather than reading or watching movies (Clickz.com 2004a).

This new generation of users of geographical information artefacts has different skills than their paper map consuming grandparents. This group might not be aware of, nor attuned to, the heritage of maps and mapping (and perhaps do not even care about their ignorance). They access and use maps and map-related services delivered via television, the Web and cellular telephones as part of how they "use" these composite digital services. There is a need to consider this group of new map (or map-related artefact) users and how the use of games-like tools may provide the means for geographical information access and geographical discovery in what could be considered to be non-conventional ways of delivery, ones better suited to this consumer group.

Looking at how the geospatial sciences might make use of games technology and gaming, Kuhn (1992) noted that including "play" would allow developers to emphasise creativity and to encourage "trying-out" in mapping and Geographical Information Systems (GIS). He further suggested that ideas from video games that included strong spatial components could be useful. (Kuhn 1992, 90) I would argue that the Nintendo generation can be made more "geographically aware" if they are provided with different ways of using cartographic artefacts, products and interfaces than the conventional ones, products designed to accord with a consumption method that the group members have already mastered and in fact prefer. No user training in package use or navigation is necessary. Delivering geographical information in novel ways might better provide for this user group, which otherwise might be unwilling to use conventional methods of geographical information access and use. Conventional "maps", whether they be static or dynamic, may not always be the best or the preferred method of access to geographical information or a preferred information consumption method by this group of users.

Banchoff and Brannon (1998) have noted that over the past several decades even the geographic sciences have been slowly disassociating themselves from maps and moved towards other means of geographical visualization.

> *The overwhelming effect of this live, in-your-face media coverage is that we have become generally desensitised by varying degrees, not only to disasters, but to geography itself. Maps do not matter any more because seeing an event as it happens puts us right on the spot; we have travelled around the globe in an instant, the television or computer monitor has become our virtual transportation device. We are right there … wherever there might be. Turn off the sound, take away the captions, and we might be looking at generic, archival footage taken from the media vaults.* (Banchoff & Brannon 1998, 6)

They consider that when the actual geography of news becomes irrelevant to society (the news event takes place "somewhere" in the world, with images provided by a quick news media "grab"), so, too, do maps. Consumers of this type of information delivery could be considered to be non-elite or naïve users of geographical visualization tools. Therefore a different "approach" to (geo)information provision, one that accords with how they might access and use other types of information, especially information via computers, could assist them to 1) View geographical information artefacts at all; and 2) Better "move" through an information resource to locate the information they desire.

This paper reports on research that explores how the use of the game playing metaphor might be employed to provide tools that allow users to explore geography in a “different” manner, using different artefacts: those developed using an interface that is more games-like. These artefacts could allow users to explore geographical information in a serendipitous manner, allowing information to be discovered rather than “just” presented to the users via a conventional map or a computer system where the delivery of information is still based on the map metaphor. Traditional map products do “work”, but they only provide one viewpoint of geography – through the map metaphor – and New Media products, including games, offer the potential to provide different “views” of geography.

New Users

Once, maps were the realm of experienced users who knew the type of map needed for a particular application. They knew where to purchase them, the appropriate products to use and how to use them. Typical of these users were, and are, bushwalkers/ramblers; experienced users who had learnt the rules needed for deciphering the icons that make up the map image. For map publishers, this made life easy: produce the maps, force the users to become competent in using your products and then just continue. Now, the myriad of Web-accessible on-line map collections and contemporary media products provide “maps for all”. Users are now unknown to the producers and their skills in map use and interpretation difficult to determine. This has meant that even naïve or inexperienced users must be catered-for.

These inexperienced users lack knowledge about “how maps work”.[1] They approach cartographic artefacts in different ways and use them differently from traditional paper products or screen displays. For example, the general public, or non-elite users, now use the Internet, more particularly the World Wide Web, to retrieve information and to communicate. A big part of this group of users are the young, computer-savvy users that belong to the “Nintendo Generation” (Ormeling 1993), also called the “Doom Generation”, from the computer game that used spatial orientation (Riddell 1997) or “Generation X” (McIntosh 1995). This new group of users approach map use with a different set of skills.

They have different skills that need to be considered with regard to how they access information and, from a cartographic perspective, how they might prefer to use geographical information tools.

The Games Metaphor and Cartography

It has been argued by geographers/cartographers like Castner (1981) that the map model works best. However, users have to appreciate the "grammar" of cartography in order to fully understand the "language" of maps and how it depicts geography (including the associated "lies" that maps have to tell to illustrate the "truth"). Many new users of cartographic products have skills that could be exploited so as to better provide information about geography. One of these skills is the ability to play computer games or use computer games-like interfaces.

Can cartographic products that invite exploration be designed to be delivered in a computer games-like manner? Any cartographic artefact needs to be designed according to certain guidelines and these guidelines, once assembled, define the "look" of the product and its utility. Historically, rules for map design and production have evolved, rather than been specifically constructed. Take for example a topographic map, where the contemporary "look" of the product is the evolution of hundreds of years of work related to design, trialling and redesign. Can games strategies and games tools be "instantly" introduced?

Metaphor models form a pivotal link between learning and memory through the abstraction of relevant properties of a situation into a simplified and convenient form. In doing so, they are usually dynamic and their development is effected by situational factors. Users interact with artefacts and then form mental models. Therefore interface metaphors attempt to map knowledge already held by a user group to a normal problem area (Smyth & Knott 1994). Cartwright (1999) proposed a number of conceptual metaphors in a metaphor set which includes the Storyteller, the Navigator, the Guide, the Sage, the Data Store, the Fact Book, the Gameplayer, the Theatre and the Toolbox. These metaphors have been acknowledged by Laurini (2001) as suitable access metaphors for visualizing and accessing urban information. A brief summary of how the Gameplayer metaphor might be employed is:

> *Multimedia and gameplay and geographic information need not be based on the typical puzzle solving / shoot-em up type games, but should consider the human part of the interpretation of the game. Computer games and the way they present landscapes help to reinforce certain ideologies. Gameplay can be used as a means of allowing the user/viewer/participant to discover patterns of phenomena that are meaningful for each individual user.* (Cartwright 1996)

The research described in this paper is a tentative step towards exploring whether games can be applied to cartographic applications.

Gameplaying and the Exploration of Geography

Cartographers have always striven to produce artefacts that have both technical integrity and graphical quality. This process has been carried out under the "umbrella" of the historical conventions and procedures that have guided designs to successful outcomes. But with other approaches to information provision, such as gameplaying, perhaps we should consider strategies other than those that have usually been applied.

We have a need to produce artefacts that provide the stimulus for humans to create a mental map or a "synthetic world". Using the "traditional" approach would mean developing strategies for artefact design and production (strategies based on an underlying theory). Maps can then be produced for general consumption as paper maps or maps delivered via the Internet and viewed through Web browsers. We develop strategies to satisfy the need to depict space using maps or map-like objects. If, instead, this process was to be guided by the theory of gameplaying, a synthetic world would still be produced, but the strategies for development would be influenced both by the need for creating accurate representations of the world (the key focus of cartography) and by gaming strategies (which could be employed to provide different, and perhaps more intuitive, methods for interacting with and moving through cartographic representations of the world).

Figure 1 compares the existing Geographical Visualization (GeoViz) method for producing tools for exploring and appreciating geography with a games approach. GeoViz creates "synthetic" worlds, traditionally producing the paper map as an artefact but, more recently, also digital counterparts of paper maps. In undertaking these tasks certain strategies for development are employed. How these tasks are undertaken have been influenced by the underlying theory of cartography, which is twofold: conventions that have evolved historically, and conventions that are still being developed due to the implementation of contemporary technologies such as interactive multimedia as a presentation method and the World Wide Web as a "publishing" medium. The underlying need to satisfy here was to produce artefacts that depicted space through the use of both traditional and non-traditional cartographic means – via maps and map-related objects. However, the means of access and the actual artefacts produced were designed and realised under the "umbrella" of GeoViz thinking. Games offer a complementary way to approach the provision of geographical information, one that can enhance the existing methods that are provided to the Nintendo generation for exploring and discovering geography. It is acknowledged that the historical underpinnings of games need to be understood, along with the theory, methods and technologies of computer games, and how they are applied for single players, for multiple players and in collaborative applications. Both the basic need for GeoViz product design – the depiction of space – and the need for play that is involved in computer games should be addressed when the GeoViz designer wishes to take advantage of the potential that computer games provide. However, there are some problems, the most important of which is perhaps the need for GeoViz products to provide geographical integrity and completeness that usually is not provided in existing computer games tools. Computer games designers and producers can distort geography when developing games, and they can end the world where they so desire. GeoViz developers do not have this luxury; they must accurately display the world as it is. This problem is being addressed by researchers in GeoViz and cartography (Germanchis, Pettit & Cartwright 2005; Champion 2003; 2004) and the solutions should make useful the power of computer games to deliver geographical visualizations that are accurate, current and rigorous. This is noted as "Games + Reality" in the bottom right corner of figure 1.

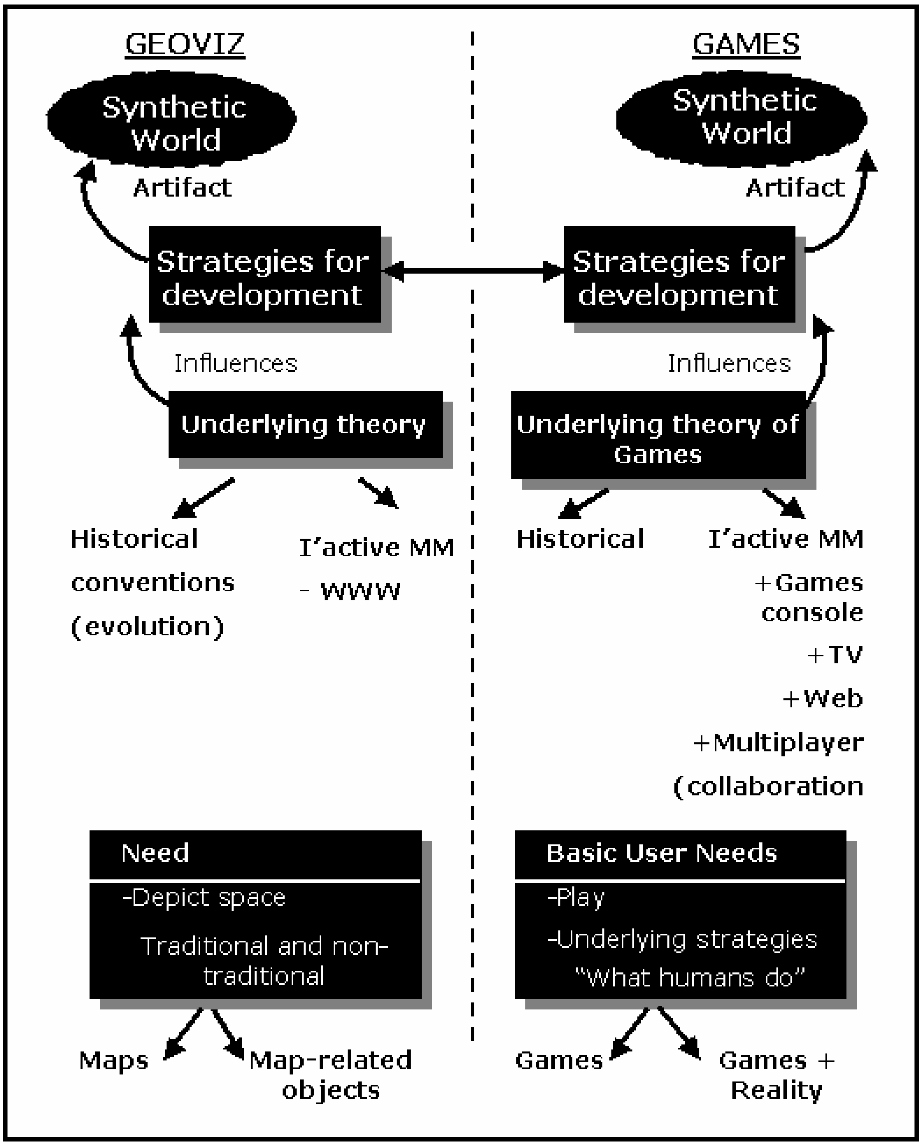

Figure 1. Comparison between traditional geospatial information artefact processing and games approaches. (Cartwright 2002, 1.30)

Katz (1997) contended that games like *Myst*, *Civilization* and *SimCity* are extraordinarily educational and that they require complex planning and rewards patience and strategic thinking. For example, the skills learned using games like *SimCity,* where players think little of moving from an aerial view, to a map, or to a subterranean view, could be applied to seeing multiple views of the city. Aerial views could be replaced by aeronautical charts, users could then move to topographic maps, move "down" through various scales to planimetric maps, down further to maps of the urban utilities infrastructure, further down to soil maps and finally to geological maps. Furthermore, geographical exploration packages could be built around Chesher and McCarthy's (1994) three genres of game: Action, Puzzle/Path and Entertainment. The Action metaphor could provide a user with the ability of moving through a simulated landscape, avoiding environmental pitfalls. The Puzzle/Path gameplayer could navigate through a virtual world where clues to navigation were uncovered by solving puzzles. And finally, an Entertainment package could provide a user with multimedia tools for building a comprehensive report on a particular geographic location or region.

To properly employ such alternative information delivery and consumption strategies, cartography needs to appreciate how games "work" and how games – and interactive multimedia gameplaying – might be employed to provide different images of reality. Similarly, cartography needs to consider both underlying theories and practical implementation realities if we are to use other, non-traditional approaches to geographical information provision. We need to develop strategies for using innovative methods and tools.

One of the characteristics of computer games that could be useful in developing games inspired interfaces to geographical information has been highlighted by Gonzalo Frasca, namely its dependency on both representation and simulation (e.g. Frasca 2003, also quoted in Dillon 2005). According to Frasca (2001), whereas traditional narratives are representational, (video)games are also simulations in that they allow the user to influence the reality of the game world.

Although a complex issue among video and computer game theorists, many also show an interest in the narrative aspect of games (e.g. Pearce 2002). The power of the narrative can be used to paint "word pictures" of the world and give the user/viewer a sense of geographical place. Electronic media can use the power of storytelling to transfer information about reality or "snapshots of reality". Geographical stories could be constructed using Platt's (1995) electronic storytelling genres: user as observer, user as director, or user as actor. As an *observer*, the user would have no control over the content or the sequence of events; the geographical phenomena would be merely described. This would be useful for telling stories about terrain or features that need to be outlined in a certain way and to build a theoretical basis upon which later information could be constructed. As *director* the user would be able to manipulate the characters in the story and choose the storytellers from a list of available *raconteurs*. For a particular application where it is important to tell a story that has credibility or authenticity, a "panel" of storytellers could be directed by the user into particular parts of the story, providing the best storytellers for a particular information dissemination task. For example, if a geographical information product was to be interrogated for an agricultural application, the user could direct the storytelling exercise so that it told the story using expert storytellers from the fields of farm management, soil science, geology, agricultural science and meteorology. To place a particular part of the world into some sort of historical context, storytellers might include map curators from national libraries, university historians, geographers with particular knowledge about the area and individuals whose families had always lived in the area. As an *actor* the user would become part of the story and digitally "woven" into the storyline. Once immersed into the story, the user could manipulate data, test various components and undertake various mapping and analysis procedures. All of these actions would be "supported" by a "mask" of the informed scientist being placed over the user as a cast member. The user, while immersed into the story, would be able to have at ready disposal any of the knowledge and tools at hand that would be needed for proper research. As the users would become fictional characters in the story, whose profiles could be "painted" by the human users, they would be adequately provisioned with a scientific and knowledge base that would enable them to complete various (virtual) tasks. The user would be able to produce a story line that best suited their needs and therefore could benefit from seeing the story from their own perspective.

Testing the Concept – Games Interface Explorations

In order to test the usefulness of the games metaphor in cartographic artefacts and to begin developing strategies along those lines, a number of games-inspired interfaces were created and subsequently tested on a group of users. The testing comprised five stages: one pretest and four test routines.

1. Pre-testing the users to gain an understanding of their previous exposure to maps and other tools for accessing geographical information.

2. Testing the effectiveness of a multimedia geographical information product in comparison with a "conventional" paper map product.

3. Evaluating the candidates' views on using other metaphors than the map metaphor as a basis for geographical information artefacts.

4. Testing whether 3D graphic interpretations of geography are preferable to 2D ones.

5. Testing if a "rich media" geographical information product provides a different "view" of a certain geography than do paper maps.

The diagram in figure 2 shows how each of these tasks was linked.

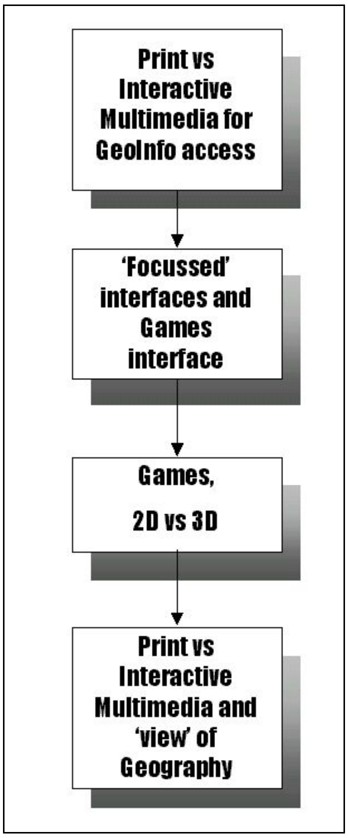

Figure 2. Evaluation components.

Three "testbed" prototypes were developed using a combination of straight HTML coding and Macromedia *Dreamweaver*. The interfaces were designed to emulate the "look-and-feel" of a gameplaying interface, albeit a modest one. The first interface is shown in figure 3, with a linking page illustrated in the right of the figure. A second prototype was developed using Virtual Reality Modeling Language (VRML), so as to provide a 3D interface (figure 4). The third evaluation tool was developed using Macromedia *Dreamweaver* (figure 5).

Stage 0

A pre-test was employed to compile a profile of the candidates. The group of candidates consisted of 50 first-year tertiary students studying in the geospatial sciences. Specific map-use information was collected through a questionnaire. The results from the pre-test allowed further testing to be completed with a knowledge about the characteristics of the group that was being tested and the level of their cartographic expertise. The participants provided the following information:

1. Age
2. Gender
3. Frequency of making enquiries about geographical information
4. How they used maps
5. If they used maps, how did they use them?
6. A self-rating of their expertise as a map user
7. How they generally used geographical information artefacts
8. If they produced mapping products, how did they produce them?

It turned out that the user group was typical of the Nintendo generation. Their ages ranged from 18–25. All candidates used maps and considered themselves to be mostly efficient or expert map users. They used a number of maps and map-like artefacts and they had experience in producing products with numerous electronic devices. The fact that the students were already attuned to using geographical information products could mean that the results of the tests were somewhat biased.

Stage 1

This stage of the evaluation was undertaken by the same user group as in Stage 0. It sought information about whether users preferred a conventional paper atlas or an interactive product. The Dorling Kindersley World Reference Atlas, produced both on CD-ROM and as a paper version, was used for this test. As Dorling Kindersley published these two versions of the atlas from the same database, both formats contained the same information, and almost identical display methods were used for the paper and electronic versions. Therefore, it proved to be an ideal way to ascertain which was preferred, the paper bound or the electronic atlas.

The candidates were asked to find answers to a number of questions using both the paper atlas and the electronic atlas. Once this was done, the candidates were asked to list 3-5 things that they liked about the electronic version of the atlas, and 3-5 things that they disliked. They were further asked if they thought that the electronic atlas was better than a paper atlas, if they would use the product, and if it was easy to use.

In answer to the question "*Is this atlas better than a paper atlas?*" the positive comments made by candidates can be summarised as:

- The electronic atlas contained more facts
- Users could make comparisons between one country and another, comparing GNP, populations, etc.
- It was easier to search for specific information
- Not just "pure" map views were provided, which was seen as a useful addition
- Educational videos that highlighted certain features were useful for comprehension of certain facts
- "Highlighting" functions provided by the package enabled users to focus on certain information that was provided

However, some of the views in the questionnaire answers were more critical towards the electronic atlas:

- The information was regarded to be "shallow", when compared to the paper version of the atlas
- The electronic atlas was generally thought to have advantages over the paper atlas, but it was not seen as a "better" product
- Problems with portability of the digital version of the atlas was not an issue with usage of the paper atlas
- Some candidates stated that they actually preferred paper cartographic products over their electronic counterparts
- The digital atlas enabled users to print maps. This was seen as an alternative that could alleviate some of the problems of an electronic-only product

In answer to the question "*Why would you use this product?*" most of the candidates answered that they would use the electronic atlas, and provided the following reasons:

- It was easy to find facts
- It was "more interesting to use and navigate"
- Information was (relatively) quick to obtain
- It was most usable as a general reference atlas, insofar as information was easy to find
- Its "fast find" functions were appreciated
- Using videos and search functions to supplement the paper atlas was seen as a superior usage method to the paper alternative
- It was seen as a useful research tool when particular facts were needed, rather than for general information gathering exercises

In answer to the question "*How easy is it to use?*" the candidates found advantages with the electronic atlas:

- It was difficult to begin with, but once the best way to use the product was found, it proved to be an effective learning tool
- It was noted that this was especially so once the structure of the atlas was deciphered
- Using both text and images to search was viewed as being supportive of different user preferences
- It was intuitive to use and the information was presented in a logical manner

But there were also some concerns about the interface of the electronic atlas:

- The product needed more detailed explanations about how it should best be used
- Cursor links (to additional information) were found to be "vague". The participants thought that the atlas might operate better if it were updated with "browser"-like functionality

- Forwards/backwards navigation was considered to need improveing
- On-line help should be included in the atlas

(These considerations are more related to interface issues, than to format issues.)

Looking generally at the results from this evaluation, what the candidates saw as positive elements of digital products was the ability to gain more facts than they could using the paper version, countries could be easily compared, and presentations that made use not only of “just” maps but also of rich media made the product more usable. The existence of interactive navigation and search functions also provided enhanced atlas functions compared to the paper product. However, a number of users preferred to use the paper product rather than the digital version. Furthermore, the information in the digital atlas was seen, in some instances, to only provide “shallow” information, rather than in-depth information. It is possible that this criticism is related to the type of atlas – a general reference atlas – rather than the product itself.

Stage 2

The second stage of the evaluation used another and smaller expert user/producer group of 8 candidates, again 18–25 years old. The choice to use a smaller and more focussed group was made because it was easier to manage and because for instance Virizi (1992) has noted that 80% of usability problems are uncovered with four or five test participants, so the use of a smaller group was deemed to be a sound one. A questionnaire asked candidates whether they agreed with a number of statements about metaphor use in interfaces, particularly the games-type interface used in this part of the evaluation (see Figure 3).

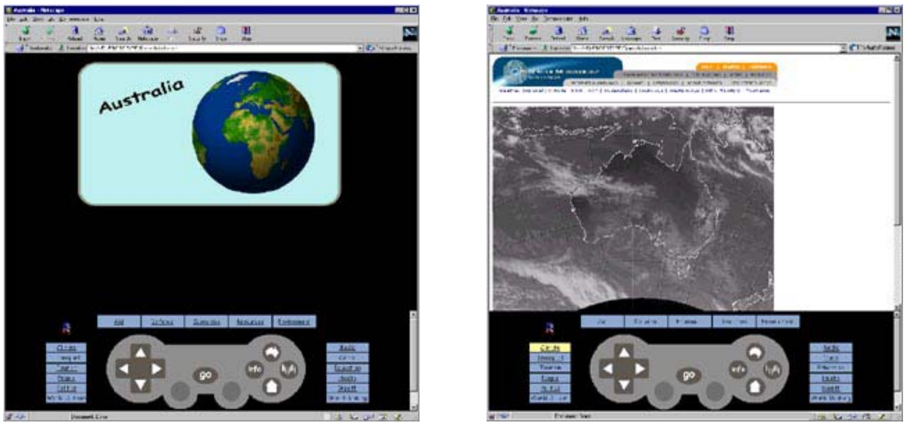

Figure 3. Gameplaying for the Nintendo Generation.

The questionnaire showed that candidates thought that metaphors helped them to better understand geography. They did not think that maps alone are best for understanding geographical information, but that the metaphor set illustrated was a useful adjunct to simply using maps. The candidates thought that the product in the test could be used with little prior experience and that a games-like interface was easier to use than traditional maps. They felt confident using it. The type of interface in the test product was in fact what they would choose over a conventional one. Finally, the candidates saw this type of interface as being appropriate for a first-time user. In general terms, this focus group of expert users/producers supported the concept of games metaphor use.

The candidates were also asked to comment on how the product could be used and to make some general operability comments. The questions asked were:

1. In your opinion, what would motivate users to use something like the demonstration product to complement maps for the "discovery" of geographical information?
2. Where would you see a product like this best used?
3. How might this product be improved?

4. Should this type of product try to mimic current computer games, or is this basic interface, without the glitz of commercial products, adequate for the task?

They generally found the package easy to use and the game-like control was considered good for users who are not competent with computers. The product was seen to be applicable to tourism, education (in schools) and in general information centres. Lastly, one of the concerns of the author was that the game-like interface would need to be similar to commercial games products with million-dollar budgets, which – nowadays – are usually "built" on the back of a blockbuster movie. This suspicion was confirmed by the focus group. Some said that while the concept and the interface might be "ok for children", it would be inadequate for other age groups. Therefore, to be useful this interface must be further developed with a "look and feel" similar to that of a commercial product.

Stage 3

The focus on this stage of the evaluation process was to compare two different methods of information access for this particular user group. Results from the evaluation would indicate whether this user group deemed that an interface that appeared more like a computer game – one that required navigation through a 3D information display – was in fact the preferred interface. As noted earlier, an interface was built using Virtual Reality Modeling Language (VRML). The interface is shown in figure 4.

Figure 4. Stage 3 evaluation prototype.

As both this interface and the previous interfaces developed for the stage 2 evaluation were designed to “link” to exactly the same information resources, the test would focus on interfaces, rather than the information access facilitated by each interface. The Reeves and Harmon (1993) User Interface Rating Tool for Interactive Multimedia was used as a “model” for constructing a questionnaire. Reeves and Harmon (1993) claim that novice users are generally not good candidates for using this type of evaluation. They consider users experienced with the type of program being rated or alternatively experienced designers of interactive products to be the best candidates for providing considered feedback. For this reason, only experienced users or producers/designers were included in the evaluation. This was the same group of evaluation candidates who completed the stage 2 evaluations of the project.

In the questionnaire used, the candidates were asked to rate the product according to 10 criteria:

Ease of use. The Ease of use category related to how easy users found the product compared to the 2D version of the program. The users were asked to consider the general use of the VRML interface as well as the use of the mapping package.

Navigation. Navigation referred to the ease with which users could move through the product. The candidates were asked to consider general navigation through the product, especially the 3D interface, and how they navigated to other parts of the product. They were also asked to consider whether this type of 3D interface assisted or hampered comprehension about their location in the package.

Cognitive load. The candidates were asked to consider how much harder, or easier, the product was to use compared to the 2D version. And, whether they had to work harder mentally, or whether it was easier or more intuitive when using the 3D product compared to the 2D version.

Mapping. Mapping related to how the program tracks a user as they use the program, and how it provides feedback. This can be in graphic form or through the use of some other medium. When considering this section, the candidates were asked to reflect upon whether or not the 3D version of the product was better in assisting the mapping of their location in the program. They were also asked to consider whether the "built-in" navigation and "world"-finding tools that are part of the general interface also assisted by providing "location in the product" feedback.

Screen design. Screen design referred to the actual design components, colours, text, symbols etc. The candidates were instructed not to focus on the overall "look" of the product, but to concentrate more on its functionality.

Knowledge space compatibility. The category Knowledge space compatibility focussed on the type of information provided in the product. This prototype "test" product was designed as an atlas. All themes were not fully developed, as this was not required for the evaluation. The candidates were asked to ignore this in the evaluation and to assume that all thematic maps *could* be accessed.

Information presentation. Comments in this category had to do with whether the information presented was in an understandable form. Had the users understood the information contained in the product and did they learn something about the themes illustrated in the map "pages"?

Media integration. Media integration related to the "putting together" of the different media types. Usually, when multimedia products are evaluated they contain many media types, thus presenting a "rich media" product. As this product provided a combination of VRML pages and map information, the candidates were asked to consider only these elements.

Aesthetics. Cartography has been defined in a number of ways, but it is generally considered to be an amalgam of ART, SCIENCE and TECHNOLOGY. This part of the questionnaire looked at the ART element in cartography and the provision of geographical information. The "look" of the product and its form were considered. Information was needed to see whether the 3D product enhanced information presentation. As the addition of 3D displays can now be readily achieved using mapping and general graphics software it cannot be automatically assumed that 3D enhances the look of the product by merely being added. This part of the evaluation sought to establish whether the candidates considered the aesthetics of the product to be enhanced when the information was provided in 3D.

Overall functionality. This category related to the perceived utility of the product. As the product provided geographical information in an atlas format, this was the main criterion that candidates were asked to consider.

The candidates found that the cognitive load effort was generally easy with the 3D version. They liked the 3D screen design and found that the knowledge space capacity was generally good. Information presentation was highly valued, as was the aesthetics. Overall functionality was considered to be easy. (It is interesting to note that Coors *et al.* (2005) had similar findings – that users preferred 3D to 2D – in their research into the use of maps on mobile devices.) Areas where the product did not score well were Ease of use, Navigation, Map content and Media integration. These areas required further product development, map product enhancement and better integration of more media types.

Positive and negative comments from the "General Comments" section of the questionnaire are summarised below.

Positive comments

- Easy for expert user.
- Easy to navigate.
- More intuitive to use.
- 3D maps make for easier comparisons to be made.

Negative comments

- Confusion about use of VRML.
- Difficult for novice user.
- Scale/distance from viewer/size of map content needs to be considered.
- Risk that 3D image looks more like a fantasy game.

- Easy to learn about connections.
- Better because it looks more real.
- 3D product is closer to reality.
- 3D image more appealing to users, but it may not provide more information.

Table 1. Summary of comments on the product.

Using a games approach provided a "focussed" interface for Nintendo generation candidates. The next stage of the evaluation, Stage 4, looked at whether a "rich media" geographical information product would provide a better "picture" of geography than a conventional product with respect to how users perceive a "selection" of geography.

Stage 4

Subjective methods are typically used to determine the level of media quality required in applications. At this stage of evaluation, an attempt was made to implement a more formal approach. The evaluation procedure demanded that it be "built" on a sound educational theory and implemented through a proven *modus operandi*. The core educational theories of Bloom's learning behaviours, developed in his taxonomy of learning objectives (1956), were considered appropriate for developing tasks for formal evaluation of the prototype product. They were used to develop specific cartographic applications for testing. A summary of how Bloom's learning behaviours can be translated into cartographic applications and how these have been implemented in this cartographic product are provided in Table 2.[2]

Table 2. Applying Bloom's Taxonomy to cartographic products.

Bloom	*Educational Focus (from Wakefield, 1998)*	*Geographical Education Focus*	*Educational Materials (from Wakefield, 1998)*	*Cartographic Materials*	*Measurable Behaviours (from Wakefield, 1998)*	*Measurable Geographical Usage Behaviours*
Knowledge	Focuses upon the remembering and reciting of information.	Learning geographical facts, for example learning country names, capital cities and then reciting this information.	Events, people, newspapers, magazine articles, definitions, videos, dramas, textbooks, films, television programs, recordings, media presentations	Maps, atlases, remotely sensed images, gazetteers, ...	Define, describe, memorize, label, recognize, name, draw, state, identify, select, write, locate, recite	Define, describe, name, identify, recite, locate
Comprehension	Focuses upon relating and organizing previously learned information.	Taking geographical information, formed as a 'mental map' and then re-organising this information into a more coherent resource. Classification of information, for example taking the population sizes of countries and then re-ordering countries according to population size.	Speech, story, drama, cartoon, diagram, graph, summary, outline, analogy, poster, bulletin board	Compilation of a thematic map, design of a cartogram.	Summarize, restate, paraphrase, illustrate, match, explain, defend, relate, infer, compare, contrast, generalise	Compile, summarise, illustrate, map, generalise

Bloom	*Educational Focus (from Wakefield, 1998)*	*Geographical Education Focus*	*Educational Materials (from Wakefield, 1998)*	*Cartographic Materials*	*Measurable Behaviours (from Wakefield, 1998)*	*Measurable Geographical Usage Behaviours*
Application	Using methods, concepts, principles and theories in new situations.	Using geographical knowledge and producing a thematic map that illustrates classified information. Information is symbolised and a map product realised, for example producing an iso-demographic map that illustrates comparative population sizes by changing the actual size of countries depicted. Relative sizes of countries are determined by their population size, rather than their landmass.	Diagram, sculpture, illustration, dramatization, forecast, problem, puzzle, organizations, classifications, rules, systems, routines	Thematic map. Mathematical element: application of map projections. Art element: map design. Science element: underlying distribution theory. Technology input: choice of production technology/ software and delivery technology/ communications systems.	Apply, change, put together, construct, discover, produce, make, report, sketch, solve, show, collect, prepare	Design, project, classify, depict
Analysis	Critical thinking which focuses upon parts and their functionality in the whole.	Using map information to compare region to region, city to city, for example using the population map described in the previous cell to compare the relative populations of various countries in a visual way.	Survey, questionnaire, an argument, a model, displays, demonstrations, diagrams, systems, conclusions, report, graphed information	Thematic map – paper or delivered electronically. May contain a tool to assist usage, for example a map legend for the paper map or an interactive 'how to' tool in an interactive multimedia product.	Examine, classify, categorize, research, contrast, compare, disassemble, differentiate, separate, investigate, subdivide	Compare, classify, measure, calculate, assemble, disassemble, map

Bloom	*Educational Focus (from Wakefield, 1998)*	*Geographical Education Focus*	*Educational Materials (from Wakefield, 1998)*	*Cartographic Materials*	*Measurable Behaviours (from Wakefield, 1998)*	*Measurable Geographical Usage Behaviours*
Synthesis	Critical thinking which focuses upon putting parts together to form a new and original whole.	Taking a number of cartographic artefacts and using them to assemble data about a certain geographical region, for example using an atlas, which contains maps, graphs, diagrams and textual information and 'assembling''information about a geographical region. Or, alternatively, a GIS.	Experiment, game, song, report, poem, prose, speculation, creation, art, invention, drama, rules	Maps, measuring tools, geographical visualization systems, Geographic Information Systems, Cartographic Information Systems.	Combine, hypothesize, construct, originate, create, design, formulate, role-play, develop	Buffer, combine, re-combine, differentiate, integrate, layer, order, filter, select, map
Evaluation	Critical thinking which focuses upon valuing and making judgements based upon information.	Taking 'assembled' information about a geographical region (from many cartographic artefacts) and making a decision about the relative growth, economic position, environmental status, etc.	Recommendations, self-evaluations, group discussions, debate, court trial, standards, editorials, values	Considered and informed decision-making using an array of cartographic artefacts, for example developing 'what if''-scenarios using Geographic Information Systems.	Compare, recommend, assess, value, appraise, solve, criticize, weigh, consider, debate	Compare, report, assess, value, appraise, consider, project, grade, demark, and speculate

The same 8 candidates as before were first asked to answer the questions using a paper map of the selected area and then with a 3D/Web information source, the *Townsville Geoknowledge Project* interactive multimedia product, developed for this evaluation (Cartwright, Williams & Pettit 2003). The questions asked are provided in Table 3.

Figure 5. Stage 4 evaluation prototype.

Application of Bloom's Taxonomy to Geographical Education	*Task*	*Question*
Knowledge	General undirected map reading.	Name the main streets in the central area of Townsville. Identify the harbours in the town, what are their names? Locate the railway station, the panoramic lookout point, the entrance to the harbour and the way to the airport.
Comprehension	Directed map reading. Users are asked to locate specific items and then to summarise and generalise this information.	Compile a list of points of importance to mariners using the port facilities. Summarise the elements that comprise the town. Generalise what constitutes the layout of the town.

Application	Classification of information shown in the product and making general considerations related to the production of a 'second generation' map product that would encapsulate the essential elements of the town.	Considering the information shown on the map, how would you classify the basic elements of the town? If you were asked to produce a map that encapsulated the essential 'things' that comprise the town what would these elements be?
Analysis	Considering different topographical features. Measuring distances. Calculation of travelling times.	Compare the central city area to the surrounding areas. How are they different topographically? Measure the distance from the panoramic lookout to the entrance of the main harbour. Calculate how long it would take you to walk this distance.
Synthesis	Making informed judgements from the geographical information provided. Selecting information deemed to be important.	Differentiate between the main elements of the town. What are they? If you were asked to act as a tourist guide to visitors to the town, which places would you take them to? Select two places that would provide the 'key' points to visit.
Evaluation	Comparing the town to other towns. Evaluating the value of the town's attributes. Projecting possible scenarios.	Comparing this town to where you live, what do you think are the main differences? What do you think is the value of the harbour to the town? Speculate that if there was a flooding related to a tropical cyclone, which areas of the town would be most likely effected?

Table 3. Formal basis for the questionnaire – applying Bloom's Taxonomy to cartographic products.

After the tasks had been performed, the candidates were asked to make general comments comparing the traditional map to the 3D/Web product. The purpose was to determine whether the medium changed their view of the geography of Townsville. Then general comments related to product improvement were solicited. The diagram in figure 6 shows how each of these tasks was linked.

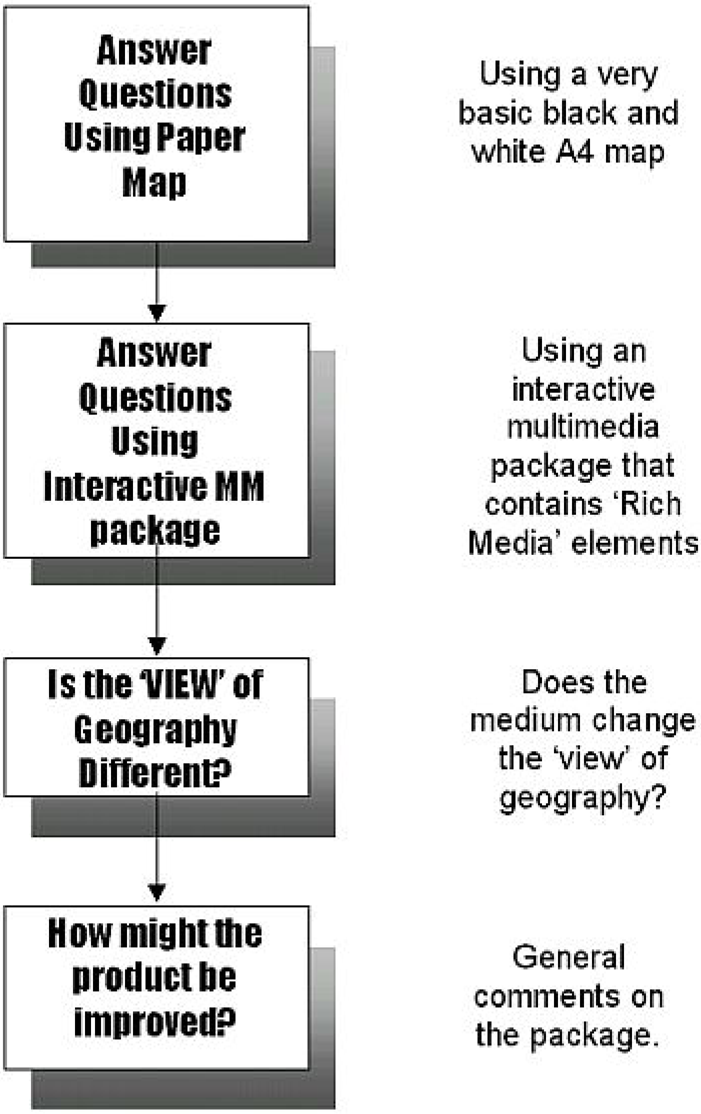

Figure 6. Stage 4 evaluation components.

At the end of each section, the candidates commented on how easy it was to perform these tasks with the artefact used – *easy*, *fairly easy*, *moderately difficult*, *difficult*, *hard*, *very hard* or *impossible.* Once they had done this with the paper map, the candidates went through the same procedure using the interactive multimedia package. One of the focus elements of this evaluation was to investigate if perceptions of geographical places are dependent upon the medium used.

There were definite changes in how the candidates viewed their allocated tasks when using the paper map and when completing the same tasks with the interactive multimedia product. Questions relating to the *Knowledge* section were rated, in the worst cases, as impossible/very difficult to answer with the paper map. This changed to fairly easy/easy with the multimedia product. For *Comprehension* hard/difficult moved to moderately difficult/easy. *Application* tasks were rated hard/moderately difficult when the paper map was used and moderately difficult/fairly easy with the multimedia product. *Analysis*-related questions were impossible/moderately difficult with the paper map and fairly easy/easy with the multimedia product. There was no change with the *Synthesis* tasks. *Evaluation* specific questions were rated impossible/moderately difficult with the paper map. This perception changed to moderately difficult/easy with the multimedia product. In general terms, five of the "umbrella" task areas were easier to perform with the multimedia product, albeit two of the five tasks only changed slightly. This indicates the effectiveness of "rich media" products.

Finally, the candidates were asked to comment on how their perception of what constituted the town had changed once they used the interactive multimedia product. The ability to describe the town improved markedly when the interactive multimedia product was used. Initially, the candidates were either unable to adequately describe what constituted the town, or they just provided a general "location of elements" statement. After they had used the interactive multimedia product, the candidates were able to comment on the structure of the town, its location by the sea, the fact that it had a harbour and that there were hills behind it. The general structure of the town – city centre with a few historic buildings and a suburban spread beyond – was also added to the description. The interactive multimedia product, with enhanced media attributes, enabled the users to get a better appreciation of the town.

The users commented that with the interactive multimedia product it was easier to imagine what the town looked like and to get a feeling for the topography. The functions of the various districts in the town were obvious and existing personal experiences could be enhanced. Generally, the candidates commented positively on the ability to gain an enhanced appreciation of the town with the interactive multimedia product.

Deliberations Related to Choosing a Gaming Approach

The basic premise of using maps and other (geo)visualization artefacts is to build mental models of reality. Ptolemy believed maps to be the means to "exhibit to human understanding […] the earth through a portrait" (Crane 2003, 33). Historically, maps have been used to provide information to users about places recently discovered or voyages made to unknown worlds or hitherto seemingly impossible journeys.

Mapping has at its core the requirement to accurately show spatial phenomena. The "stuff" that comprises the discipline is measurement and depiction. Designers and producers of map products are concerned with whereness, something that can be formulated and depicted in quantitative terms, and whatness, dealing with qualitative information. The whyness element of mapping is a combination of users' knowledge about the subject being depicted and the map producer's skill in choosing the appropriate data and designing the most effective medium for portrayal. The location of an "event" – something that occurs/did occur/will occur/could occur somewhere in space/time – is controlled by a number of elements. These are depicted in Figure 7.

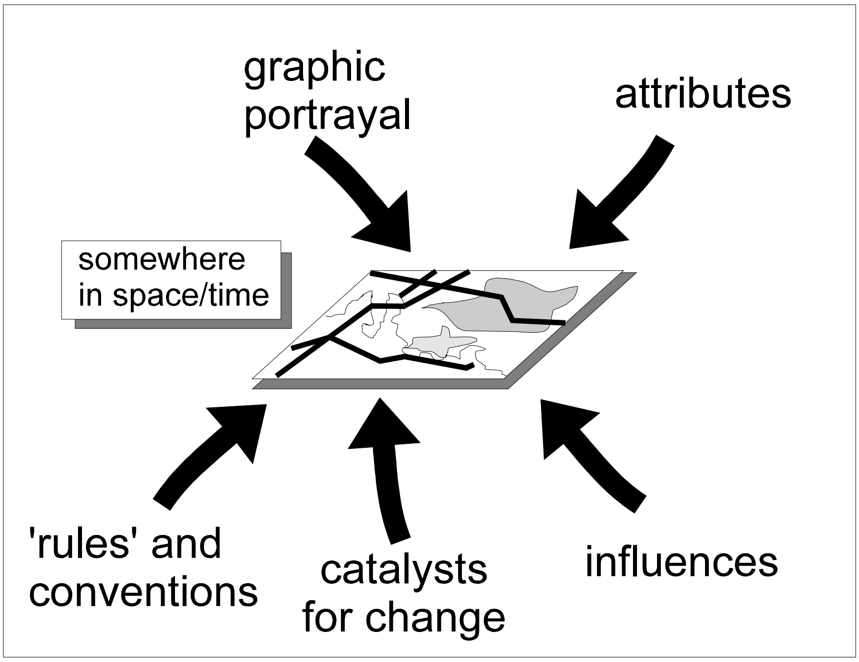

Figure 7. Elements that influence the depiction of spatial phenomena.

The depiction of "somewhere in space/time" depends on a number of elements: the choice of the method of graphic portrayal; the attributes of the information that have to be depicted; the influences on how the nature of the data and their location may alter; the catalysts for change that bring about the final location in space/time for particular data elements; and the rules and conventions that need to be employed (those that relate to the type of data being depicted, the viewing preferences of the user and the specific demands of the visualization method and equipment being used). Contemporary mapping, although providing timely and accurate products, may still be using formats which make them less suitable for being fully utilised by all users. If one were to make a very general observation, one could draw the conclusion that the formats and types of presentations used for the depiction of spatial data do not fully exploit the plethora of other information delivery devices in common usage.

Cartography needs to think differently about how to provide access to information, including geographical information. But how should a "new" system be designed? Bradbury (1997) explored what a modern *Mappa Mundi* might be like. He foresaw that it would be divided into three parts: a complex data system capturing the real environment, a powerful modelling system and an interface. It would be visual, multi-dimensional and provide computer graphics-generated displays.

Computer games and the ways in which they present landscapes help to reinforce certain ideologies (Tivers 1996). If gameplay is to be used as a means of allowing the user/viewer/participant to discover patterns of phenomena that are meaningful for each individual user, then the gameplay needs to consider not just the way things appear on the surface, but also what is happening to the human part of the interaction. Digital interactive mapping products need to be designed and produced with human interaction in mind and multimedia gameplaying, in its various forms, can assist greatly.

Perhaps a route that could be followed when developing such interfaces is that illustrated in figure 8. Firstly, user preferences are ascertained, so as to choose a particular interface path. Then, once an investigation into the hardware and communications devices that are available to the user has been conducted, a decision can be made regarding whether a games approach is useful. If the answer is "yes", the games interface and the actual game of geographical exploration can be built around a particular games strategy that accords with the user, the information being provided and the delivery mechanism that will be employed. Once the product is in use, the user can choose from first, second or third person viewpoints. They can play in collaboration with other players and also work through an avatar. The game can be provided via discrete or distributed media and be used synchronously or asynchronously. Obviously, if a gaming strategy is not chosen, then the product can still be built using contemporary New Media tools.

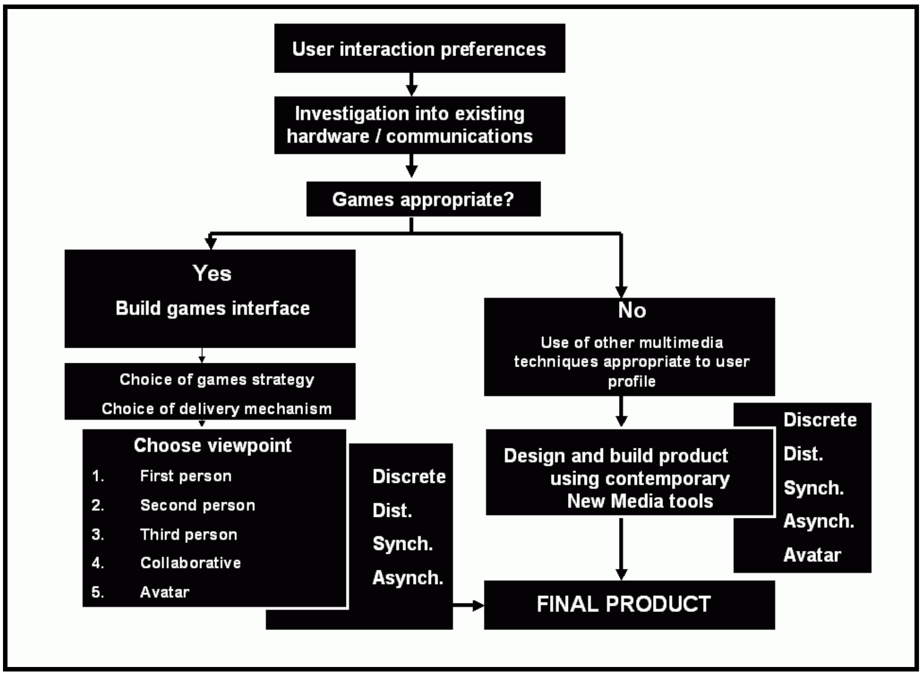

Figure 8. Decisions regarding the utilisation of gaming strategies and tools.

Where To with Cartographic Theory and Games Theory?

It can be argued that contemporary cartographic products are similar to computer games – they rely on both representation and simulation. Paper maps and early computer-generated maps produced maps and computer graphics representations of geography. It was not until later that simulations produced with computers could closely represent reality. However, it must be noted that traditionally maps and map-related products have been produced as artefacts for users to appreciate geography. Now, computers and computer simulation packages bring this task to a much higher standard than could be accomplished with map-related objects like block diagrams and artistic impressions of terrain that were hand-drawn onto paper. Contemporary cartography also strives for what computer games are trying to achieve, namely a shift in thinking that stresses that better tools can be produced by combining traditional representation methods with simulation. Many cartographic products, such as atlases and thematic maps, can also be linked to the narrative, where linear and non-linear stories are told using the "grammar" of cartography. For example, Monmonier (1992) proposed the use of "Graphic Scripts", whereby users would be provided with a "guided tour" which would include narratives of useful/interesting information. Here, a sequence of cartographic "events" could be pre-programmed, and users would be taken through a (geographically) logical set of steps that exposed the user to the pertinent information that needed to be communicated. Furthermore, cartographic products can be improved by exploring how games are played and how players explore virtual worlds with adventure games.

However, narratives must also be retained as part of the cartographer's toolbox when atlases and thematic maps are designed. Narratives can be used to give a "sense of place" using electronic storylines. They can furthermore be used interactively with interactive multimedia cartographic products where, at certain points during the narrative, users can choose to take a selected "fork" in the interactive narrative "road". Obviously, as the narratives will need to be based on geographical facts, the rich information presented and the choices that users are allowed to make will be guided by geographical realities. A composite cartographic product – one that combines narrative and gaming, stories and adventure games – can invite a structured exploration of geographical artefacts that comprise both representations of the existing world and simulations related to history and projected future geographies. From a technical perspective, computer games technology could provide geographic information products with solutions for computation (upholding the rules and deciding what happens in response to player input), game state (keeping track of the current game state) and interface (how detailed an influence the players have on the game state) (Juul 2003). The "rules" of geography, for example how landscapes and human movement patterns develop and change, can be incorporated into games. This can be used to effect a more realistic simulation for understanding how, for example, landscapes "evolve" or how geography can determine human movement and settlement patterns. Here, the computer would be the tool for remembering the rules, generating appropriate simulations and allowing certain movement and interaction, whereas the human brain controls interpretation, visualization and the comprehension of geography.

Conclusion

This article has suggested a direction for research on the provision of a "different" interactive multimedia package for the exploration of geographical space. It has outlined the main evaluation procedures followed in the project reported on and provided the results from the various stages of evaluation.

As a multimedia installation of this type changes the way in which users access and use geographical information, an evaluation of this information provision genre now seems appropriate. Apart from gauging the success of the use of the product there is a need to assess how such a product changes the user's viewpoint of geographical reality and thus a particular view of space. It is hoped that by using an interactive multimedia installation that encourages exploration in ways that new geographical information consumers feel comfortable with, a better (if not different) perception of what the world is composed of will occur. Therefore, the evaluation was completed to assess whether the package and its use provided better tools for exploration and if it provided different perceptions of geography.

Using a games approach provided a "focussed" interface to test on the Nintendo generation. It is argued that it is worth continuing with experiments related to the effectiveness of such interfaces if the true value of different interfaces for particular generations of map users is to be judged.

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Notes

1. With due apologies to MacEachren; see his excellent book *How Maps Work* (1995) for an expert analysis of how cartographic artefacts, maps, "work".
2. The comments in columns 2, 4 and 6 are taken from Wakefield (1998) and are not the author's.

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