
Title	Enabling IT: Examples of web-based learning from geography lessons
Author(s)	Chang Chew Hung and Tan Geok Chin, Ivy
Source	<i>ERA-AME-AMIC Joint Conference, Singapore, 4-6 September 2000</i>
Organised by	Educational Research Association of Singapore (ERAS)

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ENABLING IT: EXAMPLES OF WEB-BASED LEARNING FROM GEOGRAPHY LESSONS

Chang Chew Hung & Tan Geok Chin, Ivy
National Institute of Education
Nanyang Technological University

Abstract: Information Technology is commonly referred to by its acronym IT. But just what does IT encompass and what are the "technologies" of IT that are useful for learning? How will IT enrich a lesson and enable learning? In particular, the question of how different the advent of new ITs such as the World Wide Web (WWW) is from existing ITs such as the video or TV will be examined. Since learning arises from a constructive process of reflection on the material provided and interaction with it, the mere use of IT in lessons may not be a sufficient condition for learning to occur. It may not even be a necessary condition for learning to occur. Furthermore, IT refers to an extremely varied spectrum of "technologies" ranging from plain electronic manifestation of printed material to self-contained, highly interactive, communication-enabled and multi-mediated materials. There exists a problem on the choice of IT for learning. Examples will be drawn from the comparative study of two University Geography courses, one pre-service and one in-service, on the infusion of interactive online web-based courses to enable learning.

Introduction

Learning arises from a constructive process of reflection on the material provided and interacting with it (Farnham-Diggory, 1990). Indeed some advantages of using IT for instruction are the allowance for self-paced learning, visualization facilitated learning, multi-mediated learning, constantly updated materials, assessments tailored based on learners' progress and the resource-rich nature of materials on the internet. There is "growing demand for a 21st century that is independent of time and space, oriented toward goals and outcomes, centered in the student/learner, geared to active, hands-on learning and able to accommodate differences in skills and language" (Aaggarwal and Bento, 2000: 4). Indeed, the "scenario painted for our Singapore classrooms of tomorrow is a very exciting one, and one that is intimately connected with technology. There is no escaping the web of information technology" (Cheah, 1997: 140). Indeed, educators and researchers are quickly examining how IT may enhance learning (eg. Fabry, 1998, Lynch, 1998, Rada et al., 1996 and Scott, 1996).

Information Technology can be used either on a stand-alone basis or a communication dependent situation. By stand-alone, we refer to the use of IT that does not require retrieving information or engaging resources from another location. For example, the use of PowerPoint™ slides or the use of a video cassette player can be referred to as stand-alone as they can be operated in one location independent of learning resources in another location. Communication dependent IT resources, however, will require either synchronous or asynchronous information transfer, manipulation or retrieval from another geographical location, such as bulletin boards and the WWW. This paper examines the implementation of the use of web-based learning in two courses, one pre-service and one in-service, conducted by HSSE in the Geography subject areas. The pre-service course is a general elective, Introduction to Modern Geography and the in-service course is partially delivered through the World Wide Web (WWW) in Teaching Selected Aspects of Climatology for Geography Teachers. In particular, the objectives of this paper are:

1. to compare the resource and constraints considerations in adopting a web-based approach to both these courses.
2. to compare the learners' response to the use of web-based learning in both of these courses.

Implementation

The implementation of the on-line web-based learning component for both the in-service and pre-service courses were different in a number of ways. The in-service course was to be delivered via 7 hours of face-to-face interaction and 11 on-line hours (total 18 hours of contact time). The total hours of contact time for the pre-service course was 24 hours. The on-line component in the pre-service course was meant to complement the face-to-face contact rather than one of substitution. The stages in implementation of the on-line components for both courses are included in Appendices A and B for your reference..

There were two fundamental differences in the implementation of web-based learning in these two courses. 55.6% of the in-service learners rated themselves as beginners in terms of computer skill compared to only 34.6 of the pre-service learners. Table 1 summarizes the learners' rating of their own computer competency.

Table 1: A comparison of computer competency between in-service and pre-service learners.

How would you rate your computer skill level?	% of pre-service learners (NAG191)	% of in-service (XSS227) learners
Beginner	34.6	55.6
Intermediate	53.8	44.4
Advanced	11.5	0.0

The level of computer competency meant that more time had to be spent on familiarizing the in-service learners with the web-based learning environment. An additional session was conducted just to introduce the Blackboard platform for the in-service learners. In fact, more time was spent by the instructor answering emails about technical problems than about content materials for the in-service learners.

The in-service course has fewer face-to-face contact hours and hence more materials had to be delivered via the web to maximise the face-to-face interactions. For example, all content material were delivered via an on-line lecture system whereby the learners have full autonomy as to where and when they will access the material. The students will then attend tutorials on campus to discuss their learning experiences. The pre-service course has more face-to-face sessions and hence the on-line resources were used to maximise interactions that could not occur in class, for example, group discussions for their project work. Although some content material is available on-line, most students use it for discussions (through discussion boards) and for completing their on-line quizzes. The following figures show the difference in usage between the 2 classes.

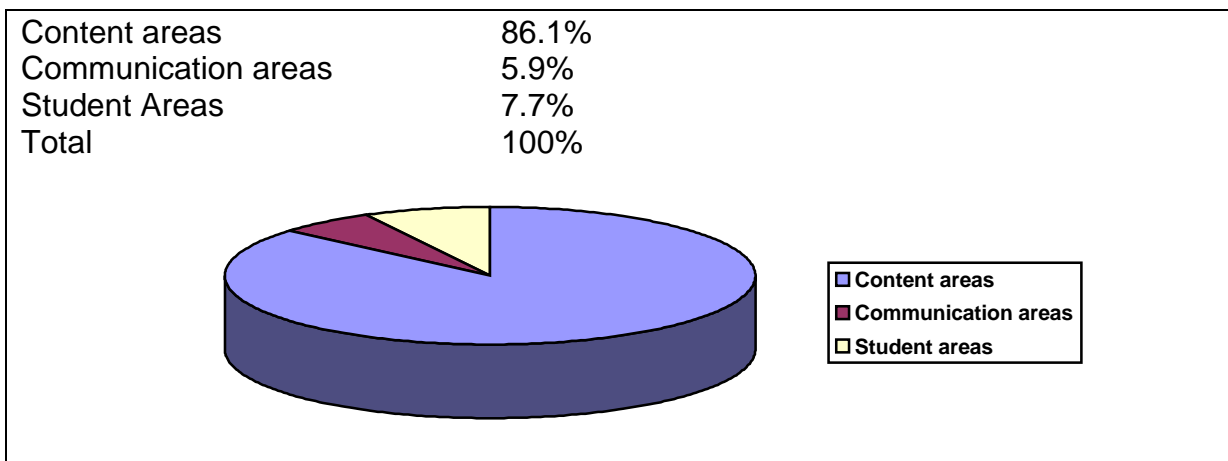


Figure 1: Percentage accesses by areas of online materials for in-service course XSS227.

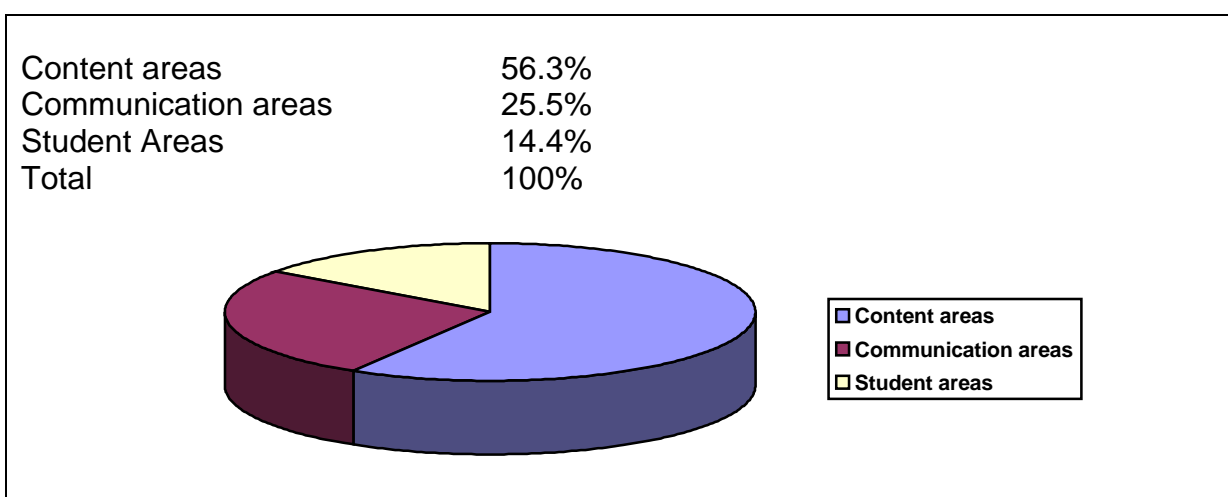


Figure 2: Percentage accesses by areas of online materials for pre-service course NAG191.

Close to 5.9% of the time spent by in-service learners was on communication areas such as email and discussion board, compared to 25.5% of time spent by pre-service learners. Student areas in the figures above refer to access to student tools such as quizzes and students personal web pages. There were some other specific elements of a web-based learning environment which were considered when implementing both courses.

Communications

1. The WWW connects the learner to the instructor allowing real-time assessment. In this course, all participants have WWW access, either at home or at school. Some course quizzes are auto-corrected while the instructor reviews others that require open-ended responses asynchronously. This reduces the number of face-to-face contact hours required for the courses. This also reduces the number of hours spent on travelling. The advantage of using hypertext web pages over linear presentation of information is that the learners can choose for themselves which pathway they want to explore. Megarry (1989:50) argues that giving the learner more autonomy in choosing how to interact with the information base makes for more effective learning. This self-directed access is important in a learner-centred course as it facilitates immediate access at the point of need. It also enables students to pace themselves, allowing them to explore issues about a topic of interest more deeply, and spending less time on concepts that are already understood. Learners in this environment are no longer passive learners trying to mimic what they see

and hear from the teacher, but are "*more active participants in the creation of knowledge and meaning*" (Brown and Thompson, 1997).

2. The use of Discussion Board in the Blackboard system enables collaborative learning in this course. The discussion board is fully automated for ease of management. The discussion list is categorized by topic. As the discussion list allows a written transcript of the online discussion, it enables a collaboratively built knowledge base about the topics being discussed. Webb (1989), in a message map analysis of interaction patterns on discussion boards, found that students do respond to the messages of others, adding on and building to the ideas proposed. The asynchronous nature of online discussions allows learners to respond at a time that "best suits them" (Brown and Thompson, 1997). It allows reflection and further research on the topic before responding. Hiltz (1986:98) found that 'time for reflection' was an important factor in learning effectiveness. It also allows immediate clarification when the need arises or to learn from "*whatever discussion is taking place even though they may not themselves have initiated it*" (Brown and Thompson, 1997).

Visualization

3. WBL allows for information to be presented in multimedia. In particular, visual images may "increase learner interest and motivation," present "inaccessible processes and events" to the learner, "*sharpen powers of observation, guide learners to think and make conclusions, present relationships, organize new information, function to integrate facts, skills and judgement*" (Chatterjea, 1998). Furthermore, "*visual representation can play a role in synthesising information or in identification of concepts as when we need to use diagrammatic and visual forms to communicate information, represent data and show relationships*" (McLoughlin, 1997). Indeed, the use of animated visual images has produced some positive feedback. A few in-service learners have requested permission to use the animations in their own classes.

Timeliness

4. Information is up-to-date and can be updated continually. In fact, review questions were posted during the course based on the progress of the class. In other words, review questions for each topic were planned based on the performance of participants throughout the course.

Resources

5. Physical space is no longer a constraint as the WWW may be accessed from practically anywhere on the island (subject to availability of suitable hardware and infrastructure). Since all the participants have either web access at home or at work, the web-based course's ability to liberate the user from spatial constraints becomes highly viable. However, there is the problem of access speeds depending on the type of hardware used.
6. The WWW is a rich source of information, much like a set of encyclopedia or a library. Unlike the CD-ROM, which can only hold about 600 megabytes of information, the WWW is made up of many machines around the world, and allows almost limitless storage of information. Some activities and discussions are built around this aspect of web-based learning. Participants are instructed to collect materials from other web sites (some common links to the selected topics are provided on the course) for class discussion.

Students' response to web-based learning

A questionnaire was administered toward the end of each course to solicit the students' responses about the use of web-based learning. This was conducted in an attempt to improve web-based delivery of future courses. The instrument was adapted from the Ministry of Education (MOE) in-service feedback questionnaire. The instrument was used primarily by MOE for assessing the students' feedback on the online delivery of the course. The adaptation focuses on a few main areas: organization and presentation of web-based materials, maintenance of web-based materials, interest generated by web-based materials and the overall satisfaction with the web-based materials. All the 9 in-service students and 26 pre-service students participated in the exercise. The findings are summarized in the table below:

Table 2: Summary of students' responses to web-based delivery.

Questions	Mean Score for XSS227	Mean Score for NAG191
	(4 = Strongly Agree; 1 = Strongly Disagree)	
The objectives of the web-based course were achieved	3.3	3.2
My interest was sustained throughout the web-based learning	3.6	3.2
The instructions given were clear	3.7	4.0
Questions emailed to the instructor were promptly answered.	3.3	3.8
I have learnt useful ideas/skills	3.5	3.7
I am satisfied with the content of the online materials	3.7	3.8
I am satisfied with the presentation of the online materials.	3.7	3.9

Although both groups of learners gave relatively high ratings for the web-based delivery of materials, the in-service group had higher mean scores for the objectives of the web-based delivery and their interest in the web-based learning than the pre-service group. The pre-service group had higher mean scores for all the other items. However, these scores might not be significantly different given the different samples sizes of 9 and 26 for the in-service and pre-service groups, respectively. A reasonable conclusion based on this summary is that on the average, both groups agree (mean score >3) that:

1. The objectives of the web-based course were achieved.
2. Learners' interests were sustained throughout the web-based learning.
3. The instructions given were clear.
4. Questions emailed to the instructor were promptly answered..
5. Useful ideas/skills have been learnt.
6. The content of the online materials is satisfactory.
7. The presentation of the online materials is satisfactory.

Further, an open question inviting general comments was included in both questionnaires and the comments are generalized in Table 3.

Table 3: A comparison of general comments on web-based learning between in-service and pre-service learners.

Nature of Comments	XSS227		NAG191	
	Comments	Count	Comments	Count
Positive	Ample resources on animations, graphics and web-links	1	Resources are vast	1
	Allows self-paced learning	3	Allows self-paced learning	3
	Allows independent learning	2		
	Allows for instant clarification of doubts	2	Allows students to ask question without feeling embarrassed	2
			Allows access from home	3
			Reduces transport cost from home.	1
			Allows access anywhere, anytime.	3
			No need to rush for photocopying lecture notes or assignments.	1
	Highly interactive	1		
			Should include all modules on Blackboard™	1
	Learnt teaching tools and method of using web-based delivery	5		
Negative	Can have more web links	1		
	Can have more interaction via email and discussion board	1		
	Can have more interactive quizzes for each section	1	Can have fewer assignments	1
			There should be no time limit to the quizzes.	1
			Computer server of the site is unstable. Often breaks down.	5
			I find difficulty to log on.	3

It appears that there are common responses from both groups on the following advantages of web-based learning:

1. Web-based learning is media rich and it affords potentially vast range of resources.
2. Web-based delivery of materials allows self-paced learning.
3. Web-based discussions enable students to clarify doubts instantly and encourage shy students to participate.

One in-service learner felt that more quizzes were needed while one pre-service learner felt that there should be fewer quizzes. Since these are individual feedback and need not necessarily reflect the entire group's feeling, no conclusion can be drawn. The other comments are mutually exclusive between the groups.

Due to the small sample size of the two groups, it is difficult to draw statistically significant conclusions. However, the feedback provided by the learners in the negative areas of web-based learning provides a good indication of the problems encountered and hence areas to improve on.

Problems

There are several key problems that were brought up during a debriefing sessions with the students as well as a discussion session among the authors. They are listed below:

1. Repeated failed logging-in.
2. Problems with saving the course content on the hard/floppy disk.
3. Malfunctions of Javascripts™
4. E-mail problems on Blackboard™
5. Attendance

The problems encountered were all technical problems which imply several things. Firstly, the problem of repeated failures in logging-in to the Blackboard™ System was primarily due to a problem with the NIE server configuration. In fact, the pre-service group was literally migrated to another server in the middle of their course. The problem is still being resolved. This points to the fact that web-based learning today is still limited somewhat by technical issues. Until these issues are resolved, web-based learning will not gain widespread popularity quick enough.

Secondly, the problem of saving course content on the hard/floppy disk reflects general incompetence with regard to computing skills among the in-service learners. Although a prerequisite of computer literacy was made known to all course participants and that all of them claim to have basic computer literacy, the problem may be corrected in future courses by specifying the specific skills required rather than a general requirement on "Basic Computer Literacy". Indeed 55.6% of the participants rate themselves as beginners in terms of computer skill level.

The problem with malfunctioning Javascripts™ was a software dependent problem. Some earlier versions of web browsers are incapable of supporting Javascript™. Although this potential problem was highlighted to the class, participants still faced the problem as the web browsers in their school/home have yet to be upgraded. Furthermore, the problem of incompetence in computer skills is further displayed when some students couldn't identify which version of the browser they were using. This problem was not present in the pre-service group.

The E-mail function resident on the Blackboard™ system poses another problem. Mails delivered through Blackboard take days to arrive at the receiver's mailbox. Students were encouraged to get around the problem by using their own email systems. This problem is similar to the server problem mentioned above.

Attendance may be monitored using Blackboard™ but policing it is hardly an equally achievable task. One of the features of using the WWW is that it allows self paced access and learning. Just how many log-ins are required and how long should each online session be? The criteria definition by itself is problematic to begin with. Furthermore, users can actually log-in, go for a cup of coffee and come back to the terminal later and that time lapsed will be counted by Blackboard™. Although Blackboard™ automatically logs-out the user after 20 minutes of inactivity, 20 minutes is still recorded. A shorter log-in time, however will be insufficient as reading information on each page may take some time. Further Blackboard only allows log-in counts and doesn't indicate how long each user had been using Blackboard!

Recommendations

Based on the problems encountered during the course a few recommendations have been made to improve future running of the same course. Firstly, a set of prerequisites pertaining to computer skills and access are to be specified at the beginning of the course. For example,

the hardware configurations of the user's computer, the type and versions of browsers and the required plug-ins such as Adobe Acrobat Reader™, FLASH™ or Shockwave™ have to be specified. Once these have been sorted out, potential problems like using older versions of browsers and inability to identify graphical buttons will be reduced. This is especially true for in-service teachers who come from a varied computer competence background.

Second, a very important consideration will be to include an orientation lesson (in addition to the intended number of contact hours) to familiarize participants to the web-based course. Although this has been done for this course, it is felt that the orientation lesson should be longer. This is crucial as the participants will troubleshoot potential problems and become more competent with using the interface.

The problem of attendance may be solved by formatting web pages shorter coupled by a reduced inactivity time to automatic log-off. This will ensure that users have to be constantly "clicking" in order to register their access on the page. An improvement to Blackboard™ would be to allow time-tracking instead of count-tracking. However, this still doesn't solve the problem of deciding how many sessions and how long each session should be. How many hours on-line are equal to one hour in the classroom? There may be no answer.

Conclusion

Both web-based delivery of course materials for the in-service and pre-service learners was reasonably successful as the mean scores indicate that the course participants agree that the objectives of the course have been met. Some in-service course participants have indicated that the course has been helpful to them. The use of interactivity and animation has enabled not just mere knowledge assimilation but the provision of examples with which the teachers can use in their own classrooms. In particular, the participants of both courses have found that the partial mounting of the course on the web has released a substantial amount of time for other work and thus enabled them to learn at their own free time and pace. Although the level of computer skills in participants can be improved, the inclusion of an orientation class to enable practice will surely improve the situation. Another improvement to the situation will be to improve the access to the page by working closely with the service providers to ensure smooth and interrupted learning experience.

"There are certainly some practices which we can look forward to eradicating with the advent of computers, [like] writing drafts in long hand ... but we must make sure that whatever works now should be sustained" (Cheah, 1997: 140). In the rush to be IT equipped and IT enhanced, we should not lose sight of the goals of education. If we may indulge in quoting Cheah (1997):

"... perhaps there is the more fundamental question of why changes are introduced. If they are introduced because they are the latest, and not because they bring about definite improvements in teaching and learning then perhaps we are being trendy rather than informed" (Cheah, 1997: 140)

Are we just being trendy or do we really benefit from using the web for education?

Acknowledgments

The authors would like to thank the Center for IT Education, NIE for the technical support provided during the provision of the 2 courses.

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Implementation of web-based instruction for in-service course XSS227

Stage 1: Web-based delivery Specification

1. Target audience is secondary school Geography teachers who have basic WWW navigation skills and who aspire to further their knowledge in selected aspects of Climatology and to enhance the teaching of these selected topics.
2. On-line course materials provide the content knowledge base which then acts as material for face-to-face class discussions and bulletin board discussions.
3. The on-line courseware is managed by Blackboard© residing on the Centre for IT in Education (CITE) server. Access to courseware is through the World Wide Web for registered users with valid usernames and passwords.

Stage 2: Scope of Web-based delivery

1. To enhance the content knowledge and to share and hence enhance teaching strategies of selected topics in Climatology.
2. Delivery of content knowledge is mostly presentational with visual aid (graphics and animations) and some degree of interactivity (navigational features).

Stage 3: Resource Summary (specification of all activities that consume resources)

1. The courseware was developed by the first author in areas of content, pedagogical and technical aspects of the courseware development. A technical support staff from the CITE was also responsible for part of the technical and the administration aspects of the courseware development.
2. Web-based material is developed mainly by hypertext markup language (html) scripting and uploaded to Blackboard web-base management system.
3. 100 work hours were planned for the initial development of the courseware to its final revision and its consequent uploading to the server. The actual time taken was, however, 130 work hours. This does not take into account the subsequent maintenance of course material, review of student responses to questions and facilitating of bulletin board discussion.

Stage 4: Content Development

1. Web-based delivery content can be outlined under the following sections:
 - a. Atmospheric Composition and Energy Balance
 - b. Atmospheric Moisture
 - c. Atmospheric Motion
 - d. Climate Classification
 - e. Humans and their impact on Climate.
2. Web-based content is designed with the intention to provide sufficient content material to further the knowledge of the reader and more importantly to prepare the reader sufficiently for discussion of issues (content and pedagogical) in face-to-face and online environments.
3. Materials are presented in a non-linear format in which users can access different sections of the web-based material through the use of an active content navigation bar (by the use of frames).

Stage 5: Prototype

1. A prototype was created using one of the major sections of the web-based material and sampled by a neutral colleague who is not in the team.

Stage 6: Web-based Integration

1. Sections of the web-based material were integrated using the active hyperlink toolbar.

Stage 7: User database Preparation

1. Users were created (usernames and passwords) on the system by the technical support staff.
2. Basic information like identification numbers were entered.

Stage 8: Full-scale implementation

1. Implementation of final product on 4 March 2000.

Stage 9: Maintenance

1. Review questions are set at the end of each section for evaluation. Submissions are reviewed and feedback is given to each student.
2. Update and revise selected sections. Refinement of material is continuous and ongoing.
3. Discussion topics were hosted on the bulletin board.

Implementation of web-based instruction for pre-service course NAG191

Stage 1: Web-based delivery Specification

1. Target audience is Diploma of Education (General) students who are taking this module as a general elective. These students have basic WWW navigation skills and are taking the module by choice, to gain a deeper appreciation for Geography.
2. Web-based management system provide additional content materials, the platform for discussions through a bulletin board and asynchronous communication with other course participants via email..
3. The on-line courseware is managed by Blackboard© residing on the Centre for IT in Education (CITE) server. Access to courseware is through the World Wide Web for registered users with valid usernames and passwords.

Stage 2: Scope of Web-based delivery

3. To enhance the appreciation for Geography as a content subject and to gain a Geographical perspective in knowledge exploration.
4. Delivery of supplementary content materials is mostly presentational with visual aid (graphics and animations) and some degree of interactivity (navigational features).

Stage 3: Resource Summary (specification of all activities that consume resources)

4. The Web-based content materials were developed by the first author in the content, pedagogical and technical aspects of the materials development. A technical support staff from the CITE was also responsible for part of the technical and the administration aspects of the courseware development.
5. Web-based material is developed mainly by hypertext markup language (html) scripting and uploaded to Blackboard web-base management system.
6. 50 work hours were planned for the initial development of the materials to its final revision and its consequent uploading to the server. The actual time taken was, however, 70 work hours. This does not take into account the subsequent maintenance of course material, review of student responses to questions and facilitating of bulletin board discussion.

Stage 4: Content Development

4. Web-based content can be outlined under the following sections:
 - a. What is Geography?
 - b. Tools of the Geographer.
 - i. Maps
 - ii. IT and Geography.
 - c. Our Physical Environment
 - i. Geography beyond Earth.
 - ii. The Violent Earth.
 - d. Our Cultural Environment
 - i. Modern inhabitants of Earth- Humans.
 - ii. Spatial Diffusion.
 - iii. Place and Placelessness.
 - e. The future of our Environment.
5. Web-based content is designed with the intention to complement content material taught in class to prepare the reader sufficiently for discussion of issues in face-to-face and on-line environments.
6. Materials are presented in a non-linear format in which users can access different sections of the course material through the use of an active content navigation bar (by the use of frames).

Stage 5: User database Preparation

3. Users were created (usernames and passwords) on the system by the technical support staff.
4. Basic information like identification numbers were entered.

Stage 8: Full-scale implementation

2. Implementation of final product on 15 July 2000.

Stage 9: Maintenance

4. Review questions are set at the end of each section for evaluation. Submissions are reviewed and feedback is given to each student.
5. Update and revise selected sections. Refinement of material is continuous and ongoing.
6. Discussion topics were hosted on the bulletin board.