Flexibility and Interactivity
In the Context of Web-based Curriculum:
Managing Change

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By

WONG Wai Man Joseph
BSc(HK), MSc(HK)
School of Education
University of Leicester

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Abstract

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change

Wong Wai Man, Joseph

The research for this thesis involves a case study about the development of a Web-based Curriculum (WBC) in the Institute of Vocational Education of Hong Kong (IVE), based on a WBC Change Model which provides a research framework emphasizing the importance of managing change in relation to the flexibility and interactivity in the context of the WBC. Previous research studies on Web-based education about its effectiveness on learning outcomes are found to be highly controversial. There is an assertion that the failure to fully use technology in education may be due to academic and technical divide. With regard to this, the study gives a balanced consideration to both educational and technological issues. It shows how the flexibility provided by the addition of WBC contributes to student learning and serves the new needs in the IVE. It also explains how strict control can stifle the growth of the WBC.

It is found that human interactions and interactive elements of the WBC are likely to improve student performance as compared with non-human and static elements respectively. The study explores the highly complicated effects of different types of virtual interaction on student learning. The overall effect can be zero or destructive if one or more components dominate the others. If this is the case, the theory of 'no-significant difference' prevails but eventually fails to reflect the true picture. The thesis provides further evidence to support the theory of additional learning benefits for different types of interaction on the Web. This research uniquely addresses the distinct characteristics of language barriers for the native Chinese students in Hong Kong especially when the Internet is primarily designed for native English users.

Finally, the study explains why and how the failure of the WBC in IVE is related to the curriculum and academic structure. It depicts the conditions to support the development of a unified WBC and illustrates why the educational institutions are slow to respond to technological change. It also identifies those critical success factors related to technology and explains why a mixed strategy on information technology (IT) is suitable for effective implementation of the WBC.

The results of this study have significant and far-reaching effects on the formulation of academic policy, organization structure and IT strategy especially for higher and tertiary institutions in Hong Kong.
Acknowledgement

First of all, I would like to express my gratitude to my dissertation committee, including Professor Vic Lally and Dr. Tony Lawson, for their time and expertise advice to endorse my thesis. In particular I would like to thank my thesis supervisor, Dr. Marianne Coleman, for her encouraging comments and the many hours she spent listening and talking to me, reading the same words over and over, and guiding my focus and my work over the past five years.

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To my best, I wish to thank my wife and my two daughters beloved for their constant support, encouragement and patience.

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Chapter One

Introduction

Aims of the Study

Since the Hong Kong Special Administrative Region (HKSAR) Chief Executive delivered his Policy Address (1997), a huge amount of funds has been injected by the HKSAR government to promote the use of Information Technology (IT) in education. In 1999, the Hong Kong Institute of Vocational Education (IVE) committed the use of Web-based technology to deliver over 75 per cent of its curriculum in five years time. It is envisaged that the new pedagogy will offer more flexibility and different types of interactivity for both IVE teachers and students. In order to recommend appropriate strategies for successful implementation of the Web-based Curriculum (WBC) in IVE, this research aims to study and evaluate the effects on teaching and learning and how IVE teachers and students manage to cope with the changes shifting towards the new paradigm. The focus of the study is to identify factors and strategies to manage the change process relating to flexibility and virtual interactivity that enhance the effectiveness of teaching and learning with the introduction of the WBC in IVE.

Background

The rapid evolution of information technology (IT) has made a revolutionary impact on the current education system. Applying IT in education is not only the responsibility of the universities. In many developed Western countries, IT infrastructure has been significantly improved in high schools and colleges in order to
facilitate widespread use of IT in secondary and higher education. In the Hong Kong SAR, it is the policy of the Government to promote the use of IT in the whole education system (Policy Address 1997). Subsequent to that, various government initiatives had already been started by late 1998 to promote the use of the Internet in both the commercial sector (http://www.info.gov.hk.itbb) and the educational sector (http://www.info.gov.hk.emb). Most tertiary institutions, viewed as leaders in applying technology in education, have been launching a series of small-scale projects applying World Wide Web (Web-based) technology in their degree programs (Kwong 1999, James 1999). Although Web-based (or Online) teaching and learning are quite new to the educational sector in Hong Kong, tertiary institutions have also launched a series of collaborative projects using Web-based technology in formal education:

For example, the University of Hong Kong has recently set up the first authorized Java Campus in the world which offers training in Java technology to the university's students as well as business executives and IT practitioners. The Chinese University of Hong Kong, together with other tertiary institutions, has embarked on the Hong Kong Cyber Campus project which will link up all universities, secondary and primary schools as well as kindergartens in Hong Kong. The project will allow teachers, students and the community to interact online and to obtain and share educational resources. (Kwong 1999)

MingPao (2000, May 5, A14) reported that an interactive Master degree program in Business Administration offered by City University of Hong Kong was elected as Number One in Asia by the Asia Magazine. In September 2000, the Hong Kong Polytechnic University also launched a "HK CyberU" project offering three programs at Master's degree level (Apple Daily 2000, June 9, A18). Although the outcome of
the above projects will take a few years to fully evaluate, the growing use of Web-based technology in education in Hong Kong is envisaged.

In 1999, the Education Commission of Hong Kong, a government appointed advisory committee on educational policy, adopted the following principles in formulating its proposals for the overall Educational Reform in Hong Kong for the next millenium:

i) Student-focused

Learning should be focused upon students' personal development. Our reform should aim to give more room and flexibility for students to be masters of their own learning.

ii) "No-loser"

There should not be, at any stage of education, dead-end screening that blocks further learning opportunities. Everyone should be given the opportunity to learn anywhere, any time, and to be given due recognition for what they achieve.

(EC 1999, p.16)

Heading into the 21st century, rapid developments in communication and IT are bringing parts of the world ever closer together. Hong Kong faces strong competition from neighboring economies in many areas, including trade, finance, transportation, communication and tourism. In response to future economic development, the Education Commission (EC 1999, p.9) made the following statement in its education blueprint for the 21st century:

The Asian financial turmoil has prompted us to reflect upon the problems we face, our future and how we should meet the challenges ahead.

In the knowledge-based economy, existing knowledge is being updated at an ever faster pace. Our young people must be outward-looking, imbued with a spirit of exploration,
able to make the best use of IT, able to master different kinds of knowledge, and willing
to strive to improve through continuous learning.

The EC (1999, p.20) raises a very important question for tertiary education in Hong Kong emphasizing the use of new learning strategies:

Does our present tertiary education endeavor to develop the curriculum and explore
new learning modes for the information era?

Within this context specifically, the Institute of Vocational Education (IVE) stresses the need for more flexible courses with enhanced IT support. In its prospectus for full time courses, IVE promises to offer its students (IVE 2000, p.5):

i) A more flexible course provision;

ii) A wide range of high quality courses;

iii) An opportunity to utilize learning resources across different campuses;

iv) An excellent environment with enhanced information technology support;

Nevertheless, with the introduction of the WBC and enhanced IT support, it is worthwhile to study whether the IVE can offer more flexibility to its students by exploring new teaching and learning strategies.

This study will focus on vocational education in Hong Kong. The Vocational Training Council (VTC), established by the Governor under the Vocational Training Council Ordinance in 1982, is the sole provider of vocational education and training to adults and teenagers of Hong Kong. In late 1995, the government appointed a consultant firm to perform a critical review of the VTC in response to the increasing demand in the community for providing quality vocational education effectively.
After a series of surveys and consultation, the consultant firm finally concluded its findings and submitted a report (Consultant Report 1996) to the government in late 1996. In response to this report, Mr. Joseph Wong Wing-ping, the Secretary for Education and Manpower, emphasized in his Education Policy Address (1997) that the VTC had to reform with the aim of making it more responsive to the changing needs of the economy and the increasing demands of the service sector. Consequently, the VTC underwent its first major review in its 15 years history. The VTC started to play a more active role in fostering high quality vocational education for hi-tech industries. Subsequently its management structure and curriculum for vocational education have undergone critical review. Starting from 1999, the VTC offers a wide range of new courses at craft level (Post-Form 3) and technician level (Post-Form 5 Diploma and Higher Diploma) in the newly established "Institute of Vocational Education" (IVE, which is composed of nine campuses). The aim is to provide adequate training of the workforce at supervisory level to meet the changing needs of industry in Hong Kong (http://www.vtc.edu.hk/ive.htm).

According to the Policy Address (1997), the Hong Kong government has launched a five-year IT education strategy to promote the use of IT to enhance teaching and learning in all educational institutions including primary and secondary schools and tertiary institutions like the VTC. The main tasks are to equip teachers with the necessary IT skills, to apply computer assisted teaching and learning across the curriculum; and to place students in an environment where they can use this technology as part of their daily activities and grow up to use it creatively. It is expected that 25 per cent of all curricula in the secondary school education will be taught using IT by the year 2002 (Education and Manpower Bureau 1998). In

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
particular the targets for the IVE, being a member of the higher education, will be even more demanding. In response to this, the government has approved HK$176 millions for the VTC to increase its IT infrastructure and equipment to enhance the effectiveness of teaching and learning using IT in five years’ time starting from September 1999. Since then the IT infrastructure and computer facilities in all the nine campuses of IVE have been upgraded substantially. IVE also promises its students that:

Courses are delivered through a variety of teaching methods where computing technology including Web-based learning is also employed. (IVE 2000, p.7)

The two documents, EC (1999) and IVE (2000), clearly specify the need to provide flexibility to students in the academic and vocational arena respectively. However, the documents do not clearly spell out whether the strategies of flexible learning are to be adopted. From the literature, it appears that the perceptions of flexible learning are quite complex. According to Wade (1994, p.12), a broad description of flexible learning is that:

It is an approach to university education which provides students with the opportunity to take greater responsibility for their learning and to be engaged in learning activities and opportunities that meet their own individual needs.

Whether this flexible learning approach applies to IVE students will be explored in this study.

To commit to the use of Web-based technology in teaching and learning, the IVE senior management has endorsed WebCT (Web Course Tools) as the software platform for supporting the development, management and delivery of IVE courses on
the Web. There is an attempt to provide a Web-based Learning Environment to all IVE students. Clearly, there is a mandate from senior management that 75 per cent of the IVE curricula must be put on the Web in five years’ time (Table 1.1, Memo from DED(A), December 1999). However, senior management has not formulated clear guidelines and details for implementation. Indeed there are always criticisms that the mandates to develop online learning initiatives are to be based on a technological imperative, a pressing need to use the Internet and Intranet technology for the sake of technology (Driscoll 1998, p.224). It seems that more details about what it means in practice should be given, otherwise teachers may have difficulties to meet the target and will have different interpretations.

Table 1.1 Implementation of Web-based Management and Delivery of IVE Courses

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<th>Year</th>
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<td>2000</td>
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<td>2001</td>
<td>50</td>
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<td>2002</td>
<td>65</td>
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<td>2003</td>
<td>70</td>
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<tr>
<td>2004</td>
<td>75</td>
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Starting from the academic year 1999/2000, a more streamlined curriculum featured by a common Year One curriculum for different courses within the same subject group has been implemented in the IVE. The common curriculum strategy affects all year one modules of all full time Higher Diploma/Diploma (HD/D) courses within the same subject groups across its nine campuses. Students have to compete for Higher Diploma places based on their academic result in year one. Apparently as a
result, common first year IVE students are anxious about the fairness and uniformity of the assessment schemes and learning resources. This sentiment has been reflected from various meetings with students over the past year. It would therefore seem to be important to study how the change in the new IVE curriculum affects the development of the Web-based courses.

Since September 1998, the former two technical colleges and seven technical institutes have been unified into one Institute of Vocational Education (IVE) consisting of three nexuses (each composed of three campuses) adopting a matrix management structure, a vertical line management structure within a campus and a horizontal structure across different departments (within same discipline) from different campuses. A related research question that arises is: How does the new organizational structure affect the implementation of the WBC in the IVE?

**Defining the Web-based Curriculum**

Table 1.1 states the percentage of the IVE curriculum to be put on the Web. In order to conduct the study, it is necessary to define the meaning of a curriculum. According to Lofthouse et al (1995), the definition of curriculum is rather complicated. They precisely highlight four definitions for curriculum (p.8):

1. The school is the curriculum.
2. The whole body of knowledge, ideas, skills, attitudes and experiences conveyed by a school to its pupils, deliberately or otherwise, explicitly and implicitly.
3. The activities which the organization undertakes to achieve its goals.
4. The contrived activity and experience - organized and focused, systematic - that life, unaided, would not provide. It is properly artificial; selecting, organizing, elaborating and speeding up the processes of real life.

Since September 1999, the IVE Academic Policy Committee has adopted a curriculum framework (VTC Intranet) for all newly validated IVE courses (Validated Course Scheme, VCS) across its nine disciplines. The IVE curriculum mainly consists of two parts: the course management file and module delivery file. In the context of this study, the curriculum refers to the IVE curriculum which has already been explicitly defined in the VCS. It is found that IVE curriculum includes the elements/activities described in definition 2 and 3 above.

From the literature, Web-based courses can be considered as a method to deliver the courses using the Internet or the World Wide Web:

Web-based training is instruction that is delivered over the Internet or over a company's Intranet (Hall 1997, p.15)

Web-based training using Web as a delivery method requires the trainer to consider three key factors: what is taught, who is taught, and where the teaching takes place. (Driscoll 1998, p.224)

Web is used as a low-cost delivery system for Web-teaching (Brooks 1997; p.28)

A Web-based classroom is an environment created on the Web in which students and educators can perform learning-related tasks. (McCormack et al 1998, p.1)

Computers do not, in and of themselves, provide new content in the subject areas or disciplines taught in the schools. They do, however, provide a significantly different
means of delivering content. When the technology and curriculum are considered, Provenzo et al (1998, p.102-103) mention that this happens in two ways:

First, with the explosive growth of new computer-based technologies such as CD-ROMs and the Internet, computers can bring much more information into the classroom; and second, innovative computer software is reshaping the presentation of information that influences the ways of knowing in the disciplines.

In her book on Web-based training (WBT), Driscoll (1998, p.224) states that "curriculum is defined as the aggregate of courses of study in a given discipline". Relating the above to the definition made by Lofthouse et al (1995), the Web-based Curriculum in the context of this study is defined as:

The Web-based Curriculum (WBC) is a curriculum delivered on the Web. It refers to the activities which the educational institution undertaken to convey to its students the whole body of knowledge, ideas, skills, attitudes and experiences.

The Emergence of the Web-based Curriculum: An International Perspective

Sandelands (1998, p.76) quotes Wills et al (1995) that there is a global context where the Internet is being heralded as the major future for education and where more individuals are seeking access to it every day. Kostopoulos (1998, p.258) advocates that Internet technology as an educator's resource outperforms even the sun:

The sun can only shine on half of the globe at one time, while Internet-delivered education can cover the entire globe, and around the clock, with knowledge.

Educators around the world are faced with a new reality of unprecedented parallel. This reality is the cyber-campus:
Introduction

Now, an educator's campus is no more the school buildings and the related physical infrastructure, but the entire world... What offers this global access, and at a relatively negligible cost, are the recent, and hopefully never-ending, advances in Internet technology. (ibid)

Referring to the ongoing Intranet project conducted in the University of Brighton Business School, Flowers et al (1998, p.345-346) conclude that it is safe to say that it appears to be an example of an innovation that has managed to cross the gulf and move into mainstream use:

A more likely scenario is that developments in Web-based learning and teaching will slowly become incorporated into mainstream educational practice and will not only slowly redefine the role and responsibilities of students and academics but also gradually widen participation through new forms of enhanced distance learning.

Brooks (1997, p.2) claims that the World Wide Web (WWW) is changing both what we teach and how we teach it. He asserts that as tools emerge, and tasks change, curriculum reform follows (ibid, p.5). He argues that the WWW (Internet or Intranet) is going to be used for instruction regardless of what teachers think, feel, or do; it will be used even in the absence of demonstrable research support (ibid, p.29). However, this might be considered as a rather risky argument for the IVE taking into account the necessity for a huge investment in IT infrastructure under stringent budgetary control especially after the Financial Turmoil in 1997. McCormack and Jones (1998, p.17-28) describe the various advantages of the web-based classroom which bring increased variety and flexibility to students. They also observe that there is increased student communication and participation. In addition, the Web-based
classroom has an advantage of relatively low cost:

For many traditional, on-campus students, access to the Web is available at no charge via on-campus computer networks. (ibid, p.22)

In response to the global trend in education, the VTC, in its Annual Report (1999/2000, p.14), announced its resolution to spearhead the use of IT in vocational education and that a major initiative of IVE is to raise the overall standards of teaching and learning through the increased use of multimedia and information technology. The integration of the former Audio Visual Center and the Teaching and Learning Center in 1999 considerably strengthened the Council's staff training capability in the area of multimedia teaching and learning:

Special emphasis is being placed on the development of IT skills for the IVE academic staff as well as on their ability to manage and deliver courses on the Web. Staff are being trained and encouraged to deliver courses interactively using the latest information technology. (ibid)

Significance of the Study

A preliminary study of literature shows that the Web-based Curriculum (WBC), advocating the sharing of resources and a border-less campus, could be an ideal approach for the new IVE curricula across its nine campuses. As the new IVE part time evening courses share the same curricula with the full time courses, the WBC allows both full time and part time students to access the same type of materials. However, with the huge investment in IT resources for WBC, it is essential to justify Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
whether it can really enhance the effectiveness of teaching and learning. It is also worthwhile to study its effect and impacts on teaching and learning. Whether the innovative approaches of WBC can be adopted by the IVE to face the challenge of future education reform and achieve the goals of IVE needs to be explored. In the executive summary of his book, Bates (2000, p.5) advocates that:

*Given the emerging context of technology-based teaching, especially for traditional campus-based universities and colleges, research and evaluation will be essential.*

It is anticipated that online learning will be used to augment traditional classroom pedagogic practices and to provide extensibility to the use of educational institution-based Web sites. However, the problem areas associated with online learning indicate that much is unknown about online instruction as a delivery paradigm (Dringus and Terrell 1999, p.57).

With the emergence of the WBC in an international context, the transformation to the new flexible paradigm in mainstream educational practice for higher education institutions in the future is envisaged (Sandelands 1998, Kostopoulos 1998, Flowers et al 1998, Brooks 1997). In Hong Kong, the study of online learning tends to be either superficial or minimal as most of the online learning projects were launched in 1998 (Kwong 1999, James 1999). Their research and evaluation results are yet to be completed. As this is the first research study concerning WBC within the context of the IVE, the research results could be extremely useful for administrators, curriculum developers, teachers and others to formulate strategies to deliver quality courses on the Web in vocational and higher education.
The Scope of Study

The WBC integrates the curriculum with an Online Learning Environment (OLE). The dynamic delivery structure of the OLE promotes an effective learning environment beyond the mere presence of an online course presentation. Dringus and Terrell (1999) define the OLE for the online instructional delivery system in higher education institutions:

A distinct, pedagogically meaningful and comprehensive online learning environment by which learners and faculty can participate in the learning and instructional processes at anytime and any place. OLEs manifest a variety of technical tools that support instructional delivery and communication in online formats. In addition, dynamic delivery structures are embedded to enhance the instructional, learning and communication processes taking place. (ibid, p.58)

The OLE framework gives balanced consideration to flexible delivery, interaction, resources, organizational culture, education and technology (Dringus and Terrell 1999). This framework defines the scope of the learning environment for online courses.

Bates (2000) also identifies flexibility and interactivity in his ACTIONS model as important factors concerning research and evaluation for managing technological change in education. The NCET report (NCET, 1994) explicitly supports the views that flexibility, accessibility and interactive technology provided by information and communication technology (ICT) help to improve student learning.

Within the context of vocational education, the educational objectives of the WBC...
must match the goals committed to by the IVE (2000, p.5):

i) A more flexible course provision;

ii) A wide range of high quality courses;

iii) An opportunity to utilize learning resources across different campuses;

iv) An excellent environment with enhanced information technology support;

In particular, it is essential to provide flexible courses across different campuses with enhanced IT support. It is envisaged that the dynamic delivery structure of the WBC will indefinitely provide flexibility for IVE students to access the course and communicate with teachers irrespective of time and place.

It is also perceived that virtual interaction is the most important strategy for online or Web-based courses to enhance students' learning (Alden 1998, Brooks 1997, Driscoll 1998, Hall 1997, Trentin 1999, Kearsley 2000, Hanna et al 2000), despite the critical debates on its virtue and problems on objective measurement of different forms and levels of student-machine interaction (Harbeck and Sherman 1999, Bates 2000). It is vitally important to study how students participate in the new forms and levels of virtual interactivity.

Subsequent to the recent review of the VTC (Consultant Report 1996), its management structure and curriculum have undergone critical structural change. How do they affect the future development and implementation of the WBC in IVE?

To make the implementation of the WBC a success, there should be a balanced consideration between educational and technological issues. Eventually, a simplified Change Model (Figure 1.1) for the WBC was derived by integrating the ACTIONS
Model and the OLE Framework. In the context of the changes that are taking place in the IVE, the intention is to study the following overarching questions:

*How does the flexibility and interactivity provided by the WBC affect teaching and learning? How can teachers and students manage the change from a traditional curriculum to the WBC, focusing on curriculum, organization and technology issues?*

**Figure 1.1 A Simplified WBC Change Model**

Flexibility

There are diverse perceptions of flexibility as well as flexible learning. Bates (2000) describes how the flexibility of technology is affecting "traditional" students:

*New technologies such as the World Wide Web and multimedia have the potential to widen access to new learners, increase flexibility for "traditional" students, and improve the quality of teaching by achieving higher levels of learning, such as analysis, synthesis,
Introduction

problem solving, and decision making. (ibid, p.1)

Education in the 21st Century will be student-centered with more flexibility and control for students to master their own learning (Downs 1998, Driscoll 1998, Kay et al 1998, McCormack et al 1997, Windschitl 1998). Meanwhile education reform in Hong Kong advocates student-focused learning with flexibility (EC 1999, p.16). Flexibility in effect refers to more control for students. There are different understandings and meanings of the term 'flexibility' defined in the literature. It is useful to clarify what is meant by flexibility in the context of the changes that are taking place. The major research question that arises in this area is:

How does the flexibility offered by the WBC affect teaching and learning?

Interactivity

Virtual interaction beyond space and time offered by the WBC definitely provides a certain flexibility for students. Trentin (1999, p.19) highlights the importance of interaction:

When planning the logical communication structure, priority should be given to defining/forecasting interaction flows between the people involved in the process and in what way the interaction will occur.

Dringus and Terrell (1999, p.63) explain why there is a need to study the effectiveness of interaction for online teaching and learning:
Interaction is an element that is not well understood within the confines of online environments because there is a limited understanding of essential dimensions of interaction and how the dimensions come into play in online settings.


According to Driscoll (1998, p.101) and Alden (1998, p.33-34), there are various types of interaction for Web-based courses:

i) Learners interacting with materials

ii) Learners interacting with learners

iii) Learners interacting with instructor

The major research question that arises is:

*How do the various forms of interactivity affect teaching and learning?*

**Managing Change**

1997, Bates 2000, Nunan 2000) are exemplified in managing the curriculum, highlighting the importance of managing change in the context of WBC. Based on the WBC Change Model, the central theme of managing change is confined to three main issues:

i) Managing Curriculum Change

ii) Managing Organizational Change

iii) Managing Technological Change

The major research question that arises is:

*In transforming to the new flexible paradigm of the WBC, how do IVE teachers and students manage to cope with the change?*

**The Research Questions**

After conducting an exhaustive literature review, research findings show that the WBC is considered an ideal route to provide flexibility to address the individual needs of students especially in distance learning (Flowers et al 1998, p.345-346; Alden 1998, p.1-4; McCormack et al 1997, p.18-22; Hulme, 1999, p.13; Driscoll, 1998, p.100).

The future educational reform proposed in Hong Kong (EC 1999, IVE 2000) promises to provide flexibility to enhance student learning. IVE (2000) has committed to the use of Web-based technology in the future IVE curriculum. Interaction is an important strategy for using WBC to enhance students’ learning. However, the virtues and level of interactivity incorporated into WBC is highly controversial. In order for IVE to transform to the new flexible paradigm, it is important and
worthwhile to conduct research for IVE focusing on the research topic:

Flexibility and Interactivity in the Context of Web-Based Curriculum: Managing Change

The purpose of this study is to answer the research questions identified above and restated below after a critical literature review. The literature introduces the emergence of the WBC from an international perspective. It emerges from the literature how the WBC Change Model is derived (Figure 1.2). Based on this model,
the three major issues: flexibility, interactivity and managing change in the context of the WBC are examined. Clusters of research questions are derived around these three issues. It is expected that the answers to these questions could help IVE teachers and others in developing strategies to create and implement curriculum change in the future. The main research questions, though interrelated, are categorized into three main issues.

1. **How does the flexibility offered by the WBC affect teaching and learning?**

   **Flexibility and Accessibility**

   How do teachers and students perceive the teaching and learning flexibility provided by the WBC? What impacts will this application of technology have on student access (e.g. home access) and flexibility to learn? What impacts will this application of technology have on teacher access and flexibility to deliver the WBC? Will the WBC enable new needs to be served, or will it disadvantage students that we currently serve?

   **Flexibility, Control and Standardization**

   What is the relationship between flexibility, control and standardization for the WBC? How do they affect the development of the WBC?

   **Flexibility and Active Learning**

   Does the WBC enable IVE students to become more independent? In the context of WBC, do the active students perform better?
2. **How do the various forms of interaction affect teaching and learning?**

**Different Types of Interactivity**

How do students communicate on the Web? How do they behave in different WBC courses? Does the WBC enhance the academic achievement of students, if so, how? How do different types of virtual interaction affect student performance?

**Additional Learning Benefits**

Does the research support the claim of additional learning benefits from different types of interactivity provided by the WBC?

**The Language Barrier**

How does the linguistic factor affect teaching and learning in the WBC? Do students prefer to use Chinese as their communication medium on the Web? Does the English standard of students serve as a major barrier to the development of the WBC?

3. **In transforming to the new flexible paradigm of WBC, how do IVE teachers and students manage to cope with the change?**

**Managing Curriculum Change**

What major changes are incurred from the new IVE curriculum? Does the new IVE curriculum support the development of the WBC, or vice versa? How does the curriculum change affect the development and
Implementation of the WBC in IVE? What are the major barriers to curriculum change?

**Pace of Change and Workload**

What are the perceptions of teachers and students on the pace of change? Does the WBC save any learning or teaching time? How does the implementation of the WBC affect the workload of teachers and students?

**Managing Organizational Change**

The recent reform of VTC consequently drove the IVE to adopt a form of matrix management system, does it encourage active participation of students and teachers in the WBC? How does the new management structure affect the development of WBC in IVE? Can it foster changes or provide enough support to teaching and learning using the WBC?

**Managing Technological Change**

What are the critical factors perceived by teachers and students for managing technological change? What kind of Web-based development platform should be supported? To effectively implement the WBC in IVE, what strategy (centralization or decentralization) should be adopted?

The above research questions have emerged from a comprehensive literature review. The next chapter explains why and how they were derived.
Chapter Two

Literature Review

The literature is a valuable guide that provides helpful ideas and suggestions to define the research questions and recognize their significance. Ignorance of prior studies may lead to spending time needlessly on a problem already investigated. Technological changes and curricular developments are constantly bringing forth new problems and new opportunities for research (Best et al 1998, p.32). Many research articles suggest problems for further investigation that may prove fruitful in these areas. It may be appropriate and worthy to replicate a study to verify its conclusions or to extend the validity of its findings to a different situation or population like the IVE. However, with so many gaps in educational theory and so many areas of educational practice in need of analysis concerning technology-based curricular developments, it is critical and essential to confine and define the relevant research questions which are particularly significant to the future development of the WBC in IVE. According to Johnson (1994, p.168-171), the critical review of literature is an essential contextual element to establish the focus and identify the specific objectives of the study.

From the literature, it is possible to develop a theoretical framework for analysis and interpretation of the research findings. The literature review also critically evaluates previous findings and studies, possible deficiencies or alternative explanations. It summarizes and analyzes previous research and shows how the present study is related to this research. The critical review of literature constitutes a guideline for research evaluation. This was emphasized by McMillan et al (1997, p.57-58) who
asked the question:

Does the review of literature establish a theoretical framework for the research problem?

There is an argument that WBC will slowly become the mainstream educational practice (Sandelands 1998, p.76; Flowers et al 1998, p.345-346; Brooks 1997, p.2; Kostopoulos 1998, p.258). However, there is no strong research evidence demonstrating successful implementation of WBC in formal or vocational education. On the other hand, research also shows how the implementation of IT in education fails (Hulme 1999, p.15; Selwyn 1999, p.226-227; Alden p.1998, preface). Meanwhile, little research has been conducted to address the issue concerning WBC in formal or vocational education in Hong Kong. Despite this, many tertiary institutions have already launched a series of projects to conduct research concerning on-line education (Kwong 1999). People in Hong Kong expect exponential growth in using the Internet, as reflected in the various government initiatives or projects for business and education in the Information Age (Kwong 1999). However, discouraging survey results show that the use of the Internet in education is very limited (Katz et al 1997, p.175; Jefferies et al 1998, p.361-364) even in the USA, a pioneer country in adopting the Internet in education. From the literature, it is highly likely that the failure of using technology in education may be due to an academic/technical divide (Betts et al 1998, p.120; McCormack et al 1997, p.25-26). To make the implementation of WBC a success, there should be a balanced consideration between educational and technological principles. This study also emphasizes the significance and uniqueness of managing both educational and technological change.

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Finally, the literature shows why it is crucial to examine the three issues: flexibility, interactivity and managing change in the context of the WBC. Eventually, a simplified change model for the WBC is derived (Figure 2.1).

Figure 2.1 The Simplified WBC Change Model

Clusters of research questions were derived around the three issues based on the simplified WBC Change Model. In order for the IVE to transform to the new flexible paradigm, it is important and worthwhile to conduct research for IVE focusing on the research topic:

Flexibility and Interactivity in the Context of Web-Based Curriculum: Managing Change
Most of the previous studies on the use of ICT compare the performance of different groups of students taking courses using different approaches in the context of distance education. In fact, many writers like Hanna et al (2000, p.xvi) regard Web-based or online education as in its infancy and still evolving. Bates (2000, p201) points out that:

[new technologies for teaching do need to be researched and evaluated, but the evaluation should not be restricted merely to replicating classroom learning outcomes.

In Hong Kong, there is little research which studies how the WBC can enhance the effectiveness of teaching and learning. Most Web-based projects in Hong Kong were launched in 1998 (Kwong 1999, James 1999) and their research and evaluation results are yet to be completed. Fortunately, James (1999) published a book containing five web-based projects in higher education institutes, which gives very useful references relevant to this study in the Hong Kong context. Greater coverage of the research relevant to this study will be discussed in the section on interactivity. Indeed, there is much room for further research and evaluation concerning the use of the WBC in the IVE.

The controversial research results on Web-based Education

Despite a vast literature, there is no consensus on terminology for Web-based education. Very often the term online education, virtual education, e-learning,

The low percentage use of the Internet in education may due to the fact that it is not primarily designed for educational sectors. Katz et al (1997, p.175) conducted a survey concerning the rankings of the most attractive aspect of using the Internet for current users and revealed that only seven percent out of 597 respondents use the Internet for educational purpose. According to Jefferies et al (1998, p.361-364) when a questionnaire survey was conducted with 45 final-year honours degree students about using the Internet as a teaching resource, only two percent of students perceived that the entire course should be delivered via the Internet. The majority of students (over 70 percent) felt that less than 20 percent of the course should be delivered via the Internet (ibid, p.363). The response rate of the small sample was 100 percent. Belcher et al (2000, p.40) further explain why the percentage use of Internet in education is low:

In particular, academics do not have the time, inclination or skills to surf the Internet for resources that could support their work. As Internet publishing and communication become more commonplace this could disadvantage some researchers as they will miss valuable information and communication resources. In the traditional information environment human intermediaries, such as publishers and librarians, filter and process
information so that users can search catalogues and indexes of organized knowledge as opposed to raw data and disparate information.

There are further reservations about the use of the Internet in education. Grey (1999, p.11) states that until recently there was limited use of the Internet in education even in the UK. He points out the weaknesses of using the Internet in education as: "spontaneous, no natural boundaries, ungovernable, untamable and unstoppable." (ibid, p.25). McCormack and Jones (1998, p.41) claim that many studies have shown that the medium in which learning takes place does not significantly affect the learning outcome. Heinich et al (1996, p.27) agree with Clark (1983) that when adjusted to account for differences in active learning components, research studies aimed at studying media often show no significant learning differences. Bates (2000, p.199) further adds that:

[t]here has been a remarkable consistency of results dating back from the early research with well-balanced comparative groups, objective learning measurements, and large enough samples is that there is no significant difference in student performance.

The research results from literature above reveal both successes and failures of using technology in education. Conflicts between educationalists and technologists can significantly affect the outcomes of applying technology in education. Betts et al (1998, p.120) spells out a problem:

...the IT systems are usually designed by technocrats rather than by those who fully understand curriculum development, and they find it hard to communicate effectively with academics who they might see as being only semi literate in IT terms and therefore unable to understand the real issues! Of course, the academics take the reverse view, that it is the technocrats who are curriculum illiterates.
Finch and Crunkilton (1999, p.219) state that the Internet in reality is another tool for the instructor to use in preparing and delivering curriculum content. Similar to traditional instructional tools such as overheads or workbooks, the instructor must determine if an Internet resource is a better tool to use than others in teaching specific curriculum content (ibid). Grey (1999, p.131) asserts that 'if interactive, student-centered learning using ICT brings about improvements, then the Internet should facilitate this'. The Internet is heralded as the major future for education even in the absence of demonstrable research support (Sandelands 1998, Kostopoulos 1998, Brooks 1997). However, critics are concerned about the effective use of the Internet in education:

A sceptic would say that these methods are still unproven and that the disadvantages of using ICT, notably the huge amounts of funding routed to pay for technology which could have been spent elsewhere in the education system, outweigh the advantages.

(Grey 1993, p.131)

The literature is rich with studies about "no difference" in educational approaches in the computer area, as a review of two Internet sites will quickly verify. The "no significant difference phenomena" (http://teleeducation.nb.ca/nosignificantdifference/, or, http://teleeducation.nb.ca/anygood/) where Thomas L. Russell presents an impressive array of references to studies (over 355 papers) concluding that the use of computer techniques makes no difference to the final result for in-class versus distance students. Morss (1999, p.399) quotes the findings of two researchers:

McAlpin (1998) found that delivery strategy was not a factor in the final academic performance of the students and Clarke (1999) found no significant differences in test scores among the students.
Conversely, the sceptics of "no significant difference" doubt whether the research based on quantitative data really present the truth and claim that qualitative researchers could provide better insights, as reflected by the other site, "A significant difference" (http://teleeducation.nb.ca/media/0594/billorr.shtml) where Bill Orr presents an extensive, but dated, bibliography of published material supporting the premise that distance education (computer based) techniques do make a difference in the final educational results for given classes. However, Morss (1999, p.399) raises a question:

Is the 'difference' being studied by so many others, the same 'indifference' being exhibited by the students in these surveys?

He further points out that this question must be the subject of future work for the study of student perspectives on Web-based learning (ibid).

Critics with regard to the use of WWW for instruction in the absence of research evidence are supported by research showing how innovations concerning IT in education failed. Hulme (1999, p.15) quotes Schulz (1992) describing how a small school benefited from intensive technology implementation funded by tax revenues from oil wealth and how misunderstanding of the project’s goals and intended outcomes resulted in a complete breakdown in community support.

Roschelle and Pea (1999, p.22-26) also quote the argument of Owston (1997) that utilizing a Web framework can make learning more accessible, promote improved learning and contain costs. However, they perceive that there are still major weaknesses which must be addressed by further innovation before the Internet becomes a key tool for learning communities. For example, the creation of shared beliefs and values are hard to reproduce in the Web environment (ibid).
Selwyn (1999, p.226-227) wonders whether educational superhighways will fail to deliver their promise to schools as so many previous technologies have done:

Two decades of educational computing policies have largely failed to make a substantial impact on the educational systems of the world.

Alden (1998, preface) mentions that the institution where she worked tried its hand at a completely online course in 1993 but failed. It took another three years to get up the nerve to try it again. From these experiences, she warns that technology alone is not enough:

Too often we all become enamoured with the technological capabilities of our bright and shiny devices and ignore fundamental learning theory. (ibid, p.ix)

The extraordinary capabilities of the World Wide Web permit us to apply learning theory in ways that are inconceivable in the classroom. However, she warns that:

If all we do is imitate a traditional classroom, then Web-based instruction will be a second-rate reproduction of the classroom experience. (ibid, p.x)

Alden (ibid, p.xi) further points out that technological capabilities will change rapidly, but instructional functionality will remain stable. This highlights the issue of how we can best manage the WBC to achieve educational purposes effectively in a dynamic environment fueled with rapidly ever changing technology.

**Flexibility and Interactivity**

The WBC integrates with an open learning environment (OLE). The OLE framework defined by Dringus and Terrell (1999) gives a balanced consideration to flexible delivery, interaction, organizational culture, education and technology.
Bates (2000, 1995) proposes an ACTIONS (Access and flexibility, Costs, Teaching and learning, Interactivity and user-friendliness, Organizational issues, Novelty, Speed) model that identifies seven critical factors when conducting research to evaluate the effectiveness of different teaching technologies. He identifies flexibility and interactivity as two of the most important factors concerning research and evaluation for managing technological change in education.

The National Council for Educational Technology (NCET) (now the British Educational Communications and Technology Agency [BECTA]), published a compendium of research findings entitled "IT works!". This report made as many as twenty-seven assertions with supportive references from research. Those concerned with accessibility, flexibility and interactivity are listed below (NCET, 1994):

Children who use a computer at home are more enthusiastic and confident when using one in school. [1]

IT has the flexibility to meet the individual needs and abilities of each student. [4]

Interactive technology motivates and stimulates learning. [14]

Giving teachers easy access to computers encourages and improves the use of IT in the curriculum. [25]

These assertions explicitly support the views that the flexibility and interactivity provided by ICT help to improve student learning. However, these assertions clearly need to be studied in the context of implementing WBC in IVE trying to reaffirm and consolidate a belief in the educational potential of the WBC to enhance students' learning. Two of the major research questions of this study are:

*How does the flexibility offered by the WBC affect teaching and learning?*

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
How do the various forms of virtual interaction affect teaching and learning?

Flexibility

Flexibility is a key issue in the context of WBC. Many writers explain how technology contributes to flexibility in course provision. Wild (1994) claims that IT can provide a medium for teaching and learning and contribute to flexibility in course provision:

...there is little doubt that as hardware and software develop, and the IT infrastructure extends, more flexible teaching and learning styles will also develop. (ibid, p.44)

McCormack et al (1997, p.18) assert that Web-based education emphasizes increased flexibility for part-time and mature students to study when and where they can. Hulme (1999, p.13) explains how the flexibility in learning is offered to all students by technology:

Technology is claimed to accommodate differing rates of learning and different styles of learning, particularly benefiting weaker students.

The demand for student-focused education for the next millenium in Hong Kong (EC 1999, p.16) is echoed by the IVE to commit the more flexible course provision with enhanced IT support (IVE 2000, p.5), emphasizing the needs of flexibility. Graham et al (2000, p.23) argue that with the advance of technology allowing inventive and creative pedagogies, the need of flexible learning and teaching is increasing. Lumby

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
(1995, p.14-17) asserts that 'the aim of placing the student at the center of curriculum development' and 'flexible learning' are two key issues in managing the content and delivery of the curriculum. She claims that this change in perspective demands greater flexibility (ibid, p.15). Young (1995, p.175) warns that a learner-centered approach cannot be just about access and choice; it must be about new pedagogy, new relationships between teachers and learners and the development of new learning strategies. Likewise, Preedy et al (1993, p.49) stress the importance of adopting the flexible approach for managing educational change. In response to managing change in higher education when employing technical systems in a learning environment, Ford et al (1996, p.36-38) stress the importance of providing flexibility to address four key student needs such as student choice, meaningful assessment, access to resources and information, and support. Academic staff need to be multi-skilled and be flexible to the changing tasks in which they involved (ibid, p.39). Hanna et al (2000, p.15) urge teachers to be prepared and flexible for teaching online groups of students, while Ryan et al (2000, p.12) quote the conclusion of a round table of high-level educators and administrators focusing on the impact of the Internet on education:

Students will demand flexible, targeted, accessible learning methods, potentially altering higher education's traditional role.

There are a range of perceptions on flexibility. Hodgkinson (1994, p.19-22) describes flexibility for diversity as provision for mature students, part-time students, disabled students and overseas students. He claims that much flexibility can be built into the timing of course modules using Summer School, weekend and twilight teaching. Costello (1994, p.26-34) asserts that flexibility in course structures can be
achieved through semesterization, modularization, flexible credit accumulation and timetabling. Lumby (1995, p.16) links up the above issues with flexible learning. Wade (1994, p.12) points out that flexible learning as a concept can have many different meanings to different individuals and it is often used synonymously with open learning and distance learning. Thomas (1995, p.4) argues that people come from an open learning background make no hard and fast distinction between open learning and flexible learning:

The term 'open learning' has connotations of being about learning packages, most commonly print-based, which an individual learner could study at or in his or her own pace, time and place.

Flexibility means giving students greater control and choice over what and how they learn at their own time, pace and place of their studies; helping them to take responsibility for their learning; and providing support appropriate to individual learner's needs. Referring to flexibility for learners on campus, Dunning (1997, p.20) comes to a conclusion that:

The key areas of flexibility lay in place and mode of delivery; students were keenly aware that more of the responsibility for learning had been shifted in their direction, and that they had more control over how, where and when they learned.

From the perspective of the teacher, flexible learning involves the intention to increase learner access to, and control over, particular teaching and learning environments (Nunan 2000, p.52). Hudson et al (1997, p.3) identify four elements of flexibility:
i) Access

ii) Control

iii) Responsibility

iv) Support

As the last element (i.e. support) is closely related to the management issue, it will be dealt with in the section on 'Managing Change'. McGhee (1997, p.160-164) describes flexible learning as a management issue: an institutional strategy for supporting flexible learning requires flexible management.

The above discussions reveal that the issues relating flexibility to teaching and learning are broad and wide-ranging. It is essential to identify and define the key areas that relate flexibility to the WBC, thereby shaping the focus of this research. The literature supports the view that it is critical to study the following three issues as far as online courses are concerned:

i) Accessibility

ii) Control and Standardization

iii) Active Learning.

Figure 2.2 shows a revised WBC Change Model highlighting the issues relating to flexibility.
Flexibility and Accessibility

In his report that studied student perspectives on Web-based learning using WebCT, Morss (1999, p.393) emphasized that the computer access issues need to be clearly spelled out beyond those general responses currently collected to identify the specifics and develop potential remedies. Kearsley (2000, p.136-137) claims that the most important issue in online education is accessibility. According to Bates (2000, p.201-202), flexibility and accessibility are interrelated and should be considered together as important factors for managing the new technology in education. Relevant research and evaluation questions for flexibility and accessibility concerning
new technologies for teaching and learning are suggested by Bates (ibid).

Kedney and Brownlow (1994, p.78) state that flexibility is linked to widening access and so increasing participation particularly among non-traditional students. Nunan (2000, p.57) claims that from the viewpoint of strategic planning for the new flexible paradigm, information technologists challenge the assumptions behind the institution-wide planning centered upon the resource issues:

How will an institution deal with questions of access to its taxpayer-funded electronic resources where students may not own the technologies necessary for access or be unwilling to pay for communications charges to use such technologies?

The literature shows that the impact of flexibility and accessibility on teachers and students should be explored. Hence the research questions arise:

*How do teachers and students perceive the teaching and learning flexibility provided by the WBC? What impacts will this application of technology have on student access (e.g. home access) and flexibility to learn? What impacts will this application of technology have on teacher access and flexibility to deliver the WBC? Will the WBC enable new needs to be served, or will it disadvantage students that we currently serve?*
**Flexibility, Control and Standardization**

Driscoll (1998, p.100) describes learners' control as student choices on the path, rate and depth of the content of the courses. Flexibility implies increased students' control. McCormack et al (1997, p.12) claim that a Web-based classroom is more suitable in a learner-centered role. They assert that:

- Increased student control also helps to cope with the increased variety in the backgrounds of students by allowing the students to choose the form of learning activity that is most appropriate for them. (McCormack et al 1997, p.22)

The Education Commission Report (EC 1999, p.16) states that “our reform should aim to give more room and flexibility for students to be masters of their own learning”. The IVE (2000, p.5) also promises to offer its students a more flexible course provision. This has already placed a high demand for a more flexible curriculum in term of student learning for Hong Kong in both the academic and vocational arena. The new IVE common year one curriculum for different courses within the same discipline requires a unified standard on the delivery of curriculum. Appropriate control is deemed necessary to ensure standardization across campuses. Betts et al (1998) describe the relationship between flexibility, control and standardization of curriculum:

- flexibility requires greater standardization, consistency of policy and regulation (ibid, p.27)
- the more flexible the curriculum the more rigid the management and control frameworks that surround the curriculum. There is a direct relationship between flexibility and control. The less flexible the curriculum, the less need for centralized
According to Betts et al, the more flexible the curriculum, the more control and standardization are required.

However, more control may limit and contradict the flexibility of the curriculum. According to Kanter (1983, quoted in Lofthouse et al 1995, p.65), there are two rules that stifle change and growth of the new curriculum:

- Control everything in minute detail
- Keep tight control on all information

Bruce (1995, p.52) also contends that it is part of the necessary and ongoing battle between the need to control and the need to permit creative freedom:

- Control sets up standards and regulators that permit monitoring, remedial action and effective financial management. Freedom encourages and releases creativity, generates feelings of ownership, and – at the same time – enriches the process and enlarges choice and variety. The balance between control and freedom in educational institutions is of crucial importance in the development of OL systems and materials.

Streibel (1998, p.292) criticizes that the technical structure imposed by computer courseware allows students only pseudo-control because they can only choose from a finite number of paths toward a predetermined goal. Hence, it is essential to strike a balance between flexibility to cater for individual needs, and proper control and standardization to foster the development of the WBC. The question that arises is:

*What is the relationship between flexibility, control and standardization for the WBC? How do they affect the development of the WBC?*
Flexibility and Active Learning

An important element of flexibility is responsibility (Hudson et al 1997). This assertion has gained further support from Wade (1994), Windschitl (1998), Driscoll (1998) and Lewis (1999) regarding the flexibility provided by Web-based courses. Wade (1994, p.12) points out that students are required to be more responsible to flexible learning:

A broad description of flexible learning is that it is an approach to university education which provides students with the opportunity to take greater responsibility for their learning and to be engaged in learning activities and opportunities that meet their own individual needs.

Windschitl (1998, p.28) criticizes the traditional against the new conceptions of learning using the Web:

Traditionally, students have worked as individuals to acquire discipline-bound knowledge from limited "authoritative" resources (teacher, text) for the purpose of performing well on objective assessments. In new conceptions of learning, students work collaboratively on multidisciplinary tasks using a variety of information resources, regulating their own learning for the purpose of developing flexible, unique understandings of subject matter.

Lewis (1999, p.144) states that students' lives will increasingly be characterized by the need to take many decisions over their learning, requiring the exercise of considerable initiative within an open environment. Driscoll (1998, p.84) claims that Web learners are responsible for selecting, sequencing, and completing material:

Some learners may want to skim instructional modules and skip exercises and are free to do so because they are responsible for their own learning.
Indeed, the flexible and open learning environment provided the WBC not only requires students to be responsible, but more active. Alden (1998, P.4) claims that in order to improve training quality using Web-based instruction, online students must be active:

...they can't just sit back and passively listen to the instructor. They can learn at their own pace and in their own style. They can interrupt the instruction whenever they wish, and reach out to the enormous wealth of information and educational resources available on the Web. They can produce products and participate in projects on the computer, individually or with others. They can share these products or projects with other students or the instructor at the push of a button and receive individualized feedback.

With the introduction of the new technology, Brooks (1997, p.12-16) advocates that teachers who demand active learning are likely to bring about substantially greater learning success than those who do not:

When the technology is put in the students' hands, and the instruction modified to include activities that illustrate the power of the software, learning gains often are substantial. (Cooley 1995, Park 1993 and Porzio 1994; In Brooks, 1997, p.16)

The summary of views from the above is that the more flexibility provided to students, the more there is a demand for students to be more active, independent and responsible. However, McCormack et al (1997, p.12) reminds us that students brought up on force-feeding education method may have difficulty in adapting to any new method of education. Students may find difficulty to adopt to the new conception of learning in an active and flexible manner. Hence, further research

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questions to explore are:

*Does the WBC enable IVE students to become more independent? In the context of WBC, do the active students perform better?*

**Interactivity**

Another key issue in the context of WBC is interactivity. There are perceived benefits of virtual interactivity. Trentin (1999, p.19) stresses the importance of interaction when planning the communication environment for online educational activity:

> [p]riority should be given to defining/forecasting interaction flows between the people involved in the process (exchange between coordinators, students, transfer of material, etc.) and in what way the interaction will occur.

>The skills for structuring the communication environment that support interaction and those for managing interactivity through the most suitable strategies are particularly important.

In the conclusion of his paper concerning the use of the Internet in education, Trentin (1999) emphasizes the importance of virtual interaction:

> Before directing students toward specific educational goals to utilizing the Internet, teachers must test first-hand the interaction opportunities the network offers. (ibid, p.22)

Dringus and Terell (1999) have already explained why there is a need to study the effectiveness of virtual interaction for online teaching and learning. Graham et al (2000, p.214) advocate that introducing elements of interactivity into the Web site can create an environment for a greater variety of learning strategies, which can be
adapted to suit different learning philosophies and goals. They further add that interactive activities can also provide a useful element of motivation, in the form of practical exercises, reinforcement, revision and reward. Kearsley (2000, p.3) added that interactivity was very important for contemporary online education:

What really impressed students and teachers was the capability to interact electronically and search through databases.

However, the virtues and the level of interactivity incorporated into the WBC are highly controversial (Alden 1998, Brian 1998, Dringus and Terell 1999, Hall 1997, Hanna et al 2000, Harbeck and Sherman 1999, Graham et al 2000, McCormack et al 1997). The disadvantages of introducing interactive elements revolve around issues of media distraction and bandwidth (Graham et al 2000, p.214). The sceptics argue that virtual interaction will have a negative impact on student learning and it is difficult to measure student learning against interactivity (Harbeck and Sherman 1999, Bates 2000). Harbeck and Sherman (1999, p.40) contend that 'virtual interactions could conceivably give children distorted conceptions of the relation between simulated and actual representations of phenomena'. Bates (2000, p.199) claims that there has been a remarkable consistency of results dating back from the early 1970s comparing technology-based learning with classroom lectures:

The most common finding from all the carefully conducted research with well-balanced comparative groups, objective learning measurements, and large enough samples is that there is no significant difference in student performance.

He (Bates 2000, p.200) criticizes the fact that the traditional classroom is nearly always used as the basis for comparison and that:

A problem with straight, quantitative, comparative research is that there are usually
greater differences in learning outcomes within a particular technology or medium of teaching than between them.

Despite the problem, he suggests that:

Research that focuses on the requirements for the effective use a particular technology will be helpful. Such research might focus on forms and levels of student-machine interaction...

(ibid)

In fact, this has triggered the need to explore the impacts and virtues of such virtual interaction on student performance.

Bates suggests the following as relevant research and evaluation questions for interactivity concerning new technologies for teaching:

What kind of student interaction does this technology enable? What forms and levels of interaction can be achieved in using this technology? Does it give reliable and comprehensive feedback to students? Can students ask open-ended questions and receive prompt responses? Does the technology encourage or facilitate discussion between students? What kind of thinking - comprehension, analysis, problem solving, decision making, or evaluation - does this technology encourage? Is the technology easy to use by learners and teachers? (Bates 2000, p.200-202)

In their book, Hanna et al (2000, p.9-13) emphasize the importance of different types of interactions for teaching online which can be classified as human interactions and non-human interactions. In the chapter on technologies of delivery and interaction on the Internet, Ryan et al (2000) emphasize the significance of interaction by asking: 'What is the nature of interaction that is enabled, or impeded, between users and the Internet?' There are two dimensions by which the technologies of the Web can be
defined and described. The two are closely bound together:

The first is concerned with the nature of the different media types; the second with the type and quality of interaction that may occur. (ibid, p.55)

Figure 2.3 shows a revised WBC Change Model highlighting the issues of interactivity.

**Figure 2.3 Interactivity for the WBC Change Model**

Different Types of Interactivity

Besides human interaction through electronic communication, interaction with materials also plays an important role for Web-based courses. According to Driscoll
(1998, p.101) and Alden (1998, p.33-34), there are three types of interaction for Web-based courses:

i) Learners interacting with materials

ii) Learners interacting with learners

iii) Learners interacting with instructor

Interactivity and student participation in the WBC are vitally important. Kearsley (2000, p.78) claims that:

The most important role of the instructor in online classes is to ensure a high degree of interactivity and participation, and that the most effective approach is to make participation a course requirement and a component of the grade.

The three types of interaction involve new activities for students. According to Fullan and Stiegelbauer (1998, p.183), any innovation that requires new activities on the part of students will succeed or fail according to whether students actually participate in these activities.

The literature further reveals the existence of both positive and negative outcomes associated with electronic communication in an international context. Brooks (1997, p.12) raises the concern that there are several areas where face validity comes into conflict with research results in ways that affect what teachers do. One of which is:

The quality of face-to-face discussions is higher than that of electronically conducted discussions. (ibid)

In addition to measuring learning outcomes, it is important to assess the other effects on learners of technology-based teaching:

One of the great challenges facing traditional campus-based institutions will be getting...
the balance right between face-to-face and technology-based teaching. (Bates, 2000, p.204)

There are positive views on virtual interactions over face-to-face (f2f) communications. Bikson and Eveland (1990, p.285) found that using computers to communicate helped reduce social barriers and broaden leadership roles:

- Electronically supported groups develop a richer communication structure with less hierarchical differentiation, broader participation, and more fluctuating and situational leadership structures.

McGrath (1990) also found that computer communication resulted in more equal (less hierarchical) distribution among participants than face-to-face (f2f) communication. Sproul and Kiesler (1993) conducted studies at Carnegie Mellon University and found that computer communication not only resulted in more participation than f2f, but also produced more proposals for action. Their findings were echoed by Carswell et al (2000) [see Case 1 below]. Harasim et al (1995, p.27) also argue that ‘online environments facilitate learning outcomes that are equal or superior to those generated in the face-to-face situation’. Alden (1998, p.44) claims that student can use synchronous chat for team projects or informal discussions on any topic they choose:

- There is a belief that people who are quiet in face-to-face discussions will “speak up” more readily in a text-based chat session, but there is little evidence to support this.

One of the successes for computer conferencing is to provide fruitful dialogue for students. Laurillard (1993, p.168) found that:

- An obvious pedagogical advantage over the normal face-to-face tutorial is that students can take time to ponder the various points made, and can make their contributions in their own time.
Not all research has been so clearly positive, however. Philson (1998, p.155) criticizes that the Sproul and Kiesler studies had predicted that computer-mediated communications (CMC) would improve group decision-making because it was largely based on plain text (thus presumably more purely intellectual) and was less affected by social skills. Although participation and action proposals increased from CMC, so did the amount of "flaming" (critical, personal attacks in rude language) and the length of time needed to make decisions (ibid). The critique also comes from Light et al (1999, p.175) concerning the participation in CMC [see Case 2 below]:

Participation was associated with a tendency towards a 'deep' as against a 'surface' approach to study, but it was not just a matter of the more able or advanced students participating; participants did not outperform non-participants in terms of assessment outcomes.

Krauss and Fussell (1990, p.143) noted that the absence of visual information "reduces the richness of social cues available to the participants, increasing the social distance that separates them and causing them to adhere closely to prescribed task roles". The absence of certain sensory inputs also affects the temporal component of messages:

Written computer communication has been found to be less orderly, with less pressure on the recipient to respond, fewer constraints on the length and number of messages, and less requirement for connectedness between messages. (McGrath, 1990, p.52)

Harbeck et al (1999, p.40) warn that virtual interactions could conceivably give children distorted conceptions of the relation between simulated and actual representations of phenomena. Collins (2000, p.27) further comments that the media distraction probably explains why the Web-based version would not necessarily contribute to elevated marks in the course [see Case 3 below]. Brain (1998, p.281)
has the following criticism over Web-based collaboration:

For all the potential, and many valuable contributions by the Web to genuine collaboration, I can see it also as a hindrance. For too often self-proclaimed exponents of collaborative working respond to accusations that they have not actually shared anything, with "but it's on the Web." The Web can be a defense against the need to collaborate.

Even when the building bricks of interactivity are already in place, Grey (1999, p.100) has doubts about the effectiveness of Web interaction on teaching and learning:

...That's interactivity, but it's not easy to produce and it's quite limited in what it can do.

Research on Interactivity for Web-based Education

The starting point for most studies of educational technology is an analysis of student achievement relative to traditional classes (Kearsley 2000, p.46). Lumby (1995, p.16) warns that 'many colleges are struggling with the speed of introduction of new initiatives, and have perhaps lost focus on the role of the curriculum in not implementing competence assessment, but in integrating assessment into learning'. However, assessment can serve as a student motivator. From the experience of creating a faculty Intranet, Flowers et al (1998, p.345) reveal that students tend to be highly motivated towards activities that are involved with assessments, with optional (albeit worthwhile) activities being neglected. Hence, a number of research studies which compare student grades in different settings are worth further consideration.

The four cases (Carswell et al, Light et al, Collins and James) which are most relevant...
to the present study are outlined in some detail below (pp.53-63). Owston (1997, p.27-33) reviews the results from a number of studies using the Web. In the summer of 1996 the Open University (UK) experimented with an advanced psychology course, using the Web and other Internet tools aimed at students who could not fulfill the short residency requirement. The students reportedly relished the opportunity to continue their studies in this way, and the instructors found the experience exhausting, but yet exhilarating. It was found that the level of contact and interaction among students and instructors was very similar to regular summer classes. Similar benefits perceived by students were also reported by Carswell et al (2000). In the IVE, most students enjoyed their summer holidays except those who failed the course and need to re-sit the supplementary examination in about one and a half months after the publishing of final examination results. Hence the impact of the WBC on the supplementary examination results is also studied in the present research.

Although Collins (2000) agrees with Owston (1997) that simply comparing student performance on Web and traditional courses is not the best way of deciding on the success of such new approaches, she claims that such a comparison should be considered as a first step in evaluation (Collins 2000, p.26). Previous research on Web-based education will provide some excellent comparative material for the present research data. There are diverse views about the effect of virtual interaction from Web-based courses on student learning outcomes. The research results are quite different in different settings. Nevertheless, critical reviews on previous research on Web-based courses in different contexts would be useful to pose research questions and analyze the findings. The following cases present research results in different settings.
Literature Review

Carswell et al (2000, Case 1) shows that there are perceived benefits for electronic communication as compared with face-to-face communication, despite there being no discrimination in grade. Use of Internet-based conferencing encourages more interactions and instills higher expectation from students. Light et al (1999, Case 2) reveals that there is a modest positive correlation between assessment outcomes and student participation in email interaction. This is probably due to the fact that students are cautious in sending emails. Collins (2000, Case 3) finds that although there is increased student satisfaction on Web-based course, it would not necessarily contribute to an elevated mark probably because of media distraction. James (1999, Case 4) reported five contemporary research studies in the Hong Kong context. The report shows that there is a general belief that Web-based courses can help to improve students' grades and that Web-based development platform should be standardized to unify the access, facilitate integration and reuse of the materials. Ryan et al (2000, p.154) further add that 'the development of common standards and Web-based delivery systems will help support the rapid growth of online education and training.'

Case 1

There are perceived benefits for electronic communication as compared with face-to-face communication

Distance education via the Internet: the student experience by Carswell et al (2000)

Carswell et al (2000) conducted research that examined students' experience of a large-scale trial in which students were taught using electronic communication exclusively on a distance-taught undergraduate Computer Science course of the Open University in the UK. The research compares the constitution and experiences of a
group of Internet students to those of conventional distance learning students on the same course. Internet students communicated with their tutors and fellow students via electronic mail and HyperNews. The students used email for one-to-one asynchronous communication, and conferencing for communication with either their tutorial group or their peer group. The populations involved 223 Internet students and 2458 conventional students. The study reveals comparable learning outcomes with no discrimination in grade as the result of using different communication media. Questionnaires were sent to a target group of 59 Internet students and 73 conventional students to elicit students' experience on using Internet. It was found that electronic students contacted their tutors more often and had more contact with their peers. Electronic communication encouraged an increased interaction between student and tutor, with an average four times as many interactions than conventional students. This phenomena supports the assertion made by Bischoff et al (1996, p.4-19):

The development of relationships between students and tutors via the Internet is not only possible, but arguably better than conventional experiences.

The reported benefits of electronic tutorial sessions, as perceived by students, include:

- You could see other people's ideas
- I made useful social contacts with other students
- Electronic tutorials act as summer school to revive interest
- The majority of Internet students said that tutorials, whether synchronous or asynchronous, were "useful for maintaining motivation and enthusiasm".

(Carswell et al 2000, p.42)

The study of Carswell et al (2000) also reported that the biggest obstacle to Internet presentation was inexperience and cultural inexperience presented tougher obstacles than technical inexperience. Internet presentation requires a culture shift by students...
and tutors:

Both must learn how to cultivate communication in a largely asynchronous environment, and both must develop a sensitivity to the emerging etiquette and conventions of Internet culture. (ibid, p45)

They also claimed that using the Internet does come with higher expectations:

One of the keys to successful Internet presentation is to instill appropriate expectations among all participants. (ibid)

Although Carswell et al (2000) argued that the target group can be considered to be sufficiently representative of the populations to draw conclusions from the data they provided, the study focuses on distance learning students at degree course, not full-time sub-degree course like the IVE courses. The Internet students used electronic communication to replace conventional tutorials, not as a supplement. Their research simply compares the average assessment grades of the two groups of students, it does not show the relationship of how different types of electronic communication affect the performances of students. Another major deficit of their research is that they did not show the teachers' perspectives as these will play a critical role in the success implementation of a Web-based Curriculum. This research is conducted within the context of distance education. However, within the context of the IVE, reference to research on conventional full time studies is extremely useful.
Case 2

There exists a modest positive correlation between assessment outcomes and student participation in email interaction, probably because students are cautious in sending emails.

Computer-mediated communication in a conventional undergraduate setting by Light et al (1999)

Light et al (1999) claim that most of the research to date on the educational uses of computer-mediated communication has been concerned with distance education. They criticize that the results of the large scale evaluation of student use of a conferencing system undertaken in relation to an Open University course concerned with information technology by Mason (1989, 1991) and Yates (1992) have been generally rather discouraging:

Most students regarded the conferencing system as less helpful than available alternatives for contacting their tutor and for getting help with the course. (Light et al 1999, p.163)

Light et al (1999) conducted a case-study research concerned with the use of conferencing within a conventional full-time university setting, asking both how productive interaction in this medium can be, and also how such productivity can be analyzed and understood. They focused upon a lecture course entitled ‘Explaining the Mind’ taken over a twelve-week period by eighty psychology honours students (plus fifty other students) in their first year study at the University of Southampton which adopted an email-based innovation called skywriting in a variety of courses. Skywriting referred to the use of multiple-reciprocal-email in the service of academic discussion. The case study used both quantitative and qualitative approaches based
on computer-logged data, questionnaires and semi-structured interviews to different study groups. Correlation research was given to a randomly selected group of twenty-four students, twelve of whom had participated in the skywriting and twelve of whom had not. The results were:

Frequency of skywriting contributions showed a modest positive correlation with assessment outcomes ($r = 0.32$), whereas the frequency of face-to-face tutorial contributions was hardly correlated at all with such outcomes ($r = 0.13$). (Light et al 1999, p.169)

From the qualitative analyses using semi-structured interviews to nineteen targeted students (eight interviews with students who had not sent messages, eleven with students who had done so), it was found that:

Many students were concerned about presentation, as indeed their lecturer had encouraged them to be: 'You have to be competent with spelling'; 'It would be very embarrassing if you made a really silly grammatical mistake'; 'There are loads of messages on the Web with spelling mistakes, syntax and grammar etc.' Everyone can communicate in English, but a lot of people have difficulty putting it on computer; it puts you off.' Compared to contributions to tutorial discussion, messages tended to be almost obsessionally well prepared, spell checked and were sometimes read over by friends before being sent: 'Before people write on the skywriting they really research their stuff and they have a query and they polish their query so that it looks sensible and it sounds right, whereas in a tutorial you just kind of come out with stuff.' (Light et al 1999, p.171)

However, the English standard of IVE students could be quite different from those in the UK, their attitude to using electronic communication may have significant effects
on the implementation of WBC in IVE.

The skywriting case study compares email communication with face-to-face (f2f) tutorials. The tutorials are conducted in a classroom setting. Sometimes it is difficult to differentiate tutorials from lectures in terms of f2f interactions. All sending of messages by students are automatically logged by computer, Light et al (1999) did not state whether these messages included forward and reply messages. These messages might also include those sent to external parties like friends which could be irrelevant and affect the results of findings. Messages to teachers and classmates are simply lumped together. This could severely affect the results of correlation research as one type of message may dominate the others. Although the target group size is about 130 students, the selected group size for those participating in skywriting is only twelve, which is relatively small. The main reason is that skywriting was offered as an optional extra, supplementing the usual lectures and tutorial meetings. The skywriting research only focuses on comparing human interaction with f2f tutorials, but not non-human interaction.

Case 3

Although there is increased student satisfaction on Web-based course, it would not necessarily contribute to an elevated mark probably due to media distraction.

Comparing Web, Correspondence and Lecture versions of a second-year non-major Biology course by Michael Collins (2000)

Collins (2000) conducted research in 1996/1997 to compare correspondence, Web and lecture versions of the same course. He claimed that:

A literature search indicated that there are very few studies which compare the relative

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successes of Web-based courses and traditional (lecture) courses as this present study does. In addition most of these other comparative studies are based on only one offering of the Web-based course, whereas the present study evaluates the Web-based course over four different semesters. (ibid, p.21)

Collins (2000) found that, although the students were very satisfied with the Web version, the correspondence section achieved the higher mean final scores in three of the four semesters while the Web course achieved the higher mean score in only one semester. He (Collins, 2000) also surveyed the Web students' satisfaction with the course. Only 21 students completed the course questionnaire. The respondents to the survey found the course worthwhile and enumerated reasons for doing so but these would not necessarily contribute to elevated mark in the course. It was also found that the overall mean score for the Web course is the lowest as compared with correspondence and lecture version. Collins (2000, p.27) argues that it is possible that the medium itself might be a major distracting element and that these students spend a lot of time on the Internet searching Web sites for information not strictly related to course content. However, the number of students involved in the Web version is relatively small (only 22) as compared with others (Correspondence (105), Lecture (151)) and this may affect the reliability of the research results.

Collin's paper also presented the views of many researchers and concluded from his literature research that most of the studies (Liu et al 1998, Owston 1997, Smith and Taylor 1995) have reported that there was seemingly no significant difference between the performances of students in the Web and traditional courses (Collins 2000, p.26). Owston (1997, p.29) states that we cannot simply ask "Do students learn better with the Web as compared to traditional classroom instruction?", or for
that matter other forms of instruction. However, he emphasizes that:

> We have to realize that no medium, in and of itself, is likely to improve learning in a significant way when it is used to deliver instruction. Nor is it realistic to expect the Web, when it is used as a tool, to develop in students any unique skills. The key to promoting improved learning with the Web appears to lie in how effectively the medium is exploited in the teaching and learning situation. (Owston 1997, p.29)

No single one of the above research projects covers all three types of interaction provided by the WBC. The findings will be partial and incomplete in relation to the implementation of the WBC in IVE. However, their research poses implications for further and more comprehensive research. In Hong Kong, the use of the Internet in education is relatively new. It was only after the Policy Address (1997) advocating the use of IT in education that higher education institutions in Hong Kong initiated the use of Web-based technology for their conventional undergraduate courses.

**Case 4**

Web-based courses help to improve students' grade and Web-based development platform should be standardized

**Web-based Education in Hong Kong: Quality in Teaching & Learning in Higher Education by Jeff James (1999)**

Many mini-scale projects were launched in 1998 and their full evaluations are yet to be completed. Fortunately, James (1999) edited a collection of refereed papers written from the 63 extended abstracts presented at the first conference on Quality in Teaching and Learning in Higher Education in Hong Kong. A section covering the Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change.
use of World Wide Web in higher education contains five papers useful to this research as listed below (James 1999, p.209-252):

1) CWS: A Course Web Site Creation and Maintenance Tool for Improving Teaching and Learning Efficiency by Andrew T. Yim

2) LearningSpace and WebCT: Perspectives from Students, Course Designers, and Instructors by Andrew Y. S. Cheng et al

3) A Lexicon-Driven Language Learning Methodology for the World Wide Web by Chris Greaves

4) Motivation, Usage Behavior, Satisfaction, and Task Performance: A MUST Model of a Web-Based Learning Process by Amy X. Y. Lu et al

5) Web-Based Education Techniques: Workflow, Collaboration, and Quality of Service by Michael R. Lyu

Although all the papers report findings concerning the undergraduate courses, they form valuable references when conducting further research at sub-degree level as in IVE courses. Papers 1, 2 and 4 involve the use of WebCT as one of their Web-based development platforms. Their experiences with WebCT are in general satisfactory. Lu et al (p.232) highlighted how WebCT can keep a complete record of students' visits to various pages and thus provides a reliable and unobtrusive measure of Web-based learning behaviour. Cheng et al (p.217) also stated that an important feature of WebCT was to provide tracking facilities for students progress. Most of them report the experience of using different Web-based development tools in teaching and learning from both the perspectives of the students and the instructors. The following are some important findings:

i) **Web-based courses help to improve students' grade**

The grade distribution for students who used WBI tools was skewed away from the D

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grade towards the B grade (Andrew Y. S. Cheng et al, p.217).

Lu et al (p. 235) found that the use behavior is highly correlated with test score ($r = 0.53$)

Forty-five percent of the students (total 100) strongly agree or agree that WebCT can help them to get a better grade in a difficult course, forty-three percent neutral and twelve strongly disagree or disagree (Amy X. Y. Lu et al, p.233)

ii) **Web-based development platform should be standardized**

The structures of the course web sites should have a standard format. WebCT has the advantage of unifying the access of its function via the Web (Andrew T. Yim, p.210 & 215)

The fundamental principal of the VLC (Virtual Language Center) design strategy is the integration of vocabulary, lexicon, concordancing and multimedia on a unified platform (Chris Greaves 1999, p.228)

The organization of the course material can be crucial to the effectiveness of the Web-based instruction. Proper organization should consider issues such as the integration of course content developed by multiple instructors. The collaborative effort can minimize the courseware production provided that courseware organization and lesson formats are standardized to facilitate integration and reuse of the materials. (Michael R. Lyu, p.250-251)

Among the above studies, the study of Lu et al is particularly worth further consideration as far as students' performance is concerned. They use WebCT to conduct research with a target group of 100 first-year university students enrolled in two classes (one full-time, the other part-time). They propose a MUST model which studies the relationship among Motivation, Usage behavior (visit WebCT web pages),
Satisfaction and Task performance (test score). They find that whether WBI is considered "interesting", "convenient" and offers "more practice" are significantly related to the satisfaction level (r = 0.40, 0.35 and 0.37 respectively). The actual use of WebCT is also correlated to satisfaction (r = 0.11 to 0.23). However, what is most important is that both satisfaction and motivation are not related to test score (r = 0.02 and 0.05 respectively), but the use behavior is significantly related to the test score (r = 0.53). They concluded that the actual use of WebCT was the best predictor of test score (p.235). The findings of Lu et al together with Cheng et al pose a further challenge to the views that "WBI has no significant effect on student's learning outcome". However, the study of the MUST model does not include human interaction on the Web.

Hence the present study includes the following research questions:

How do students communicate on the Web? How do they behave in different WBC courses? Does the WBC enhance the academic achievement of students, if so, how? How do different types of virtual interaction affect student performance?

Additional Learning Benefits

Brooks (1997, p.12) raises the concern that 'multimedia affords an inherently better way to teach' is an area where face validity comes into conflict with research results in ways that affect what teachers do. In fact, there is critical debate about the claim of additive or multiplicative learning benefits from different media (Mielke 1968, Schramm 1977, Levie & Dickie 1972, Clark 1983, 1985, Clark & Sugrue 1989, Clark & Salomon 1986; quoted in Clark and Craig 1992). Advocates of "strong" media
theory suggest that certain media produce unique cognitive effects when used for instruction and therefore some media produce more of some types of learning for certain students and subject matter (Clark and Craig 1992). However, advocates of "weak" media theory claim that the media do not have any psychological influence over learning but that media may positively influence the "economics" (speed and cost) of learning (ibid). Clark and Craig (1992) made the following comment:

At the center of the conflict between these two approaches to media use in education are issues of research design. (ibid, p.20)

A number of comprehensive reviews concluded that there was no good evidence that any medium produced more learning or motivation than any other medium. (ibid, p.21)

Clark and Craig (1992, p.23-25) made the following conclusions about research evidence for different learning benefits from different media:

So, to repeat the question that ... "does available research support the claim of different learning benefits from different media?", the answer seems to be - not yet. (p.23)

Available research does not support the claim that when two or more media are combined, their learning benefits are not greater than when they are used alone. (p.25)

Yet, it would be difficult to rule out the strong possibility that the variable which produce a learning gain was not media, but the method variable many of us refer to as "interactivity". (p.25)

Hence it is worthwhile to ask the following research question in the context of WBC:

*Does the research support the claim of additional learning benefits from different types of interactivity provided by the WBC?*
The Language Barrier

Resistance from students due to language deficiency may stifle the development of the WBC and should not be ignored. Hanna et al (2000, p.30) point out that "it's critical to be able to communicate in the language of the course being offered in order to benefit from the interaction". Most Hong Kong citizens are non-native English speakers. In Hong Kong, there is an on-going debate about the medium of instruction (MOI) used in secondary schools. Only one out of six schools is allowed to use English as their MOI. A forum in Mingpao (2000, August 14, E11) argues whether Government resources should be used to improve Chinese or English in order to maintain the advantage of being an international city as well as a window for trading with China. Frequent reports from the News media express the views of employers demanding a high standard of English skills for graduates from tertiary institutions.

Some employers expressed discontent about the low ability of the English communication skills of the Hong Kong citizens...(Hong Kong Economic Times 2001, January 31, A3)

The speech of the President of the Hong Kong and Shanghai Banking Corporation, Mr. David Eldon, about the urgent need to improve the standard of English of the graduates of tertiary education in order to be competitive with our Mainland counterpart, was widely quoted. Mr. Eldon considered that the poor English standard of our graduates will have significant impact on the future development of Hong Kong (Mingpao 2000, December 14, B4).

Philson (1998, p.170) states that eighty percent of the world's information on
computers is in English and that vast majority of online communications are conducted in English. He pointed out that:

Until 1996, that workhorse of electronic communication, e-mail, could not have been used because the technical specifications of the medium could not handle Chinese characters. Because of the way that the programming and codes were developed for the Internet (at American research universities), only phonetic characters could be transmitted. Even today, although it has become possible to use graphic script on the World Wide Web, it is still extremely difficult, and in some systems impossible, to transmit pictographic symbols over e-mail. (Philson 1998, p. 169)

A general manager of an e-learning service provider in Hong Kong warns that language can be an impediment to the growth of online learning in Asia:

US players have been creating English-only versions, because people in the US seem to think everybody speaks English. (Hong Kong iMail 2000, October 26, B6)

Driscoll (1998, p. 104-144) describes one drawback of asynchronous interactions using email and discussion forum is to penalize poor writers. However, both Philson and Ishii have quite different views:

emails' asynchronous features provides great benefits to non-native speakers. (Ishii 1993, p. 150)

Although non-native English speakers face clear obstacles when using English, asynchronous communication allows time for composition and reflection (and thus self-editing) before sending messages over the electronic networks. (Philson 1998, p. 153)

As most post-secondary five IVE courses are conducted in English, it is expected that students (especially those come from schools with Chinese as MOI) may find it difficult to use English to communicate in the WBC environment. In this regard, it
is essential to study the effect of the linguistic factor on the implementation of WBC.

The resulting research question is:

How does the linguistic factor affect teaching and learning in the WBC?

Do students prefer to use Chinese as their communication medium on the Web? Does the English standard of students serve as a major barrier to the development of the WBC?

Managing Change

Subsequent to the review stated in the Consultant Report (1996), IVE has undergone two significant changes in 1998:

i) New IVE Curriculum

ii) New IVE Organizational Structure

Lumby (1998, p.192) perceives that obligation to change may originate from new technology developments. In his book, Fullan (1993) shares “Eight Basic Lessons of the New Paradigm of Change”. In an effort to address the conflicts and the accompanying institutional changes, Scollin and Tello (1999) illustrate how Fullan's framework can be applied to a case study to develop an Internet-based course delivery program called “OnlineEd” program offered by the University of New York Buffalo (UNB). The eight lessons provide guidelines for developing the change process and offer wisdom in developing dynamic relationships while guiding change. Those relevant to this research are listed below:

i) You Can’t Mandate What Matters (Fullan 1993, p.22-24)

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
ii) Problems are our friends (ibid, p.25-28)

iii) Individualism and Collectivism Must Have Equal Power (ibid, p.33-36)

iv) Neither Centralization or Decentralization Works (ibid, p.37-38)

The major research question that relates to the management of change in the context of WBC is:

*In transforming to the new flexible paradigm of WBC, how do IVE teachers and students manage to cope with the change?*

**The importance of Managing Change in the context of WBC**

In their book, Ford et al (1996) explain why 'managing change in higher education' is critically important in the next century where the impact of technology has never been so great or so unpredictable. The integration of change management is stressed by Preedy et al (1993) who perceive that:

- The management of change is not an incremental, 'stop-start' activity, reactively responding to specific internally or externally identified needs; but is proactive and fundamentally concerned with developing a culture for change where the key purpose for staff and students is ongoing individual and institutional improvement. (ibid, p.47)

Changes in technology, and the use of technology, can present opportunities for an educational institution (Ford et al 1996, p.28). To shift to the new paradigm, it is important to understand the nature of changes. Male (1997, p.179) explains why it is necessary to explore the nature of changes as they apply to the implementation of
computers in education because they are unlike other innovations in two ways:

1) Computer technology changes so quickly that implementation and training efforts are never complete, and

2) Computers in the learning process are developmental tools that can begin at the simplest level and evolve with the learner attaining unlimited skills.

Nunan (2000) describes how technological change, as one aspect of post-Fordism, is affecting education:

The ways of thinking that are intrinsic to the 'flexible' paradigm have been, for the most part, adopted by information technologists working in education. (ibid, p.55)

...from the perspective of those dealing with information and communications technology, education is already changing to a new 'flexible' paradigm, that the change is revolutionary and that it brings structural change. (ibid, p.57)

Similar arguments are raised by Bates (2000) who emphasizes the importance of various strategies of managing technological change in his book. He (ibid, p.5) claims that the implementation of the strategies for managing technological change in education will require fundamental change in the way our higher education institutions are organized and managed. Lumby (1998, p.192) also perceives that the obligation to change in education may originate from new technology developments.

However, Alden (1998, p.ix) warns that technology alone is not enough if fundamental learning theory is ignored. Accordingly to McCormack et al (1997, p.25-26), the educational technology world is full of projects, usually run by people with education backgrounds, in which the educational principles are considered more important than ensuring that the technology is able to make the system work. They criticize that many of these projects ended either as expensive white elephants that are
too cumbersome to use or are never completed because of implementation difficulties. They claim that in building a Web-based classroom, there should be a balance between educational and technical principles:

It is essential to consider the educational principles, but without the appropriate technology knowledge, it can be difficult to implement an effective and efficient Web-based classroom. At the other end of the spectrum are the projects, normally run by computing people, that have lost sight of the educational principles by focusing on the technical considerations. These types of projects generally end up technically brilliant but fail to serve their educational purpose. (ibid)

The Dearing Report (1997, 13.2) stresses that:

We should be led by educational imperative and not by technology: in other words we should ask how technology can help students undertake the various processes involved in learning.

Lofthouse et al (1995, p.62) observed that much educational change is technically simple but socially complex. Similarly Preedy et al (1993, p.4) found that educational change is usually complex, problematic, gives rise to conflict, and often fails to be put into practice. They further claim that efforts to bring about change need to focus on people and their attitudes, rather than just technical matters like new teaching equipment (ibid).

To deliver a curriculum on the Web not only involves managing technological change, but also curriculum change. There is always debate and dispute concerning the focus of educational provision between these two issues. Blenkin et al (1992, p.15) explain how technological change in education can be the initial impetus and
motivation towards planned curriculum change but argue the appropriateness of developing the curriculum to meet and match technological advance (ibid).

On the other hand, warning notes are sounded by Bennett et al (1992, p.4-5) who states that educational management is about facilitating teaching and learning and management activity is about finding at least a satisfactory way of operating, and then trying to find ways of improving on it. They suggest that educational change is about altering both practice and organization and individuals' perceptions of their roles and responsibilities (ibid, p.10). They further warn that:

There is always a danger that implementation of change might become assimilation into existing practice rather than providing a catalyst for wider change. (ibid, p.11)

In addition to managing the curriculum and technological change, the third element critical to the implementation of the WBC is managing the organizational change and this should not be belittled. Both the OLE framework (Dringus & Terell 1995) and ACTIONS Model (Bates, 2000) identify the organizational issue as an important factor for online courses. In fact, the process and procedures for managing change in education are also important. Carnall (1993, p.60) introduces the project management strategy for managing change in education and emphasizes the following two important strategies concerning the organizational issue:

i) Establish a management structure to implement change, encouraging wide discussion of issues;

ii) Flexible controls that focus on solutions to problems, encouraging innovation and risk-taking.
The above discussions lead to a conclusion that research issues concerning managing change in the context of WBC involve three main areas:


ii) Organizational change (Bates 2000, Dringus & Terell 1995, Carnall 1993)


From this, a refined Change Model for the WBC is derived by integrating the ACTIONS Model and the OLE Framework (Figure 2.4), highlighting the issues of Managing Change.

Figure 2.4 Managing Change for the WBC Change Model
Managing Curriculum Change

Moving from a traditional curriculum to the WBC requires radical changes. Lofthouse (1994, p.151-152) points out that change is the keyword because managing the curriculum has become another facet of managing change. He agrees with West-Burnham that managing change itself needs reconsideration:

The important thing is not to manage change but to change the way we manage.

(ibid, p.152)

The literature explains why it is necessary to consider the impacts on both the students and teachers for curriculum innovations. Finch and Crunkilton (1999, p.11) emphasize that the central focus of the curriculum is the student:

In fact, one may interpret this to mean each student has his or her own curriculum.

This interpretation is a sound concept, since students often select courses, experiences and noncredit activities that align with their unique personal needs and aspirations.

They assert that not only must the curriculum meet group needs, but there is an obligation to meet the individual needs of the students (ibid, p.21).

On the other hand, successful curriculum innovations require the full support of teachers. Fullan (1989, pp.145-146) argues that the high failure rate of curriculum innovations is caused by teachers seeking to explain rather than solve. Lofthouse et al (1995, p.21) claims that:

[the active participation and support of teachers is essential, however, if curriculum reform is to achieve its objectives...The 'ownership' of change is vital if reforms are to be more than superficial.
Recent reform in IVE has streamlined and reduced about 50 percent of the number of courses. The common curriculum concept introduces a common year one curriculum for different courses within the same subject groups. The new IVE curriculum requires common syllabuses for different courses within the same discipline to be taught across different campuses which demands cross-campus collaboration. Consequently, cross-campus teams are established to ensure that the common curriculum can be successfully implemented. A similar situation arose in UK with the introduction of the General National Vocational Qualifications (GNVQ) to the post-16 curriculum. Subsequent to that, Jackson (1995, p.141) found that:

[t]here has been an increase in the impetus towards cross-curricular projects, the integration of core skills, modularization of courses...

He stresses that the cross-curricula nature of the team had two complementary effects (Jackson 1995, p.137):

i) Encouraging cooperative approaches

ii) Mapping different approaches onto the course in delivery

The formation of cross-curricula teams requires certain flexible approaches that address the needs of different subject areas. Whether the same argument applies to the new IVE curriculum needs to be investigated.

However, Lumby (1995, p.20) warns that:

An attempt to integrate the curriculum within fewer vocational areas may reduce the inter-departmental competition but does not necessarily address the need for a cross-college approach to learning, including guidance, the development of cognitive and affective skills as well as vocationally specific knowledge and skills.

Lumby (1995, p.19) expresses concern that there is a tension between providing staff with the small unit autonomy which will allow swift response, and the need for
integrated curriculum responses.

In Hong Kong, there is a strong debate about whether a unified curriculum meets the individual needs of the students. About 150 teachers and principals shared their thoughts and feelings about the school-based curriculum tailoring scheme at the City University of Hong Kong, it was reported that the scheme has been a success, according to the educators who attended a review of the scheme (SCMP 2000, Young Post, July 24, p.3). The scheme was first introduced in 1994 at 10 pilot schools. It was extended to more than 100 schools in 1999. The Curriculum Development Council Chairman commented that:

A unified curriculum is not suitable for a modern society. Students learn and absorb at their own pace. The school-based curriculum tailoring scheme allows schools to adjust their curricula according to the standard of their students. (ibid)

However, Young (1993) expects a unified curriculum bridging academic and vocational divisions will prevail in the 21st Century in the UK emphasizing more breadth and flexibility:

In curricula terms this suggests the possibility of developing new connective skills and understanding and the ability to innovative and to apply and use learning in different contexts. (ibid, p.209)

As IVE emphasizes the efficient use of resources by means of reducing the number of courses and common curriculum, it seems to contradict the trend of school-based curriculum for student-centered education in Hong Kong. As the WBC facilitates the sharing of teaching and learning resources on the Web allowing students to learn at their own pace and teachers to adjust to their pace of delivery, it is envisaged that
the WBC can foster the future development of the new unified IVE curriculum. Nevertheless, it is worthwhile to explore the nature of change and to study how the WBC and the new IVE curriculum interact with each other. The related research questions are:

What major changes are incurred from the new IVE curriculum? Does the new IVE curriculum support the development of the WBC, or vice versa? How does the curriculum change affect the development and implementation of the WBC in IVE? What are the major barriers to curriculum change?

With the introduction of the WBC, there are two areas of relevance that need further attention: the pace of change and the implications for workload.

Pace of Change

Philson (1998, p. 150) illustrates three important points which are often neglected in today's fascination with the rapid development of electronic technologies:

1) dramatic changes is not limited to recent years;
2) predictions about the future are difficult, if not impossible, to make accurately; and
3) traditional institutions are often remarkably slow to respond and change, much less adapt, to technological change.

In his conclusion about using technology in international education, Philson (1998, p. 173) warns that:

Although technology may be changing rapidly, institutions of higher education seldom
He advises those involved in strategic planning to expect change and acceptance to be slow in higher education although technology is changing fast (ibid).

Stephenson et al (1995, p.13) claim that information technology (IT) will have a growing impact, both increasing the pace of change and offering opportunities to address change not only in business, but also in higher and further education. Tracey et al (1999, p.108) point out that:

Adopting new technology is not an altruistic behavior – people want to know that there is a definite benefit in spending time grappling with technology, whether it be learning about a particular piece of software, investing in their children’s education or maintaining a relationship.

Melody (1985, p.48) also warns that such IT initiatives cannot be expected to come to fruition overnight:

The long-run transition to the so-called ‘Information Society’ involves a continuing series of technological changes, and the compounding effects of their integration. It will require the expenditure of hundreds of billions of pounds over several decades, and a significant amount of trial and error, as false paths are pursued and unforeseen developments of the scene alter the ground rules.

Increased Workload

Referring to education over the Internet, Kostopoulos (1998, p.264) iterates that the need today is for course development tools, the learning and use of which will require a minimum of skills, time and effort on the part of the educator. Belcher et al (2000, p.39) emphasize the importance of training, associated guidelines and a pre-defined
set of standards for effective implementation of the Internet in education. In their research report, Barnes et al (1989, p.163) quote the concern of a teacher:

There’s a tension between the role as a teacher and a curriculum developer when he or she is required to develop new curriculum as well as teaching due to increased workload and lack of expertise.

They worry that the coursework and end of module tests associated with the assessment of modules also increase the pressure on teachers:

[s]ome teachers are concerned that the amount of work associated with the assessment of modules might make the whole system unworkable. (Barnes et al 1989, p.159)

However, Fullan (1989, p.147) claims that support without pressure can waste resources and pressure without support creates alienation, advocating the success of managing curriculum change very much depends on an appropriate level of pressure for teachers.

McCormack et al (1997, p.34) pose a question: “How will the adoption of the Web-based classroom change your workload during its use?” The answer to this question depends how the teacher plans to use the Web-based classroom. They claim that:

Using it as simply an information distribution mechanism may not increase workload during teaching. However, using a collaborative, highly interactive approach may significantly increase workload. (ibid)

Hulme (1999, p.16) argues that:

In a broader sense, using technology effectively does not save teachers’ time. A constructivist pedagogy requires teachers to participate intensively in the learning progress of their students.

She stresses that in the early stages of technology implementation the teacher’s job
becomes harder as they acquire new skills and experiment with new modes of curriculum delivery and alternative forms of assessment (ibid).

In fact, improved training efficiency for WBC is arguable. Alden (1998, p.4) claims that Web-based instruction can reduce the time necessary to reach a specified level of performance. Research has demonstrated that computer-based instruction using active, self-paced learning with individualized feedback has often reduced total training time by 30 or 40 percent (ibid). However, a comparison was made based on many years of experience using both Web-based and classroom instruction, Alden (1998, p.5-7) found that the calendar time to complete the course is arguable:

Web-based asynchronous courses typically require up to 30 times as much time as classroom courses! (ibid, p.6)

McCormack et al (1997, p201) claim that increased interaction, although bringing many positives, can also become a negative, especially if the interaction becomes exceedingly time consuming:

An interactive use of computer-mediated communication (CMC) generally requires more teaching staff time in moderation duties than does lecturing, especially if there are problems with implementation. Students also can feel the burden of increased workload if they move from passive learners to active learners.

To cope with the pace of change, it is essential have enough support for teachers and students to alleviate the burden of increased workload and information overload. The new WBC requires time for teachers and students to acquire the new skills before they can use the WBC effectively to enhance teaching and learning. Therefore it is critical to evaluate how it affects the workload of teachers and students. Thus the
following research questions emerge:

*What are the perceptions of teachers and students on the pace of change?*

*Does the WBC save any learning or teaching time? How does the implementation of the WBC affect the workload of teachers and students?*

**Managing Organizational Change**

Organizational issues are important factors to evaluate the effectiveness of different teaching technologies (Bates 2000, p.201). Nevertheless, in large and more complex organizations, the development of flexibility in organizational structure is problematic (O'Neill 1994, p.113). Lumby (1995, p.21) explains how the organization can be structured to achieve a curriculum with flexibility. She describes the use of different horizontal groups (autonomous, matrix, network) to achieve a whole college curriculum. Each of them attempts to create non-hierarchical groups which can co-ordinate curriculum development across college departments and layers of hierarchy (ibid). She claims that all of them can be found in colleges, but there has been little evaluation as to how far they are contributing to increasing the effectiveness of learning (ibid). There are obviously potential problems when it comes to organizational structures, Bates (2000, p.181-2) claims that:

> the challenge is to develop a system that encourages teaching units to be innovative and able to respond quickly to changes in subject matter, student needs and technology.

> At the same time, redundancy and conflicting standards and policies across the institution must be avoided.

Referring to the new organizational structures for managing institutional changes,
King (2000, 115) also emphasizes that:

what is critical is that institutions develop an organizational structure that can accommodate prompt decision-making within a framework that supports quality operations in areas of core business.

Establishing a management structure that encourages wide discussion of issues is an important strategy to implement change (Carnall, 1993). According to Lofthouse et al (1995, p.65), an important factor that facilitates curriculum change is to cut across boundaries, foster active involvement and co-operation, form coalitions and real work teams.

Critics of the hierarchical and bureaucratic structure advocate the adoption of a matrix management structure. Lumby (1995, p.19) argues that colleges are still struggling to find alternative structures which will be more effective in delivering a learning-centered curriculum, while retaining accountability:

Some college organograms upend the usual pyramid and place the principal on the bottom and the learner at the top, with interposing layers of management and teaching staff.

She refers to dissatisfaction with traditional departmental structures and attempts to achieve a more student-centered approach, advocating the alternative models for matrix structures presented by Turner (1991):

A matrix organization moves closer to uncoupling staff from departments and viewing them as a resource to be used flexibly to meet the needs of individual learners.

(Lumby 1995, p.20)

The increasing emphasis on accountability has led to a need for clear lines of responsibility, but the resulting vertical information flows can militate against achieving cross-college integration. Lewis (1994) stresses the importance of
bringing about cultural change in ridding the organization of rigid organization structures and replacing them with a form of matrix organization involving delegation of responsibility and project-based management teams. The success of the implementation rests upon the efforts of the managers to win the college staff's support. Lewis (1994) argues that radical restructuring is needed in order to overcome resistance to major policy changes, it becomes necessary to destroy certain rigid organization structures which are restraining cultural change. The nature of the organization structure that facilitates WBC development in IVE becomes a critical factor.

The recent reform of VTC merges nine campuses into one IVE institution with a new matrix management structure. The VTC aims to achieve a more streamlined and less hierarchical IVE structure. Consequently, the post of vice-principal in all IVE associate campuses has been deleted to achieve a flatter organizational structure. However, Lumby (1995, p.19) warns that:

- There is a tension between taking out layers of management to allow a flatter, less hierarchical structure, and the need for promoted posts which may motivate staff in times of low morale.

Bates proposes the research and evaluation questions relevant to the organizational issues:

- What are the organizational requirements, and the barriers to be removed, before this technology can be used successfully? What changes in organization need to be made?

(Bates 2000, p.201)

Indeed, Herson et al (2000, p.55) made a recommendation for individualized implementation strategies for educational Intranet resources:

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Intranet implementation is a process that changes with technology and the requirements of the users. No two organizations are the same, and any implementation strategy must match the culture and structure of the organization.

No two organizations are the same, whether the new matrix management structure is beneficial to the development of the WBC need to be explored.

**Changing roles of teachers and students**

The OLE framework emphasizes the importance of identifying the new roles that learners and faculty take on in OLEs, as well as an understanding of a shift toward a learner-centered paradigm. Future research is needed to explore more fully the culture element for comprehending the roles that the learners and the faculty assume for a learner-centered paradigm (Dringus and Terrell 1999, p.65). The Education Commission (EC 1999, p.23), an advisory body advising the HKSAR Government on future direction of educational reform, suggests that there are new roles for schools and teachers and the need to create more room for teachers so that they can exercise their professional judgment to cater for students' individual needs. However, teachers need time and resources to learn the skills to develop the materials for the WBC. Tracey et al (1999, p.99) stress that teachers and peer students become significant co-learners, coaches and teachers within a social setting. Lewis (1999) asserts that, with the use of technology, learning will increasingly take place off-campus and in dispersed environments:

...Teachers and learners will thus need to work in different ways and these will include the use of technological applications in the pursuit of learning, requiring the students to learn more independently and in the process acquire some of the habits of self-reliance.
that employers are looking for. (Lewis 1999, p.142)

The question is not whether or not the technology can perform but whether staff and systems can change quickly enough to take advantage of its power. Lewis (1999, p.147) explains why it is inevitable that the use of technology will require teachers to change their roles to a significant extent. He argues that the conventional view of the teacher’s role is undoubtedly a major brake on the transformation to a new learning environment in which technology is fully used to support the learning process. Hence it raises the following research questions:

*The recent reform of VTC consequently drove the IVE to adopt a form of matrix management system, does it encourage active participation of students and teachers in the WBC? How does the new management structure affect the development of WBC in IVE? Can it foster changes or provide enough support to teaching and learning using the WBC?*

**Managing Technological Change**

The WBC involves the use of Web-based technology in education. Lewis (1999, p.142) explains how curriculum and assessment are affected by technology in terms of accessibility, processor power and cross-platform compatibility. The technical considerations presented by Kostopoulos (1998) explain how accessibility and virtual interaction of a web-based course are affected by technology. The delivery of courses via the Internet depends on three main technical factors:

1. Network access
2. Server capabilities

*Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change*
(3) Browser compatibility  (ibid, p.259-260)

Speed and Bandwidth

Speed and bandwidth have significant effect on network access and server capabilities. Jefferies et al (1998, p.365) warns that current bandwidth does not support fast enough delivery, particularly for multimedia communication. They claim that this is a serious concern and the one that is most often cited by students as an inhibitor to the use of the Internet (ibid). Katz et al (1997, p.183) report that the key concerns of Internet users are primarily traffic and navigation problems, with cost a somewhat distant third. Harrison (1999, p.269) has the following advice:

- Be wary of large graphics and streaming audio and video. They can appear very slowly to the learner. Put in some text or a very simple graphic at the top of the page so that the learner has something to look at whilst a larger picture builds up.

Browser Compatibility

Hall (1997, p.26) states that one of the major advantages of Web-based training over other types of computer-based training is cross-platform compatibility. The learners do not need the same computer system as the developer. Web browsers can access Web-based information using a language that is platform-independent. According to McCormack et al (1997, p.13), the Web-based information is platform independent meaning anyone with a computer that has a Web browser can access the information. There is no longer any need to have a specific program to view the information. To design a good Web page, Alden (1998, p.17) emphasizes the use of a standardized
template. She also warns that great design is often lost with the use of many types of browsers.

McCormack et al (1997, p.30) claim that it is important to consider the language background of the students as it influences the design of a Web-based classroom. The browsing capabilities in different languages (e.g. Chinese and English) are quite often not the same. Jefferies et al (1998, p.365) point out the fact that browsers differ can make publication and other collaborative activities difficult. Indeed Grey (1999, p.41) states that:

Although there is an international standard which the writers of Web pages must follow, there are, unfortunately, variations in the way this standard is implemented by the browsers.

According to Grey (1999, p.117), incompatibility between different browsers may lead to temporary confusion and animations may not work on certain terminals due to different versions of browsers.

**Standardized technological approaches for the WBC**

There are perceived benefits to adopt standardized approaches for technology. Network designs should be based on standard building blocks (Long 2000, p.43). Betts et al (1998) have already pointed out that flexibility requires greater standardization. Bates (2000, p.181-182) is critical that the appearance of decentralization in the new technologies is deceptive:

In fact they [the new technologies] depend on agreed-upon standards and networks for communication interoperability as well as on human and technical support infrastructures that require policymaking across the institution.
Emulating the traditional classroom as an instructional paradigm in online form may be difficult to achieve, Dringus and Terell (1999, p.60) view the problem as a lack of a systematic approach to conceptualizing and implementing OLEs as unique and distinct learning environments. Harrison (1999, 287) perceives that Web-based training will finally allow the convergence of different media onto one common platform, the desktop computer. Kostopoulos (1998, p.262) emphasizes the importance of standardized shell structure for Web presentation:

For design simplicity, and to provide the users with a feeling of security, that they would not get lost inside a labyrinthine Web site, the course presentation should have a consistent appearance.

There are various reasons to adopt a standardized approach for the Web-based courses. McArthur et al (1998) emphasize that there is a need to provide a common infrastructure for online courses:

Setting standards for courseware format (to ensure interoperability) will probably be as important as establishing content standards. Overall, the intent of these tactics must be to foster a culture of sharing in online communities of higher education. (ibid, p.xx-xxi)

A unified strategy is needed for effective Intranet implementation. Herson et al (2000, p.54) explain why:

The underlying reason for an intranet in the educational arena is that it is a focused resource. Another reason for the unified approach is ease of maintenance...module pages should ideally be uniform and have the same core items – thus providing the students with a minimum realizable expectation of what they will find.

However, there are different views on standardized approaches to technology and contradictory views on whether a standardized approach should be adopted in
Web-based teaching and learning. Herson et al (2000, p.5) warn that a barrier to adopting the unified strategy by teaching staff may be due to professional resistance to a threat to their autonomy or an example of organizational resistance to innovation. Driscoll (1998, p.4) also warns that Web-based training (WBT) will not work if only one WBT tool is used as the solution for all problems. Flowers et al (1998) have the following argument against the standardized Intranet system design:

[i]t was recognized that to design and enforce a standard format for such documents as course or assessment outlines would be likely to alienate the very individuals on whom the system is dependent. (ibid, p.344)

Some institutions are criticized that they have tried to standardize on one course authoring system in order to keep down administrative costs:

Any attempt to impose a single course authoring software solution on a whole institution is likely to impose a serious restriction on academic freedom and could lead to a highly undesirable uniform approach to teaching across all subjects.

(Bates 2000, p.203)

Centralization versus Decentralization

As far as managing change is concerned, Fullan (1993) has expressed his views from an educational perspective that neither centralization nor decentralization works, and that it is tempting to adopt a mix of both. However, Nunan (2000, p.61) introduces a centralized teaching and learning framework in the University of South Australia with its teaching and learning strategy built upon an intention to produce students with particular qualities in a teaching and learning environment that is student-centered and flexible. Within the framework, the support infrastructure consists of information
technology services and a flexible learning center. He introduces an organizational model that delivers the new flexible paradigm:

A new 'subsidiary' delivers IT-based teaching and learning, undertaking its innovative IT-based development in a separate, centrally resourced unit, and building new core competencies. (Nunan 2000, p.56-57)

Although new technologies such as the Web appear to be decentralized, Bates (2000, p.181) asserts that high-quality educational multimedia requires a range of specialist skills that go beyond the capability of any single individual. He advocates that a central unit with staff with different expertise can ensure that quality standards are followed in the development of technology-based teaching and learning (ibid, p.182). However, the danger of such central units is that they in turn would become too large to manage efficiently, and be seen as diverting resources from core academic activities. Too often, these central services have had little impact on the core teaching activities of an institution, partly because academics have felt that they had no control over them. Bates (2000, p.185-197) echoes the views of Fullan that a mix of centralized and decentralized technology support services is required. He explains why the use of a centralized unit is needed to ensure quality and standards for technology-based development:

There is a risk that all these separate services will consider new technologies to be part of their mandate and will start duplicating services and competing for resources. (Bates 2000, p.185)

Fullan (1993) presents his views from educational perspective, whereas Nunan and Bates present quite different views from a technological perspective concerning centralization and decentralization with regard to sustained educational and technological change.
Hence further research questions emerge from the above discussions on managing technological change:

*What are the critical factors perceived by teachers and students for managing technological change? What kind of Web-based development platform should be supported? To effectively implement the WBC in IVE, what strategy (centralization or decentralization) should be adopted?*

**Summary**

From an international perspective, there are both successful (Sandelands 1998, Flowers et al 1998, Brooks 1997, Kostopoulos 1998) and failed cases (Hulme 1999, Selwyn 1999, Alden 1998) when applying Web-based technology in teaching and learning, highlighting the need to explore how we can manage the change in the traditional curriculum to achieve the educational purposes effectively in a dynamic environment using the WBC. Although Trentin (1999, p.18) claims that the acquisition of knowledge through network interaction does not necessarily imply the act of distance learning, it appears that most online courses are mainly favorable to distance learning courses (Flowers et al 1998, Alden 1998, McCormack et al 1997, Hulme 1999, Driscoll 1998) and it is arguable whether this also applies to traditional IVE courses. However, discouraging survey results show that the use of the Internet in education is very limited (Katz et al 1997, Jefferies et al 1998) even in the USA, a pioneer country adopting the Internet in education. It is highly likely that the failure of using technology in education may be due to an academic/technical divide (Betts et
al 1998, McCormack et al 1997). To make the implementation of the WBC a success, there will need to be a balanced consideration between educational and technological principles.

From the literature, a Change Model (Figure 2.5) for the WBC, emphasizing the impact on teaching and learning, is derived by integrating the ACTIONS Model and the OLE Framework.

**Figure 2.5 The WBC Change Model**

![Diagram of WBC Change Model]

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
This model helps to establish the focus and identify the specific objectives of the study. It depicts the three major interrelated elements for the research study concerning the WBC: flexibility, interactivity and managing change. Clusters of research questions around these three major issues are identified. This model will also provide a basic theoretical framework for analysis and interpretation of the research questions.


are critically evaluated with possible deficiencies and alternative explanations explored. They are found to be very useful to extend the validity and verify the conclusions of the research study. Prominent research questions about the theory of additional learning benefits for different types of virtual interactions (Brooks 1997, Clark and Craig 1992) and the impacts of language barriers peculiar to non-native English students (Hanna et al 2000, Philson 1998, Driscoll 1998, Ishii 1993) are examined.

Chapter Three

Methodology

The purpose of the study is to identify factors and strategies to manage the change process relating to flexibility and virtual interactivity that enhance the effectiveness of teaching and learning with the introduction of the WBC in IVE. From the literature, a WBC Change Model (Figure 2.5) is derived. Three major research questions are identified:

1. How does the flexibility offered by the WBC affect teaching and learning?
2. How do the various forms of interaction affect teaching and learning?
3. In transforming to the new flexible paradigm of WBC, how do IVE teachers and students manage to cope with the change?

The research questions emerge from the literature review. Many of them are controversial. However, it is undeniable that the WBC is an emerging field of study in education both locally and internationally. As explained by Yin (1994, p.1) and Johnson (1994, p.20), the case study is an appropriate strategy to conduct research on a contemporary phenomenon when the researcher has little control over the events. The literature also shows that most previous research concerning WBC are either superficial or yet to be finalized. According to Best and Kahn (1998, p.248-9), a case study approach which examines a social unit as a whole, emphasizes analysis in depth and better understanding of the research questions, is considered as an appropriate strategy. The understanding of experiences and the concepts generated from this case study can be extended to subsequent cases in the future.
The study examined the perceptions and behaviors of all teachers and students in an IT/Computing department of the IVE. How and why the various data collection tools were used in this case study are also outlined and justified in this chapter. The literature showed that documentary research, interview and observation were most commonly adopted tools to collect data in case study research. As the student population size was large, a questionnaire was designed to solicit their views. This research also emphasized the creative use of the computer to capture huge amounts of data unobtrusively from the Internet, Intranet and the WebCT log files.

Both qualitative and quantitative approaches were used to collect and analyze the research data. These data were analyzed statistically to allow the case study results to be explained quantitatively, providing alternative insights to triangulate results that were interpreted qualitatively. Bassey (1999), Sturman (1999) and Yin (1994) explained how the qualitative and quantitative approaches could be applied to case study research. The data collected from different sources also provided means of triangulation which was deemed important for case study research. Analytical techniques like categorical aggregation and interpretation, content analysis and statistical analysis were used to analyze data qualitatively and quantitatively. Due to sufficient large sample sizes for different groups of students, their behaviors could be operated in a mainly positivistic framework.

This chapter considers the limitations of case studies and how they could be resolved. Certainly the issue of unobtrusive research raised big ethical questions, leading to a specific section on research ethics to be addressed. As reliability and triangulation were crucial for establishing the validity and credibility of case studies, this chapter
also defended why the four triangulation protocols suggested by Stake (1995) and Yin (1994) were applied to alleviate the limitations of case studies. Another limitation was that the success of research on WBC very much depended on the extensive computer knowledge and skills required by the investigator. The strong technical support in computer-related applications provided by the Computing department proved to be vitally important in carrying out the study.

**Why Case Study?**

The research questions attempt to explore why and how the WBC can be applied to traditional vocational education. The context of study clearly defines a specific case to be studied. Yin (1994, p.1) claims that case study is the preferred strategy when the investigator has little control over the events, and when the focus is on a contemporary phenomenon within some real-life context. Johnson (1994, p.20) defines case study as:

> ...an enquiry which uses multiple sources of evidence. It investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident.

She explains the strengths of case study as it can provide interpretations of other similar cases and the ability to explore diversity of practice (ibid, p.22 & 107). According to McMillan et al (1997, p.391), it is expected that the understandings of people’s experiences and the concepts generated from a typical case study could be extended in subsequent cases.

The literature reveals that research on the WBC is an emerging field of study.
According to Best et al (1998) and McMillan et al (1997), there are various reasons why 'case study' is the most relevant strategy for this kind of research. One reason is that the element of typicalness rather than uniqueness is the focus of attention, for an emphasis on uniqueness would preclude scientific abstraction in this study; the other reason is that case studies are not confined to the study of individuals and their behavioral characteristics (Best et al 1998, p.248-250). McMillan et al (1997, p.394-395) explain that case study design, because of its flexibility and adaptability to a range of contexts, processes, people, and foci, provides some of the most useful methods available in educational research:

Case studies are appropriate for exploratory and discovery-oriented research.

As the research questions are examining something contemporary, current documents and issues have already been the foci of this research in order to add knowledge to the fields of inquiry. The new development of WBC is definitely a study of contemporary phenomenon. The context of study and research questions for this new way of delivering the curriculum have established a clear indication that case study will be an appropriate strategy to conduct the research.

Research Strategies

Qualitative versus Quantitative Research

Both quantitative and qualitative research methodologies can be used to complement and illuminate the findings of the case study. Gall et al (1999, p.13) claim that educational research is not a unified enterprise. They believe that ‘the methods of
qualitative research and quantitative research are complementary, and that researchers
who use a combination of both types of methods can give the fullest picture of the
nature of educational phenomena' (ibid, p.14). Yin (1993, p.57) explains that a
critical advantage of this approach is to avoid the unproductive debate between
qualitative and quantitative research. He further emphasizes that case study can be
based on any mix of quantitative and qualitative evidence (Yin 1994, p.14). It is
important to develop a recognition of the value of blending different methodologies
(Sturman 1999, p.111). In this study, a qualitative approach served as a holistic
approach to analyze the complexities of human systems like the perceptions of both
teachers and students related to the research questions. Although holists frequently
use qualitative techniques, they are not distinguishing features of case study (Sturman
1999, p.104). Sturman explains why the two should work together:

    Qualitative research is useful both in developing concepts and theories that can be
    further tested through quantitative approaches. (ibid)

In his book, Bassey (1999) gives an overview suggesting that there are two kinds of
outcome of empirical educational research: predictions of what may happen in
particular circumstances, and interpretations of what has happened in particular
situations.

    Predications may be statistical generalizations, where a quantitative estimate of the
    likelihood of something happening can be made (for example, ‘there is a 50 per
    cent chance that...) or fuzzy generalizations, where a qualitative estimate only can
    be made (for example, ‘it is very likely that...’). (ibid, p.4)

He further explains how the perspectives of the positivist (quantitative) and the
interpretive (qualitative) paradigms asserted by Yin and Stake respectively can be
applied to case study research (ibid, p.22-36).

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
In quantitative studies, the research question seeks out a relationship between a small number of variables (Stake 1995, p.41). For example: "Is there an enduring correlation between the WBC grade and the various types of virtual interactions? In qualitative studies, research questions typically orient to cases or phenomena, seeking patterns of unanticipated as well as expected relationships (ibid). For example: How can teachers cope with the educational and technological changes arisen from the development of the WBC in IVE?

This research aims to use a positivist framework with qualitative data used to provide depth in respect of beliefs and feelings and also to illustrate points made through the quantitative analysis. It generally follows the positivist traditions to analyze student behaviors in Student Questionnaire Survey (SQS), WebCT logs (WLF) and Student Grade Report System (SGRS). The perspectives of teachers and students solicited from interviews are mainly analyzed in the interpretive framework.

**The Population**

The total number of teaching staff in the IVE is about 1,100 across nine campuses. The total number of full-time student is about 19,000. The total number of full-time students in the IT Discipline across nine campuses is 2,132. There are 103 teaching staff and 1,414 students respectively in the campus under study.

This study involved a computing department of one campus of the IVE. There were twenty lecturers. The student population were divided into four groups. The characteristics of the four groups of students are described below:
Methodology

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>121</td>
</tr>
<tr>
<td>D1</td>
<td>81</td>
</tr>
<tr>
<td>FD</td>
<td>113</td>
</tr>
<tr>
<td>D2</td>
<td>102</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>417</strong></td>
</tr>
</tbody>
</table>

**Higher Diploma/Diploma Group (HD/D)**

Students are studying the new IVE Year one courses based on common curriculum for Diploma (D) and Higher Diploma (HD). They have to compete for HD year 2 places based on their academic results of first year of study. This group of students is under extreme examination pressure. The weekly class contact hours is 19. The average Education Attainment Index (EAI) is 14.5. The EAI is the total score of the best 7 subjects of HKCEE results. The WBC module under study is Programming Project (four hours per week, same syllabus as D1 group).

**Standalone Diploma Group (D1)**

Students are studying Year one of a new IVE two-year standalone diploma course. The weekly class contact hours is 18. The average EAI of this group of student is 12. The examination pressure faced by this group of student is the least. The WBC module under study is Programming Project (four hours per week, same syllabus as HD/D group).

**Foundation Diploma Group (FD)**

Students are studying a one-year Foundation Diploma (FD) courses. The average EAI of this group of student is 8. They are perceived as a group of students who
failed in HKCEE. This group of students normally failed in English. The weekly class contact hour is 22. The WBC module under study is Information Technology Project (three hours per week).

**Old Diploma Group (D2)**

Students are studying in the graduating classes from the old courses which will fade out in the coming years. These students will be the last cohort of the old diploma courses. According to the old curriculum, they have to attend 32 hours of lectures per week. The average EAI is 12. The WBC module under study is Project II (twelve hours per week).

The computing department under study is committed to take the lead to explore the possibilities of using IT in teaching and learning. Both teachers and students in the department are better equipped with the basic skills required for the new WBC. Mambretti (1999, p.113) emphasizes the importance and challenge of mastering and supporting the new technology like the Internet in teaching and learning. Teachers from the department have already undergone training on WebCT and are computer literate thus relieving the concerns of mastering the Internet technology. The department has better IT technical support than its counterparts.

**Research Methods and Sampling Strategies**

A range of research tools like documentary research, questionnaire, observations and interviews were used within the case study. Both qualitative and quantitative
Methodology

techniques were used to complement each other. This research demonstrated the creative use of computer to capture huge amount of relevant data to be analyzed both statistically and interpreted qualitatively.

When document analysis is used as descriptive research, current documents and issues are the foci, it serves a useful purpose in adding knowledge to fields of inquiry and in explaining certain events (Best and Kahn 1998, p.247). In the IVE, important minutes and documents were converted into an electronic format and kept in the document center of the VTC Intranet. They were ideal sources to provide contemporary information about the current development of Web-based teaching and learning. To better understand the perception of teachers, the Web-based discussion forum among teachers on the development of the WBC modules were examined. The WebCT logs containing very accurate data on student participation in various kinds of virtual interactions were captured. The student examination results were found to be extremely useful for analyzing the impacts of various types of WBC interaction on student performance.

For the student questionnaire, a mix of convenience, purposive and comprehensive sampling strategies were used (Cohen and Manion 1997, p.89-90; McMillan et al 1997, p.398). The whole population in the computing department was chosen because of its convenience. It was purposively sampled because of its typicality: a leading department to implement online learning. A comprehensive sampling strategy was used to select the whole population of students (in the Computing department) from four different subject groups with a smallest group size of 81. According to Cohen and Manion (1997), this sample size for a questionnaire is large
Qualitative data were used to complement and illuminate the findings of the questionnaire. In order to clarify various issues (like language barriers and short-form English), purposeful sampling was used to conduct in-depth interviews with student representatives. Student representatives participating in the WBC development teams were purposively sampled as they were likely to be knowledgeable and informative about the phenomena to be investigated (McMillan et al 1997, p.397) and information-rich cases for study in-depth (Patton 1990, p.169). Four group interviews were conducted. Each interview consisted of three student representatives from the same group.

To better understand student behavior during the tutorial session, a mix of convenience and random sampling strategy was used to select one tutorial group from each of the four groups under observation. Twelve observations (three for each tutorial group) were scheduled. The sample size was about 20 to 25.

Similar strategies to the student questionnaire were used for the semi-structured interviews with teachers. All twenty lecturers in the computing department were interviewed singly. They could be divided into four homogeneous groups with the smallest sample size of four. However, one teacher may teach more than one module from different subject groups. Although it might be difficult to infer teacher perception from different groups, they could represent a holistic view from teachers in the Computing department. McMillan et al (1997, p.401) claim that qualitative researchers view sampling processes as dynamic, ad hoc, and phasic rather than static.
or a priori parameters of populations:

The insights generated from qualitative inquiry depend more on the
information-richness of the cases and the analytical capabilities of the researcher than
on the sample size.

Research Tools and Data Collection

The literature shows that data collection in case study usually involves several
research tools such as interviewing, observation and use of records or documents
In addition to the three research tools, Best and Kahn (1998, p.248-249) also suggest a
variety of methods to gather data including questionnaires or opinionnaires for case
study approach. Bassey (1999, p.69) argues that case study research has no specific
methods of data collection or of analyses which are unique to it as a method of inquiry
and urges researchers to be creative and adventurous in their choice of data collection
methods, depending on the nature of the research questions.

The Research Schedule

The research schedule adopted in this study is listed in the following table:

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Schedule</th>
</tr>
</thead>
</table>

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Methodology

<table>
<thead>
<tr>
<th>Method</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Questionnaire Survey</td>
<td>October 2000 - February 2001</td>
</tr>
<tr>
<td>Observations</td>
<td>January 2000 - June 2000</td>
</tr>
<tr>
<td>Unstructured Interviews with student representatives</td>
<td>April 2001</td>
</tr>
<tr>
<td>Semi-structured Interviews with teachers</td>
<td>January 2000 - February 2000</td>
</tr>
</tbody>
</table>

**Documentary Research**

Many writers mentioned above claim that documentary analysis is widely used in case study design. Merriam (1998, p.112) explains why documents are used for educational research:

> The presence of documents does not intrude upon or alter the setting in ways that the presence of the investigator often does...Documents are, in fact, a ready-made source of data easily accessible to the imaginative and resourceful investigator.

Johnson (1994, p.27-28) reiterates why documentary research is adopted mainly because it is of relatively low cost and an 'unobtrusive' method of research. As suggested by Johnson (1994, p.59), the range of documents, their accessibility and purposes to be prepared should be determined. The range of documents in this study mainly involved the VTC Documents, WebCT Log Files, Student Grade Report Systems and Web Forum for teachers. Besides the paper documents, most of them could be accessed through the computer networks. These documents were found to be most relevant to the whole range of research questions.
VTC Documents (VTCD)

VTC documents contained information such as the policies on curriculum, management structure and technology. Apart from the paper documents, the VTC Intranet (http://intra.vtc.edu.hk) provided rich online documents within two years. It included a rich data bank concerning various issues on IT, academic policies and structure, and curriculum. The following documents depicted the new IVE policies on common curriculum:

i) Curriculum Development Guidelines
ii) IVE Student Handbook
iii) IVEAB (Academic Board) Papers

WebCT Log Files (WLF) and Student Grade Report System (SGRS)

With the extensive use of computer, a huge amount of electronic data were captured unobtrusively through the WebCT servers (WLF) and the MIS servers (SGRS). These data were cut and pasted for later analysis. They were analyzed statistically to allow the case study results to be explained quantitatively, providing alternative insights to triangulate results that were interpreted qualitatively. Data from the WebCT servers and MIS servers could be matched by student number and course number for correlation analysis.

The WebCT logs together with the Student Grade Report System (SGRS) provided very useful information to analyze the effect of different types of virtual interactions on student performance. The WebCT logs recorded the number of incoming and outgoing messages for different kind of emails and postings, and the number of page
visits for each WBC module. To analyze the effects of different types of virtual interactions on student learning, separate mail-boxes were designed to send and receive messages for peers and teachers respectively.

The interaction records were captured monthly (from October 1999 to August 2000, including the periods before the supplementary exam) by the WebCT logs. These data were verified by means of online monitoring and observation. The various types of interaction were measured against student's academic results (SGRS) in order to understand whether there was any relationship amongst them. A summary interaction table was designed as follow, from which correlation matrices could be constructed.

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Interaction 1</th>
<th>Interaction 2</th>
<th>Interaction 3</th>
<th>Marks or Grades</th>
</tr>
</thead>
</table>

Web Forum for Teachers (WFT)

From the open forums on the Web for IVE lecturers in the computing departments of seven campuses, a total of nearly 1,000 threaded Web messages among IVE lecturers were browsed (from October 1999 to July 2000). As teachers might teach modules for different groups of students, it was not possible to identify the perception of teachers representing which groups in the open forums. However, some of them provided very useful information about teachers' perception related to the research questions.
**Observation (OB)**

Cohen and Manion (1997, p.107) claim that whatever the problem or the approach, at the heart of every case study lies a method of observation which can be used to probe deeply and to analyze intensively the multifarious phenomena that constitute the life cycle of the unit with a view to establishing generalizations about the wider population to which that unit belongs. According to Johnson (1994, p.52), observation is generally used to record behavior in social research and gain insights which can be tested by other techniques.

Best and Kahn (1998, p.253-254) also state that when observation is used in qualitative research, it usually consists of a detailed notation of behaviors. Observation is adopted as a versatile research tool which can be used to derive both quantitative and qualitative data (Kane 1985, p.53).

Unobtrusive observations on tutorial sessions in computer laboratory were scheduled. A total of twelve observations were conducted in January, March and May 2000 (i.e. three for each group). The findings from these observations were found to be most relevant to the research questions related to interactivity.

All observations were conducted in the tutorial sessions in a computer laboratory equipped with the LAN School. Two observations had to be rescheduled due to technical problems. The group size was about 25 students. A checklist (Appendix A) was used, three times a session at 20 minutes interval. The activity was confirmed if it lasted for fifteen seconds. Each observation lasted from fifteen seconds to one minute. The use of English and Chinese language in WBC Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
communication was noted. To analyze the language issue, all postings and emails were captured during the observation and printed afterwards. The frequencies of various types of WBC interactions and activities were summarized. The tutor-in-charge was approached at the end of each observation in order to investigate why some frequencies were exceptionally higher than others.

**Student Questionnaire Survey (SOS)**

Questionnaires were used to solicit the views of students mainly because the student population size was large (over 400). The questions were designed to cover the whole range of research questions related to student perceptions. Best and Kahn (1998, p.299) claim that the questionnaire has unique advantages and the properly structured and administered questionnaire may serve as a most appropriate and useful data-gathering device in a research project. They describe the characteristics of a good questionnaire (ibid, p.307-308). However, they warn that the rate of returns is frequently disappointing and may provide a flimsy basis for generalization (ibid, p.299).

Both open-ended and closed questions were used in the questionnaire in order to allow the respondents an option to elaborate the views in their own words in either English or Chinese. Questionnaires are research tools which perhaps more than any other need a pilot run (Johnson 1994, p.39). After checking against a number of traps to avoid problem questions as suggested by Kane (1985, p.78-79), the sample questionnaires were issued to 36 class representatives (3 from each class) and 20 teachers during the pilot run in January 2000. It was found that the answer to some
Methodology

research questions which might require further explanation, clarification, elaboration, discussion could be solicited by interviews with student representatives or other means. For example, "what is the relationship between flexibility, control and standardization?" The questionnaire (Appendix B) was then refined based on the feedback of the pilot run.

Two versions of questionnaire (Web-based and Word document, Appendix B) were sent out to students who had completed the final examination, by means of email with the questionnaire attached and enclosed as Web-link in February 2001. Berdie et al (1986, p.5 – 6) and Czaja et al (1996, p.59) stress the importance of the study goals and purposes of the questionnaire being clear in order to collect exact information from respondents. The researcher briefed all classes before the questionnaires were distributed to students. A total of around thirty email inquiries were received from students seeking for clarifications and elaboration of certain terms. Nearly 30 per cent of students used the electronic versions to return their replies. Some of them (about 20%) sent back the Word document hard copies with comments in a combination of English and Chinese. FD and D2 students had already graduated. These students were also notified during the graduation ceremony held on January 2001 by their class tutors. Those who did not respond were sent hard copies and reminder. The rates of return of different groups of students were quite satisfactory.

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Student (a)</th>
<th>No. of Return (b)</th>
<th>Return Rate (a/b) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D1</td>
<td>121</td>
<td>89</td>
<td>74</td>
</tr>
<tr>
<td>D1</td>
<td>81</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>FD</td>
<td>113</td>
<td>80</td>
<td>71</td>
</tr>
<tr>
<td>D2</td>
<td>102</td>
<td>79</td>
<td>77</td>
</tr>
</tbody>
</table>
Methodology

The questionnaire contained mainly quantitative data with some qualitative data from students’ comments. The percentages of frequency count from different groups of students were evaluated.

**Unstructured Interviews with Students (UIS)**

Although the purposes of the research govern the questions asked, their content, sequence and wording are entirely in the hand of the interviewer when the unstructured interview is conducted in an open situation, having greater flexibility and freedom (Cohen and Manion 1997, p.273). It is likely to provide greater depth of response and exploit the advantage of the interview in getting beneath-the-surface reactions (Best and Kahn 1998, p.320-321).

Four unstructured group interviews each with three student representatives were conducted to clarify some important issues and provide supplementary explanations related to the outcomes of the student questionnaire:

-  **i)** Flexibility and control
-  **ii)** The WBC contributions on supplementary examination
-  **iii)** The language issues

Each interview lasted for about one hour. The conversations were tape-recorded and later transcribed.
Semi-structured Interviews with Teachers (SIT)

Semi-structured interviews were used in this research with open-ended questions derived from the literature to enable coverage of all relevant areas of interest. Based on the WBC Change Model, the interview questions were divided into three clusters. Cohen and Manion (1994, p.271-273) claim that informal or unstructured interviews, where the interviewer may have a number of key issues which he or she raises in conversational style instead of a set of questionnaire, should be conducted in an open situation having greater flexibility and freedom.

This does not mean, however, that the unstructured interview is a more casual affair, for in its own way it also has to be carefully planned. (ibid, 273)

In this research, the techniques of asking good questions (Merriam 1998, p.93) and probing and flexibility (Johnson 1994, p.46-47) were used. The techniques of probing and flexibility were used in a neutral way to encourage the teachers to give an answer or to clarify or amplify an answer without leading them in a particular direction. All the twenty lecturers in the department were interviewed individually. Each interview lasted from 60 to 100 minutes. The conversations were tape-recorded and transcribed later for analysis.

Data Analysis

Many writers (Bassey 1999, Sturman 1999, Yin 1994) have already pointed out both qualitative and quantitative approaches can be applied to case study research. Categorical aggregation, interpretation, content analysis and correlation analysis were
used to analyze data accordingly.

**Categorical Aggregation, Interpretation and Content Analysis**

Data analysis for the case study evidence consisted of examining, categorizing, tabulating and recombining the evidence to address the initial propositions. According to Stake (1995, p.74), two strategic ways that researchers reach new meanings about cases are through direct interpretation of the individual instance and through aggregation of instances until something can be said about as a class. Patton (1990, p.371-372) explains the three steps to organize and analyze qualitative data:

i) Organize the data

ii) Describe the various pertinent aspects of the study

iii) Interpretation

The most distinctive characteristic of qualitative inquiry is its emphasis on interpretation (Stake 1995, p.8). Interpretation has been reasserted by Patton (1990, p.375) as the most critical phase of the analysis process:

Interpretation involves explaining the findings, answering 'why' questions, attaching significance to particular results, and putting patterns into an analytic framework.

This approach has been described by Gall et al (1999) as interpretational analysis. They (ibid, p.298) explain how it is employed as an approach to data analysis in case study research:

It involves a systematic set of procedures to code and classify qualitative data to ensure that the important constructs, themes and patterns emerge. These procedures
can be carried out manually, but use of a computer with appropriate software programs makes the task much more manageable.

Most interview data were analyzed using the above approach to explain and answer the research questions in the WBC Change Model. Important constructs, themes and patterns emerged in major areas concerning flexibility, the language barrier and managing change. The literature could provide alternative theoretical viewpoints to interpret and analyze these interview data qualitatively (Stake 1995, p.112-115; Yin 1994, p.91-93).

Cohen and Manion (1997, p.56) explain the more sophisticated approaches to content analysis are careful to identify appropriate categories and units of analysis, both of which will reflect the nature of the document being analyzed and the purpose of the research. The following give the essence of this approach.

[Content analysis is] a multipurpose research method developed specifically for investigating a broad spectrum of problems in which the content of communication serves as a basis of inference. (Holsti 1968, quoted in Cohen and Manion 1997, p.55)

Best et al (1998, p.246-248) relate content analysis to documentary analysis and illustrate how it serves the following purposes:

i) To describe prevailing practices or conditions

ii) To discover the relative importance of, or interest in, certain topics or problems

iii) To explain the possible causal factors related to some outcome, action, or event
The above analytical techniques were used to analyze qualitative data collected from different research tools and answer the research questions based on the WBC Change Model. These techniques were widely used in the Web-forum for teachers and documentary research relating to the research questions on curriculum change, organizational change and technological change. Close examination of the content of student emails during observation revealed the problems of using short-form English and irrelevance to their studies.

Statistical Analysis

Besides the use of Internet and Intranet as mentioned earlier, the computer really played a crucial role both in data collection and data analysis. The WebCT kept a complete record of students' visits to various Web pages and logged all online communication and activities of students. A substantial amount of statistical data were captured. The behaviors of the four groups of students were compared to elaborate their commonality and differences. The average frequency counts for different categories of answer were evaluated for student questionnaires in order to obtain a majority views for student perception. Correlation research was conducted to find out the relationship between different types of interactivity and student grades.

Correlation Research

Cohen and Manion (1997, p.133) emphasized that correlation research is particularly useful in exploratory studies into fields where little or no previous research has been
undertaken. They state that a major advantage of correlation research is to yield information concerning the degree of relationship between variables being studied:

...as a basis for prediction studies, it enables researchers to make estimates of the probable accuracy of their predictions; it is especially useful for lower-level ground work where it serves as a powerful exploratory tool; and it does not require large samples. (Cohen and Manion 1997, p.137)

However, Triola (1997, p.483) identifies three of the most common errors made in interpreting results involving correlation:

1. We must be careful to avoid concluding that correlation implies causality...a third variable lurking in the background,

2. Another source of potential error arises with data based on rates or averages;

3. A third error involves the property of linearity.

The techniques of correlation research were applied to analyze the relationship between student participation in various types of interaction and student performance. The total frequency of participation (instead of averages) in different types of interaction for each student and corresponding module grade were measured.

Best and Kahn (1998, p.372) use a crude criterion for interpreting the magnitude of correlation as follow:

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>.00 to .20</td>
<td>Negligible</td>
</tr>
<tr>
<td>.20 to .40</td>
<td>Low</td>
</tr>
<tr>
<td>.40 to .60</td>
<td>Moderate</td>
</tr>
<tr>
<td>.60 to .80</td>
<td>Substantial</td>
</tr>
<tr>
<td>.80 to 1.00</td>
<td>High to very high</td>
</tr>
</tbody>
</table>
Whether or not a correlation is significant is heavily dependent on the sample size. With large samples relatively low correlation coefficients can be deemed significant in statistical terms. Many writers have already pointed out that the correlation coefficients of most social and educational research seldom exceed 0.7 (Cohen and Manion 1997, p.130; Charles and Mertler 2002, p.283). For correlation research design, Charles and Mertler (2002, p.286) suggest a minimum sample size of 30. With the sample size between 81 and 121 (i.e. sample size of D1 and HD/D respectively), the correlation coefficient should be greater than 0.29 (0.22) and 0.24 (0.17) respectively at 1% (5%) level of significance (Charles and Mertler 2002, p.374; Triola 1997, p.98-99; Best and Kahn 1998, p.461). The confidence level of 1% significance was used in the correlation analysis to get a more accurate result.

**The Computer as an Analytical Tool**

Other than its powerful capability to collect and categorize rich amounts of electronic data, the computer was used extensively to analyze the data. Simple EXCEL statistical functions and formulae were designed to calculate the means for student questionnaires and the correlation coefficients for variables relating to interactivity and student grades. A standard EXCEL worksheet was created and used for all four groups of student data. To improve the reliability and validity of the results, sample test data were used to test the worksheet.

One major deficiency of previous research is the inability to differentiate the impacts of different types of virtual interactions on teaching and learning. The temptation for
this is that it is simple and straightforward to lump all types of interaction together. Researchers normally do not have the computing skills and techniques to record different types of interactivity separately. In this study, with the help of the Web-master, it was tactfully designed to categorize the mail-boxes for receiving and incoming messages for both teachers and students. An automated frequency count for emails and Web pages was logged by the computer.

The Limitations of Case Study Method

There are various limitations for case study. Merriam (1998, p.6) warns that the key concern of qualitative research is understanding the phenomenon of interest from the participants' perspectives, not the researcher's. Johnson (1994, p.22-23) points out the weaknesses of case study methods as 'lack of scientific rigour, possible uniqueness of the material and the possibility of uneven access to all aspects of the phenomenon studied'. A huge amount of data were captured by means of appropriate Web-based technology and analyzed both qualitatively and quantitatively, attempting to address the critics on lack of scientific rigour. However, it is still not generalizable outside the case. Merriam (1998, p.42-43) presents further limitations to deal with huge amount of data. Fortunately, the computer can be a critical instrument to facilitate and speed up the process of data collection and analysis. When conducting case study research, Guba and Lincoln (1981, p.377) warn that 'the readers tend to masquerade as a whole when in fact they are but a part - a slice of life'. They note an additional limitation of case study narratives:

Case studies can oversimplify or exaggerate a situation, leading the reader to
erroneous conclusions about the actual state of affairs. (ibid)

The uniqueness of the case study is sometimes unavoidable especially when the research is dealing with innovative technology where the pace of development can be uneven among various departments or disciplines, thereby increasing the possibility of uneven access to all aspects of the phenomenon studied. However, the experiences gained from the case study could be shared with others to invoke subsequent cases to be studied. The researcher had clearly defined the context of study and emphasized that the case applied to traditional vocational education, as segregated from other forms or modes of education.

Qualitative case studies are limited by the sensitivity and integrity of the investigator who is the primary instrument of data collection and analysis (Merriam 1998, p.42-43). Merriam also points out further concerns about the unusual problems of ethics and emphasizes the need to be aware of biases that can affect the final product. This triggered the need of investigator triangulation where some research results were being interpreted by other colleagues in this study.

Reliability and Validity

The issues of reliability and validity are essential to the effectiveness of any data-gathering procedure. Their importance are stressed by many writers especially when adopting qualitative approaches in case study (Cohen and Manion 1997, Merriam 1998, Best et al 1998, Johnson 1994, Stake 1995, Yin 1994, Bassey, 1999,
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Gall et al 1999). Their definitions are presented as follow:

Reliability 'is the degree of consistency that the instrument or procedure demonstrates: Whatever it is measuring, it does so consistently' (Best et al 1998, p.276); it 'refers to the extent to which research findings can be replicated' (Merriam 1998, p.205)

Validity 'is that quality of a data-gathering instrument or procedure that enables it to measure what it is supposed to measure' (Best et al 1998, p.276); it 'refers to the degree to which the explanations of phenomena match the realities of the world' (McMillan et al 1997, p.404)

There are various means to enhance the reliability and validity of the study. The ways to record data mechanically/automatically (e.g. computer logs) and use of participant researcher suggested by McMillan et al (1997, p.406) were adopted to enhance the validity of the research data. Reliability and validity are related to the concepts of trustworthiness which illuminates the ethic of respect for truth in case study research (Bassey 1999, p.75). In order to enhance the credibility of the study, he (ibid, p.76) suggests that 'raw data checked with their sources' and 'sufficient triangulation of raw data leading to analytical statements'. Gall et al (1999, p.305) emphasize the importance to test and enhance the soundness of a case study finding by drawing on corroborative evidence:

It is the process of using multiple data-collection methods, data sources, analysts, or theories to check case study findings.

Hence, in this study, student perceptions were solicited through questionnaire, in-depth follow-up interviews and observations while teacher perceptions were gained
Methodology

through the Web-based forum and semi-structured interviews.

The concepts on reliability and validity are going to be examined in respect of the tools used in the research.

**Documents and Electronic Data**

It is emphasized that the authenticity, credibility, representativeness and meaning of documents should be considered for an accurate account of the events or issues with which they deal (Johnson 1994, p.59-62; Merriam 1998, p.124-125). WebCT kept a complete record of students' visits to various pages and thus provided a reliable and unobtrusive measure of Web-based learning behavior of students. It recorded all online communication and activities of students, hence the use patterns and behaviors for major types of interaction could be identified.

To enhance the credibility of the documentary research, the techniques of content analysis and careful interpretation of data were used with sufficient time, patience and thoroughness in unearthing relevant materials. For example, the computer was used to search for important keyword like "control", "curriculum", "assessment", "change" and "technology" in the Web forums for teachers. Key patterns around the research questions were categorized, interpreted and checked against the results obtained from other research tools. Out of 1,000 threaded discussions, about 100 of them were found to provide useful explanations to the research questions relating to flexibility and managing change.

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Methodology

**Student Questionnaire**

There are potential limitations for semi-structured questionnaire, like the issues of bias and validity or reliability of the instrument (Best et al 1998, p.310; Cohen and Manion 1997, p.99-101). To improve the validity and reliability of the questionnaire data, a pilot run was conducted with 36 student representatives and twenty teachers in January 2000. Suggestions from colleagues and students helped to reveal ambiguities. Anonymity and confidentiality were addressed and strengthened. Four unstructured follow-up interviews with student representatives were used for issues that required detailed clarification (for example, the issues of control, supplementary exam and language). This was very useful and also provided supplementary evidence to enrich the findings from the questionnaire and other research tools.

**Observation**

Johnson (1994, p.25) emphasizes that observation becomes a research tool when it is subjected to checks and controls on validity and reliability. Unobtrusive measures by means of the LAN School software were used to increase to the reliability of observation. A check list (Appendix A) was used to observe what were to be observed.
Semi-structured Interviews with Teachers

Perhaps the most practical way of achieving greater validity for interview is to minimize the amount of bias as much as possible (Cohen and Manion 1997, p.281). One way to achieve this is careful formulation of the questions so that the meaning is crystal clear. In view of the potential bias from an insider researcher, great effort and constant endeavor were spent to maintain the objectivity for both favorable and unfavorable data. To increase the reliability suggested by Best and Kahn (1998, p.322), some questions with uncertain responses were restated in a slightly different form at the end of the interviews. With the consent of the interviewees, the conversations were tape-recorded. This could provide more accurate rendition of verbal data and increased the accuracy due to poor recall. The transcribed data draft was sent back to the colleagues for comment. Minor amendments and comments were received. Some of them suggested not to use the strong word like "hate" or "stupid" regarding the responses to curriculum and academic structure.

Triangulation

Qualitative research is marked by criticism of the quality of the data obtained and the problems encountered. This being the case, it poses further questions on the validity of data that needs triangulation. It is widely accepted that triangulation is a useful procedure for establishing validity and credibility in case studies (Merriam 1998, p.204; Cohen and Manion 1997, p.238; Stake 1995, p.108; Sturman 1999 p.110; Gall et al 1999, p.305). Cohen and Manion (1997, p.233-251), in their book, use a
chapter to emphasize the use of triangulation to map out, or explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint and by making use of both quantitative and qualitative data. They (ibid, p.241) assert that triangulation can be a useful technique where a researcher is engaged in case study.

In its use of multiple methods, triangulation may utilize either normative or interpretive techniques; or it may draw on methods from both these approaches and use them in combination. (Cohen and Manion 1997, p.235)

They (ibid, p.233-234) highlight two major advantages of triangulation:

i) Exclusive reliance on one method may bias or distort the researcher’s picture of the particular slice of reality he or she is investigating. Triangulation gives researchers more confidence about their findings;

ii) Triangulation helps to overcome the problem of ‘method-boundedness’.

Stake (1995, p.112-115) and Yin (1994, p.91-93) explain four triangulation protocols:

i) Data source triangulation

ii) Investigator triangulation

iii) Theory triangulation

iv) Methodological triangulation

All the four triangulation protocols were used in this research. Giving enough technological consideration to the data collected (e.g. from different WBC servers) helped to analyze the results from different perspectives. The data collected from different groups of students using different servers provided data source triangulation. Some of the research findings were discussed with or interpreted by other colleagues.
This served as investigator triangulation. The theories developed from rich literature definitely helped to interpret results from alternative theoretical viewpoints. Methodological triangulation was adopted where data in this research were collected through multiple sources such as documents, observations, semi-structured interviews and questionnaires. These data, together with those archival data sources obtained from computer (e.g. the log files of WebCT), were analyzed both qualitatively and quantitatively, thereby providing ample means for triangulation protocols.

Research Ethics in Case Study

Unobtrusive measures were used in documentary research and observation to minimize the disturbance to the subject of study. However, Johnson (1994, p.33) warns that whilst unobtrusive measures are entertaining to read, they raise a number of serious ethical issues. The ethical issues for case study research are vitally important. In planning a research project involving human subjects, Best et al (1998, p.40-45) stress that it is important to consider the ethical guidelines designed to protect his or her subjects.

It is important to balance the costs and benefits related to the ethical dilemma. Despite the major difficulty in assessing the full extent of costs and benefits, Singleton and Straits (1999, p.515-516) claim that a cost-benefit analysis can be a helpful first step in examining the ethics of a proposed study. In planning a research project, researchers have the obligation to carefully weigh the potential benefits or contributions of a project against its costs to the individual participants:
Such costs may include affronts to dignity, anxiety, embarrassment, loss of trust in social relations, loss of autonomy and self-determination, and lowered self-esteem.

...the benefits of the study are potential advances in theoretical or applied knowledge...and better understanding of the researched phenomena. (Nachmias 1996, p.80-81)

In his conclusion and recommendation concerning ethics and values in applied social research, Kimmel (1988, p.139) advocates that the traditional cost-benefit model that underlies ethical decision making in social research should be modified to emphasize the outcomes of both doing and not doing the research. With careful planning and consideration to the participants, the costs of the study as specified by Nachmias (1996) were minimal. The benefits of the study were better understanding and justification for the change to the WBC. Huge amount of IT investments and human efforts could be wasted without appropriate research and evaluation.

Within the ethical context of costs versus benefits, Nachmias (1996, p.81) raised the two central problems that most often concern investigators: informed consent and privacy. Obtaining informed consent is an effective means to address the ethical concerns as suggested by many writers (Cohen and Manion 1997, p.349-354; Johnson 1994, p.79-82; Best et al 1998, p.42-44; Berger and Patchner 1994, p.93). Through the briefing sessions to classes and discussion with colleagues in informal meeting, it was possible to obtain informed consent from the subjects in the study. To protect the privacy of the participants, the fundamental ethical dilemmas such as anonymity and confidentiality as recommended by Nachmias (1996), Burger and Patchner (1994), Cohen and Manion (1997), Best et al (1998) and Johnson (1994) were strictly followed. Such instances include the use of anonymous questionnaires, observations
in a natural setting, and archival research data. In no way were the identities of the research subjects to be disclosed.

The ethical issues relating to observation were fully addressed. Observation would not be conducted without full consensus from the target groups. Informed consent was sought from the subjects who were assured that all information gathered was kept in strict confidence and complied with the Data Privacy Ordinance of the HKSAR. Under no circumstance were any personal data being revealed. All student groups under observation were briefed about the purpose and duration of the observation. LAN School was used to observe the WBC activities in the computer laboratories. It was a software which allowed the lecturer to broadcast the screens, mouse inputs and keystrokes of their students in normal laboratory settings. The lecturer could also browse student screens remotely thus creating a very effective interactive working models for the class. This nurtured an effective way for the lecturers to control the pace of online teaching.

Having considered various issues in the case study, the data collected from different research tools are organized, interpreted and analyzed in the next chapter.
Chapter Four
Research Findings and Analysis

Before the commencement of detailed analysis, the raw data, both quantitative and qualitative, are summarized, categorized and interpreted. They are then synthesized, analyzed and interrogated using the research questions based on the WBC Change Model (Figure 4.1).

Figure 4.1 The WBC Change Model

```
Flexibility
Accessibility
Control & Standardization
Active Learning

Interactivity
Different Types of Interactivity
Additional Learning Benefits
The Language Barriers

The WBC
Teaching & Learning

Managing Change
Curriculum Change
Organizational Change
Technological Change
```
Both qualitative and quantitative analyses were applied to solicit the answers for questions clustered around the three major research questions:

1. **How does the flexibility offered by the WBC affect teaching and learning?**
2. **How do the various forms of interaction affect teaching and learning?**
3. **In transforming to the new flexible paradigm of WBC, how do IVE teachers and students manage to cope with the change?**

The behaviors and perceptions of students and teachers were studied using different research tools restated below:

i) **Documentary Research**
   - VTC Document [VTCD]
   - WebCT Log Files [WLF]
   - Student Grade Reporting System [SGRS]
   - Web Forum for Teachers [WFT]

ii) **Observation** [OB]

iii) **Student Questionnaire Survey** [SQS]

iv) **Semi-structured Interviews with Teachers** [SIT]

v) **Unstructured Interviews with Student representatives** [UIS]

In this chapter, the origins of data sources used in relation to the research results are clearly indicated in square brackets. For example, [SQS, Part III] refers to Part III of the Student Questionnaire Survey. For comparison purpose, the values of different groups of students are presented in the order of [HD/D, FD, D1, D2] respectively. The findings are analyzed from both qualitative and quantitative perspectives. Their differences and similarities are compared and analyzed. Qualitative data are
categorized and interpreted in order to solicit answers to research questions. Quantitative data are analyzed statistically. Correlation analysis is used to find out the relationship between various types of interactions and student performance. The theory developed from literature is used to interpret the results from alternative theoretical viewpoints (Stake 1995, Yin 1994). To avoid the difficulties of the academic/technical divide (Betts et al 1998, McCormack et al 1997), balanced consideration is given to both educational and technological issues.

The sequence of presentation is structured in accordance with the WBC Change Model: Flexibility, Interactivity and Managing Change. The research questions are restated and emboldened while the research results are summarized and underlined.

Students came from four different subject groups:

i) Higher Diploma/Diploma Group (HD/D)

ii) Standalone Diploma Group (D1)

iii) Foundation Diploma Group (FD)

iv) Old Diploma Group (D2)

D2 group followed the old curriculum whereas others studied the new curriculum. It was expected that there would be distinct differences between the views of the D2 group and the others. However, it was surprising to learn that the behaviors and perceptions of the D1 and D2 groups were quite similar in various aspects, but significantly different from the other two groups. Although HD/D and D1 groups adopted the same syllabuses, their responses were rather different.
Flexibility

How does the flexibility offered by the WBC affect teaching and learning?

Flexibility and Accessibility

How do teachers and students perceive the teaching and learning flexibility provided by the WBC?

The student questionnaire [SQS, Part II] had the following findings concerning the first research question. Referring to the questions of whether the existing WBC provided different learning flexibility, D1 and D2 groups had much positive feedback (average number of learning flexibility provided by the WBC module > 5); but most HD/D and FD students did not perceive that their WBC provided them with much learning flexibility (average < 2.5).

There were diverse views from students about which type of learning flexibility provided by the WBC was important. The majority of FD students were neutral about the following:

i) More flexible learning schedule to learn at their own pace

ii) More flexible learning paths for individual students

A higher percentage of HD/D students than their counterparts expected that the following types of learning flexibility provided by the WBC were important:

i) More flexible learning paths for individual students [58,32,35,38]

ii) More flexible teaching approaches to cater for the individual needs [56,36,33,37]
Although D1 and D2 students were positive about the learning flexibility provided by the existing WBC, the majority of them did not expect that it was important for the WBC to provide more flexible learning paths for individual students. They were more satisfied with the existing WBC module. On the contrary, HD/D students were very dissatisfied, hence they demanded more learning flexibility. Unstructured interviews with student representatives [UIS] affirmed the above perceptions of different groups of students.

Semi-structured interviews with teachers [SIT] revealed consistent views with student perceptions concerning learning flexibility. D1 and D2 teachers believed that WBC could help to enhance teaching and learning flexibility:

"WBC allows more flexibility for students to learn anywhere, any time."

"The supplementary servers provide more teaching and learning flexibility as they can address the needs of different groups of students. More flexible pedagogy can be adopted."

"Teachers have more flexibility to design their own online teaching materials to suit students with different level of academic ability."

HD/D and FD teachers had much reservation about the flexibility provided by the WBC [SIT]:

"The WBC can only provide limited teaching and learning flexibility. There is much room to improve."

"WBC alone cannot enhance the teaching and learning flexibility. The academic policy should allow more room for teachers to maneuver."

"The flexibility of the WBC is limited by common curriculum and academic structure."
The common curriculum and academic structure could be factors limiting the teaching and learning flexibility of the WBC.

From the perceptions of teachers and students, it was found that the WBC for D1 and D2 groups provided more flexibility. The critical factors limiting the freedom to develop the WBC for HD/D and FD groups probably could be the common curriculum and academic structure raised by the teachers. The common curriculum restricted the teaching pedagogy and learning paths for individual students in the HD/D and FD groups. However, the documents [VTCD] showed that HD/D and D1 were basically studying the same curriculum and syllabus but the findings for these two groups of students were quite different. Further analyses conducted in later sections concerning the curriculum and academic structure may provide further insights to explain such phenomenon. The following analysis then returns back to the next research question on flexibility and accessibility.

What impacts will this application of technology have on student access (e.g. home access) and flexibility to learn? What impacts will this application of technology have on teacher access and flexibility to deliver the WBC?

The student questionnaire [SQS, Part II] revealed that most students (over 92%) had a computer at home. However, only a small percentage of them except D2 students perceived that home access was important [21,23,18,45]. The majority of students had relatively low frequency of home access rate (the ratio of home to on-campus access is less than 25%). The document [VTCD] revealed that students could access the WBC at home through a designated Internet Service Provider (ISP). However,
some student representatives commented that the access to the WBC at home through a designated ISP would limit their choice as most of them joined other ISP and some of them were free of charge. Nevertheless, they were willing to pay the Internet fee on their own just like their mobile phones [UIS]. The question of taxpayer-funded access to the WBC raised by Nunan (2000) and the IT Advisory Group is really not a matter of concern. Most teachers perceived that the impact of limited home access to the WBC was not significant for both teachers and students. Some teachers responded [SIT]:

"The development of the WBC is at its infant stage, the content of the WBC is not that interactive." [HD/D]

"The demand of home access for WBC is not significant especially for on campus students." [FD, D1]

Flexibility is linked to widening access and increasing participation (Kedney and Brownlow 1994). The majority of teachers perceived that the WBC could widen access and increase participation for teaching and learning [SIT]:

"The WBC is very useful for students who missed something in the lecture."

"The WBC allows flexibility for students to download teaching materials and lecture notes at home."

"The WBC can facilitate collaboration among colleagues; and discussion between teachers and students." [D1, D2]

"It is convenient to raise questions during face-to-face class contact and post the solution on the Web afterwards; or the other way round." [D1, D2]

D1 and D2 student representatives shared similar views with teachers but their HD/D and FD counterparts were neutral [UIS].
Accessibility and Technology: on-campus computing facilities, bandwidth and software capability are critical factors to enhance the accessibility of the WBC

Traditional students rely more on on-campus computing facilities. Some D1 and D2 students pointed out that they did not have sufficient free sessions of computer laboratories for them to access the WBC on campus. They were concerned that the free-booking sessions after class were insufficient [SQS, Part II]. A D1 student representative explained why on-campus computing facilities were essential [UIS]:

"On-campus computing facilities are essential for free-booking as they can supplement our requirement on home access."

In general, teachers perceived that on-campus access to the WBC was limited by high utilization of the computer laboratories [SIT]. The documents [VTCD] also showed that the utilization rate of the computer laboratories were as high as 90%. Only less than 10% of time was available for student free-booking periods.

Bandwidth is critical to enhance the accessibility of the WBC. Katz et al (1997) and Jefferies et al (1998) have raised the problem of bandwidth as a major concern to Internet access. Some students pointed out that slow response rate was another important barrier to home access [SQS, Part II]. They perceived home access was not so important simply because the response rate at home was unacceptably slow. Some D1 students complained [SQS, Part II]:

"Very often the computer is hung up when I attempt to access the WBC during weekend and the evening."

"The slow response time is a critical barrier to home access."
The Web notice revealed that there was frequent suspension of the Internet services for maintenance work on weekends and evenings in order to avoid affecting normal transactions during office hours [WFT]. Home access was seriously affected by the slow response of the network due to high access rate especially at critical times such as assignment deadlines [UIS]. Although they were reluctant to access the WBC at home due to slow response, the D2 student representatives stated that they were compelled to do so [UIS]:

"We need to make use of the weekends to complete the Web-based projects before the deadlines."

The slow response has significant impact even for on-campus accessibility and adverse effect on the development of the WBC materials due to undue uploading and waiting time. Some teachers from all four groups believed that the slow response for uploading of materials on the Web would severely affect the updating and development of the WBC [SIT]. D1 and D2 teachers explained how to use the Intranet and Virtual Private Network (VPN) to improve the speed by over 100 times (for on-campus access) and 30 times (for home access) respectively.

Software capability is another technology issue that can severely affect the accessibility of the WBC. Technical issues such as browser and plug-in software can enhance the accessibility of the WBC. Teachers perceived that a potential accessibility issue surrounding the downloading of WBC documents was that the student should have the requisite software to view the document [SIT]. Access to interactive content was dependent on the capabilities of the browser in use and therefore, some interactive elements of the WBC might not be accessible to all
students. Some D1 and D2 teachers made the following suggestion [SIT]:

"This software limitation on the WBC accessibility can be overcome by providing documents in formats such as Portable Document Format (PDF) and Dynadoc. Such formats can be viewed using software that are freely available on the Internet at no charge from the software vendors."

"PDF is particularly valuable for its graphical and accurate representation of formatted documents. A hyperlink for accessing the required software should be provided when downloadable documents are provided."

Some students pointed out that they had great difficulties to access the WBC at home due to unavailability of browser and plug-in software [SQS, Part II]:

"Certain Web pages requires special software which is very expensive."

"Our browser is inferior to display special characters like Chinese."

"Since WebCT does not support Chinese, there may be problems for accessing certain Chinese module like Putonghua." [FD]

"We cannot display some video clips and graphics at home." [D1, D2]

**Accessibility and Interactivity:** online interactive activities enhance student participation and further widen the accessibility of the WBC

For the HD/D and FD students, their WBC had less interactive elements and were more or less like a printed text. Hence they perceived that home access as not so important. However, some of them made the following comments [SQS, Part II]:

"The WBC should include more interactive elements like online assignments"

"The WBC should provide more interactivity like video-on-demand so that we can capture the missed lecture anytime, anywhere."

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
The student questionnaire [SQS, Part III] and WebCT showed that the WBC for D1 and D2 students included online assignments. These two groups of students were found to be the most active WBC users. In addition, D2 students were the most active home users of the WBC [SQS, Part II]. Some students explained that home access was important because the WBC allowed them to perform their online assignments at home. Some student representatives explained why online interactive activities were useful [UIS]:

"It is difficult to contact the teacher on campus. We can simply send him an email requesting him to further elaborate the requirements of the projects." [D1]

"Face-to-face group discussion is difficult due to limited space and time on campus. We prefer Web-based discussion on the Web after class." [D2]

"To improve the accessibility of the WBC, it must contain more interactive elements."

[HD/D, FD]

Teachers also perceived that higher level of online interactivity could enhance student participation and accessibility of the WBC, but it demanded more on technology. Some teachers made the following comment about online interactivities [SIT]:

"Access to interactive elements is dependent on the power of technology which may limit the accessibility of the WBC." [HD/D, D1, D2]

"Online interactive elements are essential for enhancing student participation and widening the accessibility of the WBC." [FD, D1, D2]

The problems of accessibility have demonstrated that: accessibility, interactivity and technology are interacting with each other in the WBC (Figure 4.2). It seems to support the use of the WBC Change Model as a research framework in this study.
As far as the flexibility and accessibility provided by this new way of delivery are concerned, is it possible to bring about new teaching and learning opportunities without others being disadvantaged?

**Will the WBC enable new needs to be served?**

New opportunities arise: the WBC can supplement the needs of the students requiring consultation during summer time, thereby improving their grades in the supplementary exam.

Many teachers pointed out that the WBC really brought about new opportunities for students to improve their performance [SIT]:

*Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change*
"Students can track their own progress on the Web. This also helps to remind students with poor performance, thereby improving their grades."

"The WBC is very useful for students who missed something in the lecture."

A HD/D teacher claimed that the response time of the WBC on home access was unexpectedly high during the summer time. He saw the opportunity of home access for the WBC [SIT]:

"Home access is useful to provide online tutorial to students especially in summer time."

Some teachers also saw the opportunity to use the WBC to enhance student performance in the supplementary exam [SIT]:

"The WBC provides a convenient way to get in touch with students in summer time."

[HD/D, FD, D2]

"It is important to keep in touch with the students who need to take the supplementary exam and need extra help from their teachers while most of us are on leave. We are willing to provide this kind of remote assistance to them." [HD/D, D1]

The student questionnaire survey did not reveal this scenario. The Student Grade Report System [SGRS] showed that the HD/D and FD students had the highest overall failure rate (35% and 30% respectively) in their final exam. All twelve students in one of the HD/D classes failed a non-WBC module in the supplementary exam [SGRS].

Figure 4.3 shows that the WBC modules had the highest pass rate of 90% (the overall average was 62%, SGRS) in the supplementary exam. It was found that students attempted to contact their teachers through the Web during their summer vacation [WLF].
Research Findings and Analysis

Figure 4.3  Comparison of Pass Rate

<table>
<thead>
<tr>
<th>Group</th>
<th>Main Exam Pass Rate (%)</th>
<th>Average Pass Rate (%)</th>
<th>Supplementary Exam Pass Rate (%)</th>
<th>Average Pass Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>73</td>
<td>65</td>
<td>92</td>
<td>61</td>
</tr>
<tr>
<td>D1</td>
<td>91</td>
<td>81</td>
<td>91</td>
<td>64</td>
</tr>
<tr>
<td>FD</td>
<td>87</td>
<td>70</td>
<td>89</td>
<td>60</td>
</tr>
<tr>
<td>D2</td>
<td>100</td>
<td>89</td>
<td>-</td>
<td>65</td>
</tr>
</tbody>
</table>

The student representatives had the following responses about the contribution of the WBC in the supplementary exam [UIS]:

"As most computer laboratories are open for free-booking, we can keep in touch with the teachers on leave in summer by means of electronic communications."  [D1, D2]

"The response rate during summer period is unexpectedly high."  [HD/D, FD]

"Some classmates make use of the WBC as a means of online tutorial with teachers before the supplementary exam."  [HD/D, D1]

"By means of the WBC, I can really enjoy the merits of distance learning in summer."  [D1]

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
“Unlike other non-WBC modules, we can contact our WBC tutors online during the summer vacation.” [FD]

“The WBC acts as savior to students taking the supplementary exam when it is difficult to get in touch with the teachers on leave.” [HD/D]

According to the interviews with teachers [SIT] and student representatives [UIS], the pressure of common assessment was relieved in the supplementary exam where students at most got a pass and their chances of being promoted to Higher Diploma (HD) or Diploma (D) courses were only based on the main exam results. Teachers were free to elaborate the materials in more detail without fearing others being disadvantaged. Students were allowed to have an option to submit their supplementary assessment online. The research had shown that the WBC really helps to improve the pass rate of the supplementary exam results. The WBC enhanced communication between teachers and students in the summer time, thereby providing better tutorial support and consultation for needy students, eventually helping students to perform better in their supplementary exam. Similar outcome from Owston (1997) was also experimented with the successful use of Web and Internet tools to enhance communications between teachers and students in summer.

**Will the WBC disadvantage students that we currently serve?**

**Will passive students be disadvantaged by the WBC?**

Online learning requires students to be active (Alden 1998). How about passive students? Most student representatives except FD believed that passive students
would not be able to gain advantage from the WBC [UIS]. Some teachers were concerned that the WBC would disadvantage the passive students and those who were not aware of the distance learning mode of accessibility to their tutors in summer [SIT]:

"The WBC helps to improve the pass rate of the supplementary exam through online tutorial. However, this may disadvantage those who do not aware of this kind of distance learning flexibility." [HD/D, D1]

"We can use the WBC as online tutorials for student taking the supplementary exam, but passive students cannot take this advantage." [FD]

As students brought up on a force-feeding education method may have difficulty in adopting to any new method of education (McCormack et al 1997), like the WBC which requires students to be active and responsible for their own learning (Driscoll 1998, Wade 1994). Although both students and teachers perceived that passive students might be disadvantaged, there was no clear statistical evidence showing that passive students had worse performance.

The next research questions arise from the argument that the implementation of a flexible curriculum requires more control and standardized approach (Betts et al 1998). It is important to know how does it affect the development of the WBC.
Flexibility, Control and Standardization

What is the relationship between flexibility, control and standardization for the WBC?

Both students and teachers expect a direct relationship between flexibility and standardization to ensure the quality and standard of the WBC. They perceive that flexibility for the WBC refers to more user control and less management control.

Betts et al (1998) expected a direct relationship between flexibility, control and standardization on curriculum. Both the Education Commission Report (EC 1999) and IVE (2000) emphasize the flexibility for students to master their own learning. Flexibility refers to increased student control on the path, rate and depth of the content of the courses (McCormack et al 1997, Driscoll 1998). The research findings showed that teachers and students had different views on flexibility and control concerning the WBC. The majority of student representatives perceived that there should be more student control and less management control (or teacher control) on the WBC; and that the more flexible was the WBC, the more standardization was required to ensure the standard of the course [UIS].

The majority of teachers perceived the relationship between flexibility, control and standardization as followed [SIT]:

"To allow for more flexibility for the WBC, there should be more student and teacher control. Management control should be kept at a minimum."

"There should be a direct relationship between flexibility and standardization to
Both teachers [SIT] and students [UIS] perceived that there should be a balance between management control, user control and flexibility. Nevertheless, they expressed concerns about how they affected the development of the WBC.

How do the flexibility, control and standardization affect the development of the WBC?

Tight control stifles the growth of the WBC

There was evidence to support the argument of Kanter (1983) that control could stifle the change and growth of the new WBC. The management had laid down strict control on the delivery of the WBC due to a common curriculum policy [VTCD]. It restricted the arrangement of reserved-free-booking periods for the HD/D and FD students for the sake of avoiding uneven resources in different campuses to ensure that no students were disadvantaged by unequal accessibility [VTCD, SIT]. The questionnaire survey [SQS, Part II] showed that very few students from HD/D and FD groups perceived that the existing WBC enabled them to become independent learners. They expected a more flexible teaching approach for the WBC. The existing WBC for these two groups provided less flexibility [SQS, Part II]. These students were comparatively inactive and had relatively low participation rate when compared with the other two groups [SQS, Part III; WLF]. The majority of HD/D and FD student representatives perceived that their schedules and methods of delivery of the WBC were rather rigid and lacking of flexibility [UIS].
The Web-forum revealed that the control and management of the common WBC module accounts was problematic [WFT]. As the common and standardized WBC had to be shared by teachers and students from as many as nine campuses, the ownership of the WBC account remained unresolved. The Computing Course Board [5th meeting, VTCD] clearly indicated that impartiality for all students should be ensured, requiring the standardized WBC materials to be moderated by module team, assessment team and course team with overlapping memberships and responsibilities. It was found that the academic leaders, course leaders and module leaders had laid down rigid rules on the posting of the WBC materials for HD/D and FD groups [SIT, WFT]. Eventually, most HD/D and FD teachers were cautious to handle email messages for their students and hesitant to put their teaching materials on the Web [SIT]. They did not have the flexibility to post freely on the Web. Online assessments and assignments were prohibited due to tight control imposed by a common curriculum [SIT]:

"Teachers do not have the freedom to upload files to the WBC sites. Any WBC materials must be moderated by all the WBC team members before they can be published onto the Web "  [HD/D, FD]

"Students do not have the flexibility to do online assignments. The course board has laid down strict control on any form of assessment for common modules."  [HD/D, FD]

Tight control stifled the growth of the WBC. There should be a balance between control and academic freedom in educational institutions (Bruce 1995). The D1 and D2 teachers perceived that they had more freedom to post their WBC materials on the supplementary servers or Web sites to serve the specific needs of their groups of
students [SIT]. These two groups of students were more satisfied with the learning flexibility provided by the WBC and they perceived that the WBC enabled them to become independent learners [SQS, Part II].

There is a conclusion that online learning requires students to be more active and independent (Lewis 1994, Alden 1998, Brooks 1997, Windschitl 1998, Driscoll 1998). Although Brooks (1998) and others advocate that active learning is likely to bring about substantially greater learning success, there is no strong evidence from previous research to support the same argument for the WBC.

**Flexibility and Active Learning**

**Does the WBC enable IVE students to become more independent?**

There were diverse views from teachers and students: HD/D and FD groups had different views with D1 and D2 groups. It seems that independent learners need more learning flexibility.

The student questionnaire [SQS, Part II] showed that the majority of D1 and D2 students perceived that the WBC could enable them to become a more independent learner. A high percentage of FD students (42%) were neutral. The majority of HD/D students had negative views.

Interviews with teachers [SIT] revealed that both HD/D and FD teachers were either
neutral or not certain, with the introduction of the WBC, whether the WBC could enable students to be more independent. The majority of the D1 and D2 teachers were quite positive.

It is likely that independent learners required more learning flexibility. It was strange to learn that HD/D and D1 students had quite different views on various issues concerning learning flexibility because basically they followed the same syllabus [VTCD]. It was found that D1 students perceived that their WBC provided more learning flexibility [SQS, Part II]. Hence they were more satisfied [SQS, UIS]. The WBC for HD/D was under strict control, hence HD/D students demanded more learning flexibility [SQS, Part II; UIS]. This was seen as enabling them to be more independent [UIS].

**In the context of WBC, do the active students perform better?**

Both teachers [SIT] and student representatives [SQS, UIS] had diverse views whether active students would perform better in the WBC. To answer the question, the relationships between the frequency of participation and student performance in the WBC modules were analyzed.

The exam scores reflect student performance. The Student Grade Report System [SGRS] accurately recorded the exam scores of individual students. Active students have higher levels of participation. Participation in any new innovation is critical (Fullan and Stiegelbauer 1998). The WebCT logs [WLF] accurately recorded the frequency of participation in various forms of interactivity for each student. Similar
data were captured from the student questionnaire [SQS, Part III]. The data collected from the two methods were compared. The latter had slightly higher means and standard scores. As the SQS was conducted after the supplementary exam, some students might include the values after the main exam. Hence the two sets of data were found to be fairly consistent in statistical terms (Triola 1997). The data from WebCT logs [WLF] are used as they can correlate with the student grades.

Driscoll (1998) and Alden (1998) clearly explain the nature of different types of interactivity. They can be classified as human (HI) and non-human or computer interaction (CI) (Hanna et al 2000). In order to better understand the effects of different kinds of interactivity on student performance, the average frequency of student participation in various forms of virtual interactions and grades are tabulated in Table 4.1.

**Students actively involved in human interactions are likely to out-perform others in the WBC**

Table 4.1 shows that all four groups of students had higher WBC grades than their respective group averages. Although D1 and D2 students were found to be more active and had higher average WBC grades, it was inappropriate to compare the performance of different groups of students as they studied different syllabuses. The average figures cannot indicate whether being an active student contributed to higher marks.
Table 4.1 Virtual Interaction Table

<table>
<thead>
<tr>
<th>Group</th>
<th>P</th>
<th>T</th>
<th>C</th>
<th>t</th>
<th>c</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>S</th>
<th>G</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>3</td>
<td>20</td>
<td>38</td>
<td>22</td>
<td>44</td>
<td>60</td>
<td>21</td>
<td>-</td>
<td>8</td>
<td>4</td>
<td>-</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>D1</td>
<td>6</td>
<td>33</td>
<td>53</td>
<td>32</td>
<td>81</td>
<td>96</td>
<td>31</td>
<td>37</td>
<td>5</td>
<td>5</td>
<td>57</td>
<td>64</td>
<td>59</td>
</tr>
<tr>
<td>FD</td>
<td>4</td>
<td>28</td>
<td>34</td>
<td>32</td>
<td>40</td>
<td>51</td>
<td>20</td>
<td>-</td>
<td>9</td>
<td>3</td>
<td>-</td>
<td>58</td>
<td>55</td>
</tr>
<tr>
<td>D2</td>
<td>3</td>
<td>19</td>
<td>108</td>
<td>19</td>
<td>228</td>
<td>88</td>
<td>42</td>
<td>34</td>
<td>8</td>
<td>9</td>
<td>-</td>
<td>63</td>
<td>60</td>
</tr>
</tbody>
</table>

Note:

Human Interaction (HI) Computer Interaction (CI)
P: Number of Postings 1: Course content and Course guide
T: Email to teachers 2: News
C: Email to classmates 3: Assignment or Test
t: Email received from teachers 4: FAQ and User guide
c: Email received from classmates 5: Online technical support
S: Learn/Supplementary Server G: WBC Grade GA: Group Average

The correlation coefficients between the total frequency of student participation in various types of interactions and their respective WBC grades were evaluated as [0.45, 0.34 (0.38), 0.53, 0.11] for [HD/D,D1,FD,D2]. The bracketed value took into account the effect of the learn server (i.e. student participation including visits to the learn server). According to Charles & Mertler (2002), Best & Kahn (1998) and Triola (1997), correlation greater than 0.29 is critical at 1% of significance when the sample size is greater than 81 (D1 group had the least sample size). Hence the overall correlation for the first three groups showed that active students were likely to perform better. However, it was disappointing to learn that the overall correlation for D1 and D2 students was among the lowest (0.34 & 0.11) but they were found to be the most active students (the two groups have the highest frequency of participation,
Table 4.1). It was even more disappointing to learn that the correlation of D2 was the lowest (0.11), meaning that for the most active students, their performance had no relationship to their participation in the WBC.

Table 4.2 shows the respective correlation for HI and CI. It was found that students actively involved in human interactions (HI) were likely to perform better in the WBC module.

Table 4.2  Correlation coefficients between interaction and grade

<table>
<thead>
<tr>
<th>Group</th>
<th>HI</th>
<th>CI</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>0.48</td>
<td>0.17</td>
<td>0.45</td>
</tr>
<tr>
<td>D1</td>
<td>0.45 (0.49)</td>
<td>0.16 (0.23)</td>
<td>0.34 (0.38)</td>
</tr>
<tr>
<td>F1</td>
<td>0.59</td>
<td>0.06</td>
<td>0.53</td>
</tr>
<tr>
<td>D2</td>
<td>0.39</td>
<td>0.35</td>
<td>0.11</td>
</tr>
</tbody>
</table>

It seems that it is inappropriate to lump different types of interaction together due to their different nature and level of interactivity. There are different types of interactions incurred through the WBC. They can be classified as human and non-human interactions (Hanna et al 2000). As the actual timing and effort contributed by students in each type of interaction are unknown, it is essential to separately evaluate the correlation between different types of interaction and student grades in order to get a more accurate picture.
Interactivity

_How do the various forms of interaction affect teaching and learning?_

Most previous research, no matter whether it claimed that WBC had significant effect on student performance or not, did not tell how different types of virtual interaction contributed to student learning. Carswell et al (2000) studied the effect of virtual human interactions and found no discrimination in grade. Light et al (1999) showed a modest positive correlation between assessment outcomes and frequency of contributions for virtual human interactions. Collins (2000) compared the performance of the Web-based course with other modes of instruction and found that the Web-based course would not necessarily contribute to an elevated mark. The Web-based course in Collins' case had both the elements of computer interactions and human interactions. But Collins did not separately study the effects contributed by each of these elements.

Within the context of Web-based Education in Hong Kong, Cheng et al (In James 1999) argued that there was improvement in student grades when WBI was used as a supplement to other teaching methods; and Yu et al found that there was significant correlation between the use behavior and test score (James, 1999). Cheng's case involved the overall effect of human interactions and computer interactions whereas Yu's case only involved computer interactions. Their research outcomes do provide very useful alternative viewpoints to this study.
**Different Types of Interactivity**

Before the effects of different types of interactions on student performance are evaluated, it is useful to have a better understanding on how students communicated on the Web and behaved in the WBC.

**How do the students communicate on the Web?**

There are critical debates concerning face-to-face (f2f) and virtual communications from the literature. The research aims to solicit an answer by studying how students communicated on the Web. It explains why on-campus students prefer f2f communications to human interactions on the Web.

**On-campus students prefer face-to-face (f2f) to human communications on the Web**

The observation [OB] recorded the frequency count of different types of interaction, including both online and offline, WBC and non-WBC activities. The following tables depict the total count in three observations and the ratio of different types of interactions:

<table>
<thead>
<tr>
<th>Total Count</th>
<th>A</th>
<th>B</th>
<th>C Teacher</th>
<th>C Classmates</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>43</td>
<td>53</td>
<td>25</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>D1</td>
<td>29</td>
<td>122</td>
<td>21</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>FD</td>
<td>38</td>
<td>62</td>
<td>18</td>
<td>19</td>
<td>49</td>
</tr>
<tr>
<td>D2</td>
<td>38</td>
<td>81</td>
<td>13</td>
<td>46</td>
<td>11</td>
</tr>
</tbody>
</table>
The observation results revealed that the frequencies of virtual interaction (VI, human and non-human) were higher than f2f communications. The table showed that the ratios for different groups were [1.7, 3.2, 2.7, 2.0]. This is understandable because one teacher had to look after more than 20 students during the laboratory sessions. Despite the WBC activities, students also spent their time in non-WBC or offline activities. However, it was found that the frequency of human interaction (HI) was less than f2f communications. Evidence shows that students mainly participate in non-human type of interactions as far as WBC activities are concerned, or they prefer f2f to human communications.

The student questionnaire survey [SQS, Part III] affirmed that the majority of students preferred f2f to electronic communication [65,61,73,59]. The student representatives explained why [UIS]:

"Face-to-face discussions with teachers and classmates are more useful as we can have immediate response to problems and solutions." [FD, D2]

"It is time consuming to discuss problems on the Web. We can hardly get a
consensus after several rounds of threaded discussions." [D1]

"By means of f2f communications, decisions can be made immediately." [HD/D]

"We have some difficulties to communicate in English on the Web." [FD]

The majority of teachers perceived that students preferred f2f to electronic communication. Some teachers explained why on-campus students preferred f2f communications [SIT]:

"Students are not quite adapted to this asynchronous mode of communications."
[HD/D, D1]

"They are still a bit shy to share their ideas openly with others on the Web." [FD, D1]

"There are many barriers for students to communicate freely on the Web like the language and technology issues." [D1, D2]

Although Laurillard (1993) claims that students can take time to ponder and make their contributions on the Web, the research does not support this argument. The results show that one reason why students hesitated to communicate on the Web was the excessive time spent on the asynchronous mode of communications [UIS]. Krauss and Fussell (1990) have pointed out that the recipient has less pressure to respond on the Web because of absence of sensory inputs for these temporal messages. The SQS [Part III] showed that few students took part in other synchronous forms of communication like ICQ chat rooms. Students preferred immediate response [UIS]. Alden (1998) claims that students are likely to use synchronous chat for team projects and informal discussions. However, the WBC did not have such a provision because of technology constraint [SIT].
Research Findings and Analysis

How do students behave in different WBC courses? Does the WBC enhance the academic achievement of students, if so, how?


Both teachers [SIT] and students [SQS, UIS] had quite diverse views about whether the WBC could help to improve their performance. The SQS [Part I] also showed that the majority of D1 and D2 students perceived that the WBC helped to improve their grades. The HD/D and FD students had equivocal views. A high percentage of HD/D (39%) and FD (42%) students were neutral [SQS, Part I]. Some teachers doubted whether the WBC could benefit the students [SIT]:

"Students tend to escape from classes more frequently, as they think they can study on their own with the use of the WBC." [HD/D, D1]

"Students do not have the initiative to explore on the Web and are unlikely to benefit from the WBC." [FD, D1]

However, some D1 and D2 teachers were quite confident that the WBC helped to improve student performance. They believed that students could benefit more because [SIT]:

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"Silent students are willing to speak out by means of e-communication." [D1]

"Through collaborative discussions on the Web, students can benefit from their peers."

[D2]

The WBC is likely to help improve the performance of students

From the SGRS, the average scores (Table 4.1) of the WBC modules for all four groups of students were found to be higher than their respective group averages in the main exam. A closer critique on the mark distributions [SGRS] revealed that the scores of the WBC modules were skewed towards higher marks. In fact, Cheng et al (James 1999) reported similar findings. The pass rates of the WBC modules for all four groups of students were also higher than their respective group averages in both the main and supplementary exams (Figure 4.3). Hence, evidence showed that the WBC helped to improve student performance.

However, there is little literature to support the above argument and there are perceived benefits and criticisms of virtual interactions for online courses. James (1999) reported improved student grades for an online course. It seems that this research provides further evidence to support the assertion that the WBC really helps to improve student performance. However, the criteria of marking different modules (WBC or non-WBC) are not the same because of different syllabuses. The fact that the WBC modules have higher pass rates cannot lead to a firm conclusion that the WBC really helps to improve student performance. There may be other factors leading to higher student grades. More accurate results can be achieved by comparing the performance of different groups of WBC and non-WBC students.
taking modules with the same syllabuses. Collins (2000) compared student performance for Web, corresponding and lecture versions but did not find any significant improvement in student performance for the Web version. Due to the different nature and level for different types of interactivity, their effects on student performance can deviate substantially.

How do the different types of virtual interaction affect student performance?

Interactivity and student participation in the WBC are vitally important to ensure involvement of students in the new online activities (Kearsley 2000, Fullan and Stiegelbauer 1998). However, it is uncertain how student participation in various types of interactions affects their performance purely based on qualitative analysis. Most teachers expressed that there was no significant difference for different types of virtual interactions on student performance [SIT]. A few D1 teachers perceived that the learn server could help to improve student grades as it could address the specific needs of each group of students. A few D2 teachers believed that more collaboration between students on the Web could improve their grades. The majority of D1 and D2 students perceived that human interaction is useful whereas the majority of HD/D and FD students held different views [SQS, Part III]. Some HD/D and FD students did not perceive computer interaction as useful because they made no difference from a text book [SQS, Part III].
There is a temptation to lump together all sort of virtual interactions simply by counting the home page visits. However, when the interactions are of both a human and a non-human nature, their overall effects on student learning are complicated. The effect of different types of interaction on student performance must be evaluated separately.

Table 4.2 attempts to conclude the relationship between overall interaction and WBC grade for the four groups of students. It shows that the overall correlation coefficients are from low (0.34) to moderate (0.53), except D2 (0.11, which is negligible). The overall correlation shows that active students are likely to perform better, but this is not true for the most active D2 students. It indicates that it might be inappropriate to lump different types of interaction together due to their different nature and quality of interactivity. The two dimensions (nature and quality) of each type of interaction are closely bound together (Ryan et al 2000), but they can be different for each type of interaction.

It is necessary to analyze the effect of different types of interactions separately. To record the overall interaction is easy as it can be obtained from the home page visit counter in most Web sites. In fact, this may only measure the overall effect as it lumps all sort of virtual interactions together. However, the nature and quality (like the level of interactivity and duration of visit) of human interaction (HI) and computer interaction (CI) are quite different. The magnitudes of human interaction (HI) and computer interaction (CI) are normally not comparable as the actual time and efforts spent on each type of interaction can not be measured easily nor compared accordingly. As the level, nature and quality of interactivity for various types of interaction.
virtual interactions are not the same, student participation in different types of interaction can not be simply added together. To record student participation for different types of interaction in the WBC separately is by no means an easy task. This has posed great difficulties to researchers. Perhaps this explains why previous research can hardly draw a conclusion about how different types of interaction affect student learning separately, and why most previous research only deals with one type of virtual interactions.

There is no direct relationship between Human and Non-human Interactions for the WBC

Online interaction can be classified as human and non-human interactions (Hanna et al 2000). The corresponding total frequency count of HI and CI for each student were computed. The correlation between HI and CI for the HD/D, D1, FD and D2 groups were evaluated. They were found to be rather low or negligible [0.26,0.17,0.10,0.25]. The correlation coefficients should be greater than 0.29 at 1% level of significance, it appeared that there was no direct relationship between human interactions (HI) and non-human interactions (CI) for the WBC. It was likely that student participation in human interactions had no connection with non-human interactions.

Two types of virtual human interactions are available: Email and Discussion Forum (Posting). As the nature and quality of interactivity for outgoing and incoming messages are different, they may have different effects on student learning. Although Table 4.1 shows that student participation in the Web forum (posting) was
rather disappointing, but interaction with teachers and peers were encouraging. D2 students had very high participation rate for peer communication. The majority of students did not perceive postings as useful [SQS, Part III]. Some students explained that they did not want to disclose their messages openly [SQS, Part III]. Some student representatives stated they tended to ignore postings or simply not responded to them [UIS]. As the discussion forum is open, it is highly likely that students prefer private discussions instead of an open forum. Interviews with student representatives affirmed that there was such a perception [UIS].

For each student, two mailboxes (one for teachers and one for classmates) were used to separate the emails with teachers and classmates. For each mailbox, the numbers of email sent out and received were automatically logged by the WebCT. As the email accounts for students only contain digits whereas those for teachers normally started with alphabetic letters, the detailed logs from the message folders were examined showing that a small percentage (less than 5 per cent) of emails to classmate mailbox were also copied to the teacher. This phenomenon was mainly found in the D2 group. However, the overall effect on the correlation analysis is minimal (±2%).

To understand how different types of virtual interaction affect student performance, detailed correlation analyses are conducted. The student usage patterns of the WBC were collected from the student questionnaire survey [SQS, Part III] and the WebCT logs [WLF]. Unlike WLF, the SQS data were anonymous and could not be used to correlate with student grades. The SQS data served the purpose of triangulation. The two sets of data were quite consistent. WLF contained the frequency record of
student participation in various types of WBC interactivities. Based on the student number, corresponding student grades could be obtained from the Student Grade Report System [SGRS]. Correlation matrices for the four groups of students (Table 4.3 - 4.6) were then constructed using Microsoft EXCEL statistical functions.

**Human Interaction (HI)**

More human interaction with teachers is likely to improve student grades

Human interactions involve asynchronous communications with teachers and classmates. To better understand the effect of interaction with teachers and peers on student performance, the corresponding correlation coefficients (HI(T+t) and HI(C+c)) were evaluated. The findings were contradictory to the perception of the D2 teachers who believed that more collaboration among students on the Web could improve their grades. Although D2 students were very active in peer communication (Table 4.1), the correlation (HI(C+c)) between peer interaction and the WBC grade for D2 was negligible. It was the lowest of the four groups [0.27, 0.17, 0.24, 0.04]. However, it was found that more interaction with teachers was likely to improve student grades. The correlation (HI(T+t)) between interaction with teachers and student performance was found to be [0.40, 0.40, 0.45, 0.36]. These figures are quite substantial as the correlation for social and educational research seldom exceeds 0.5 (Cohen and Manion, 1997).
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<td></td>
</tr>
<tr>
<td>5</td>
<td>0.10</td>
<td>0.11</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Note:

Human Interaction (HI)  Computer Interaction (CI)
P: Number of Postings  1: Course content and Course guide
T: Email to teachers  2: News
C: Email to classmates  3: Assignment or Test
t: Email from teachers  4: FAQ and User guide
c: Email from classmates  5: Online technical support

O: T + C;  o: t + c;
G: WBC module grade;  E: English module grade

From the correlation matrices, the correlation coefficients for human interactions and
student grades are extracted and summarized in Table 4.7 (Send Messages) and Table
4.8 (Receive Messages).

Table 4.7 Correlation Table (Send Messages)

<table>
<thead>
<tr>
<th>Group</th>
<th>C_{PG}</th>
<th>C_{TG}</th>
<th>C_{CG}</th>
<th>C_{OG}</th>
<th>C_{TC}</th>
<th>T:C</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>-0.10</td>
<td>0.46</td>
<td>0.34</td>
<td>0.63</td>
<td>-0.40</td>
<td>1:1.9</td>
</tr>
<tr>
<td>D1</td>
<td>0.14</td>
<td>0.46</td>
<td>0.28</td>
<td>0.61</td>
<td>-0.40</td>
<td>1:1.6</td>
</tr>
<tr>
<td>FD</td>
<td>0.09</td>
<td>0.50</td>
<td>0.32</td>
<td>0.76</td>
<td>-0.42</td>
<td>1:1.2</td>
</tr>
<tr>
<td>D2</td>
<td>0.19</td>
<td>0.47</td>
<td>0.25</td>
<td>0.36</td>
<td>-0.51</td>
<td>1:5.7</td>
</tr>
</tbody>
</table>
Table 4.8 Correlation Table (Receive Messages)

<table>
<thead>
<tr>
<th>Group</th>
<th>$C_{tg}$</th>
<th>$C_{cg}$</th>
<th>$C_{og}$</th>
<th>$C_{te}$</th>
<th>t:c</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>0.29</td>
<td>0.17</td>
<td>0.29</td>
<td>-0.19</td>
<td>1:2.1</td>
</tr>
<tr>
<td>D1</td>
<td>0.31</td>
<td>0.09</td>
<td>0.28</td>
<td>-0.36</td>
<td>1:2.6</td>
</tr>
<tr>
<td>FD</td>
<td>0.29</td>
<td>0.15</td>
<td>0.30</td>
<td>-0.25</td>
<td>1:1.4</td>
</tr>
<tr>
<td>D2</td>
<td>0.19</td>
<td>-0.07</td>
<td>-0.06</td>
<td>-0.32</td>
<td>1:11.9</td>
</tr>
</tbody>
</table>

Table 4.7 and 4.8 show that peer communication for D2 students was much higher than other groups. From the observation [OB], it was found that D2 students were assigned group projects whereas other groups were taking individual projects. It is reasonable to learn that D2 students have a higher participation in peer communications. However, the correlation for D2 students on peer communication was the lowest ($C_{CG}$ & $C_{cG}$). The effect on student performance from interaction with peers was not obvious when compared with teachers.

The correlation greater than 0.29 are significant at 1% confidence level for the sample under study. To interpret the magnitude of correlation according to Best and Kahn (1998), the relationship between various types of interactions and student performance are summarized below.

i) There was a low relationship between sending messages to peers and the WBC module grade ($C_{CG}$)

ii) There was a moderate relationship between sending messages to teachers and the WBC module grade ($C_{TG}$)

iii) The relationship between sending messages and the WBC module grade was moderate for D2 group, but substantial for the other three groups ($C_{OG}$)
iv) The relationship between receiving messages and the WBC module grade was weak ($C_{CG}$).

v) There was negligible relationship between receiving messages from peers and the WBC module grade ($C_{CG}$).

vi) There was a low relationship between receiving messages from teachers and the WBC module grade ($C_{IG}$).

vii) The negative correlation coefficients ($C_{TC}$ & $C_{IC}$) indicated that human interaction between teachers and peers had complementary effect.

It was found that interaction with teachers had a more significant level of influence than peers on the WBC module grade; and active interaction (send messages) was more likely to improve student performance.

Active virtual interactions with teachers are more likely to improve student performance as they are more relevant to their studies.

Interaction with teachers had a better effect than peer interactions on the WBC module grade. For the D2 students, collaboration with peers was essential as they were involved in group project work. However, Table 4.8 shows that there was a slightly negative correlation between student grade and in-coming messages from peers (-0.07). For the D2 students, virtual interactions with peers dominated (Table 4.1) and the overall effect on student performance was the lowest (HI(C+c), 0.04).

When the performance of the student was measured against the overall human interactions on the Web like in the skywriting project (Light et al, 1999), the effect on virtual interaction from teachers might not be explicit if any interaction with a
negligible or negative effect dominated. Collins (2000) explained why there was no improvement on student performance as due to the fact that medium itself could be a major distracting element. Observation on student emails to peers revealed that some were not related to their studies [OB]. Some students used short-form English or even wrote incomplete sentences with wrong spelling and grammatical errors in their emails with peers. Virtual interactions with peers could be a distracting factor. Perhaps this explains the conflicting results for the active D2 students.

Even if a correlation is statistically significant, it gives no information about cause and effect (Cohen and Manion 1997, Best and Kahn 1998, Charles and Mertler 2002). A relationship between interaction with teachers and higher performance might indicate that the former lead to the latter, or that active students would perform better.

Evidence showed that active interaction was more likely to improve student performance than the passive one. It is expected that a student taking the initiative to send messages or post in the Web forum is likely to take a more active role than a passive recipient. When the effects for out messages and in messages were analyzed separately, it was found that the correlation between the messages sent to teachers and grades ($C_{TG}$, Table 4.7) were substantially higher than those received messages ($C_{IG}$, Table 4.8). It is possible that, like the skywriting projects, most emails to teachers were spell checked and polished before sending out. The fact that students were more cautious about sending teachers emails which were relevant to their studies might explain why virtual interactions with teachers had a higher correlation with WBC grades. Table 4.7 & 4.8 also show that the correlation between the messages sent to peers and grades ($C_{CG}$) had a far better effect than those received messages.
It was found that active virtual interaction was likely to improve student performance in the WBC.

**Computer (Non-human) Interaction (Cl)**

From the correlation matrices, the correlation coefficients for different types of computer interactions and student grades are extracted and summarized in Table 4.9. The correlation between the interactions with the learn server for D1 students and their grades ($C_{SG}$) was also evaluated separately. According to Best and Kahn (1998), most of the correlations between various types of computer interactions and student grades were negligible. Moderate correlation was found in $C_{3G}$ (online assignment and grade) and $C_{SG}$ (learn server and grade). With a sample size greater than 81 (i.e. D1 group), a correlation greater than 0.29 is significant at a 1% level of confidence.

**Table 4.9 Correlation Table (Cl)**

<table>
<thead>
<tr>
<th>Group</th>
<th>$C_{1G}$</th>
<th>$C_{2G}$</th>
<th>$C_{3G}$</th>
<th>$C_{4G}$</th>
<th>$C_{5G}$</th>
<th>$C_{SG}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>0.13</td>
<td>0.14</td>
<td>-</td>
<td>0.19</td>
<td>0.06</td>
<td>-</td>
</tr>
<tr>
<td>D1</td>
<td>0.04</td>
<td>0.21</td>
<td>0.34</td>
<td>-0.03</td>
<td>0.00</td>
<td>0.33</td>
</tr>
<tr>
<td>FD</td>
<td>0.01</td>
<td>0.08</td>
<td>-</td>
<td>0.13</td>
<td>-0.07</td>
<td>-</td>
</tr>
<tr>
<td>D2</td>
<td>-0.09</td>
<td>0.09</td>
<td>0.30</td>
<td>0.09</td>
<td>0.10</td>
<td>-</td>
</tr>
</tbody>
</table>
Computer interactions with low level of interactivity have no effect on student performance

According to Alden (1998) and Brooks (1997), active learning is likely to bring about substantially greater learning success than the passive elements. Computer interaction for the WBC under study was rather passive [SQS, OB, SIT]. As it is not certain for how long students visited the Web pages, the frequency of participation may not show the actual efforts students spent in each visit. The participation on certain Web pages was pretty low (Table 4.1). Computer interactions were normally dominated by Web pages with static content and a very low level of interactivity. Table 4.2 shows that the effects of these interactions on student performance were negligible, supporting the "no significant difference phenomena" argument stipulated by Morss (1999).

Interactive, structured and assignment-related Web-based activities have a positive effect on student performance

The majority of students considered the Web pages for "FAQ and User guide" and "Online technical support" as not useful [SQS, Part III]. The WebCT logs, observation [OB] and SQS [Part III] affirmed that there were very few visits to the two Web pages. Some students explained why they were not useful [SQS, Part III]:

"FAQ and User Guide' page only contains static information of not more than 30 A4 pages." [HD/D, FD]

Most materials in the Web pages for "FAQ and User guide" can be printed out without much difficulty." [D1, D2]
Online technical support is not that critical for full-time students." [D1, D2]

"On-campus technical advice can be obtained from technicians and teachers directly."

[D2]

Table 4.9 depicts that most correlations concerning computer interactions were negligible except those relating to online assignments for D1 and D2 groups. It is likely that assignment-related WBC activities can help to improve student performance. The results of the observation [OB] provided further evidence. It indicated that the frequencies of some WBC activities were much higher than others. The lecturer was approached at the end of each observation in order to understand why some frequencies were exceptionally higher.

The frequencies of various types of WBC interactions and activities are summarized in Table 4.10. It shows that most WBC activities having high frequency counts were related to assignments. Similarly, Flowers et al (1998) demonstrated that students tended to be highly motivated towards activities that were involved with assessment. From the observation [OB], it was found that online assessment-related activities were more interactive (with immediate prompts and feedback) than other non-assessment-related activities. Evidence showed that interactive, structured and assignment-related Web-based activities were likely to have a positive effect on student learning.
Table 4.10  The Observed WBC Activities

<table>
<thead>
<tr>
<th>Group (No. of students)</th>
<th>HD/D (23,19,20)</th>
<th>D1 (24,21,23)</th>
<th>FD (23,19,20)</th>
<th>D2 (21,20,22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Approach</td>
<td>Individual project, tutorial</td>
<td>Individual project, tutorial</td>
<td>Individual project, tutorial</td>
<td>Group project, tutorial</td>
</tr>
</tbody>
</table>

WBC activities:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email teacher</td>
<td>161,2,3</td>
<td>2,3,3</td>
<td>181,5,2</td>
<td>2,3,3</td>
</tr>
<tr>
<td>Email classmate</td>
<td>2,5,6</td>
<td>0,4,3</td>
<td>1,4,3</td>
<td>4,3,10</td>
</tr>
<tr>
<td>Discussion Forum</td>
<td>2,4,3</td>
<td>2,5,7</td>
<td>2,1,2</td>
<td>7,4,2</td>
</tr>
<tr>
<td>HI sub-total:</td>
<td>20,11,12</td>
<td>4,12,13</td>
<td>21,10,7</td>
<td>13,10,15</td>
</tr>
<tr>
<td>Reading news</td>
<td>191,2,3</td>
<td>1912,1713,1813</td>
<td>5,7,1613</td>
<td>1714,1813,3</td>
</tr>
<tr>
<td>Browse content page</td>
<td>4,3,3</td>
<td>4,1,2</td>
<td>3,2,4</td>
<td>3,2,3</td>
</tr>
<tr>
<td>Doing online exercise</td>
<td>NA</td>
<td>4,195,203</td>
<td>NA</td>
<td>156,4,1</td>
</tr>
<tr>
<td>Reading FAQs and user guide</td>
<td>4,3,1</td>
<td>3,2,2</td>
<td>5,6,3</td>
<td>3,2,1</td>
</tr>
<tr>
<td>Seeking online technical support</td>
<td>1,2,0</td>
<td>2,1,1</td>
<td>1,3,2</td>
<td>1,1,2</td>
</tr>
<tr>
<td>Home/other Web pages</td>
<td>3,2,3</td>
<td>4,1,2</td>
<td>3,1,1</td>
<td>2,2,1</td>
</tr>
<tr>
<td>CI sub-total:</td>
<td>31,12,10</td>
<td>36,41,45</td>
<td>17,19,26</td>
<td>41,29,11</td>
</tr>
<tr>
<td>WBC Total:</td>
<td>51,23,22</td>
<td>40,53,58</td>
<td>38,29,33</td>
<td>54,39,26</td>
</tr>
</tbody>
</table>

Note:

1: An online assignment that requires student to send email to teacher.
2: The lecturer posted the project schedule on the Web recently.
3: Lecturer posted the solution of an offline assignment on the Web.
4: The lecturer posted the requirement and guideline of the second group project work on the Web.
5: An online exercise (MC type of questions) was released.
6: The first group project was due. The project required students to comment other group members' work online.
The supplementary server provides more flexibility and interactivity for students, thereby allowing them to regulate their own learning for the purpose of developing flexible understanding of subject matter.

Table 4.2 shows that when the effect of the learn server is considered, there is enhancement in HI, CI and overall correlation. The number of visits to the learn server over the past seven months was 57 (Table 4.1), which constituted the fourth highest frequency count for different types of interactions of the D1 students. The correlation coefficient between the number of visits to the learn server and the WBC grade was 0.33 (Table 4.9), which was relatively high as compared with other types of computer interactions. A visit to the learn server revealed that it mainly contained the following materials:

i) Supplementary notes to help elaborate the difficult concept

ii) A case study on the System Development Life Cycle

iii) Two video clips on teacher demonstration, each lasts for about fifteen minutes

iv) Separate interest group discussion areas

v) Separate tutorial group discussion areas

The observation [OB] did not reveal the significance of the learn server, but the majority of D1 students responded in the questionnaire that the learn server was their other most frequently visited web site [SQS, Part III]. D1 and D2 teachers also perceived that the learn server could help to improve student grades [SIT]:

"It could address the specific needs of each group of students." [D1, D2]

"Students are divided into smaller interest and ability groups. We have more flexibility"
to regulate student learning according to their interests and capabilities." [D1]

"The learn server is partitioned to allow different groups with different tasks and
schedules." [D2]

Wade (1994) and Windschitl (1998) have emphasized the importance of providing
more opportunities for students to meet their own individual needs for flexible
learning, although this may not have direct effect on student performance.
Windschitl (1998) has asserted the importance of allowing students to regulate their
own learning for the purpose of developing flexible and unique understanding of
subject matter. Some D1 students made the following comments about the
flexibility provided by the learn server [SQS, Part III]:

"The learn server allows more flexibility for us to master our own learning."

"It contains more information to elaborate the difficult concepts, thereby helping us to
better understand the subject matter."

"It's more interactive, I can get immediate response for the online quizzes on the two
teacher demo."

"I enjoy the small-group discussion forum on SAD."

As there are human and non-human interactions for the learn server, the overall
correlation may not reflect the true picture. However, it is likely that it can help to
improve student performance and attract student participation because of the
following factors:

i) Increased interactivity;

ii) Addressing the specific needs of students through separate interest and tutorial
groups;
iii) Smaller Web-based discussion groups instead of an open forum.

Some teachers believed that the WBC could act as a supplement to augment regular classroom practice but wonder whether different types of interactions contributed to additional learning benefits [SIT]. It is essential to single out each type of interaction, evaluate and compare their effects on student learning accordingly. However, it is unlikely to achieve this purpose simply by qualitative analysis. As the nature and quality of interactivity for human and non-human interactions are different, they must be considered separately.

Additional Learning Benefits

Does the research support the claim of additional learning benefits from different types of interactivity provided by the WBC?

There are critical debates about the claim of additive learning benefits from different media (Mielke 1968, Schramm 1977, Levie & Dickie 1972, Clark 1983 1985, Clark et al 1986 1989 1992) and the concern indicated by Brooks (1997) about the face validity of multimedia. According to Clark and Craig (1992), the theory of additive benefits for instructional multi-media is described as:

*Instructional media, if used properly, make valuable contributions to learning and therefore instruction presented in two or more media produce more learning than instruction presented only by one medium because the learning benefits of each of the combined media are additive.* (Clark and Craig 1992, p.19)
Additional learning benefits from different types of static computer interactions are not obvious

How did different groups of students behave in different types of computer interactions? Table 4.3 - 4.6 show that some correlation between two non-human interactions were substantial. They indicate that students who actively participate in one type of computer interaction was likely to participate in others. Table 4.2 shows that the overall correlation between computer interaction (CI) and grade were not significant except for the D2 students [0.17, 0.16, 0.06, 0.35]. In response to the flexibility provided by the WBC, the D2 teachers explained the use of supplementary servers (which were transparent to students) to provide more teaching and learning flexibility [SIT]. Hence the overall correlation for CI of the D2 group might take into account the effect of various transparent supplementary servers. It was also found that most computer interactions except online assignments were static and had no significant effect on student performance (Table 4.9). Additive effects from different computer interactions are not obvious, probably having one type of interaction dominating the others.

There is evidence to support that additional learning benefits are provided by interactive WBC elements

There are additional learning benefits contributed by the online assignments and learn server. They were found to be more interactive [SQS, OB, UIS, SIT]. Their effects on student performance for D1 and D2 students were significant (Table 4.9). Table 4.2 indicates that HI, CI and the overall correlation were increased when the visit to
the learn server was counted. It also show that the additive effect from the overall correlation for CI of the D2 group was apparent.

However, the effect of the learn server on student performance is complicated as it consisted of both human and non-human interactions. According to Triola (1997), the error of correlation analysis may arise from the third variable lurking behind. The third variables lurking in the background could be the supplementary servers for the D1 and D2 groups.

Additional learning benefits are substantial for active virtual human interactions (HI) especially when interactions with teachers and peers are supplementary

Table 4.7 shows that the effects of active human interactions on student performance were additive and the overall effect of active human interactions could be substantial, except for the D2 group \([0.63, 0.61, 0.76, 0.36]\). The correlation \((C_{TC})\) between the two types of virtual interactions was found to be moderately negative \([-0.40, -0.40, -0.42, -0.52]\). This means that when there were more interactions with teachers, there would be less with peers and vice versa. In fact, the negative correlation between the two types of virtual interactions showed that they supplemented each other and the overall effect could be substantial except for the D2 case which was dominated by peer interaction. If the virtual interactions with teachers and students are treated as different types of media, the theory of additive learning benefits (Clark and Craig 1992) applies to active virtual human interactions for the WBC.
The study of the skywriting project (Light et al, 1999) may help to explain the exception of the D2 case. The study showed that the overall correlation between human interaction (HI) and student grade was only 0.32, although it reported a relatively high correlation (0.50) for male students and moderate correlation (0.29) for female students. As the sample size was very small (e.g. only 12 involved in the skywriting projects were analyzed in the correlation research with four male students), the female category might dominate the male. In this case, the correlation may only reflect the majority. It explained why the skywriting project did not show an obvious correlation between student contribution and grade, probably due to one type of interaction with a low correlation dominating the others.

The frequency of interactions with peers for the D2 students was much higher than for that with teachers (Table 4.1 & 4.7). When this was the case, the overall effect on correlation analysis could be dominated by the former. The findings revealed that more collaboration with peers did not necessarily contribute to enhanced student grades (Table 4.7 & 4.8, $C_{CG}$ & $C_{CG}$, where the D2 group has the lowest correlation). One possible reason is that virtual interactions with peers could be a distracting factor to student learning as the observation revealed that many student emails were not relevant to their studies [OB]. Similar findings are also reported by Collins (2000).

The research results showed that the learning benefits from active virtual interactions with teachers and peers were additive especially when they supplemented each other. However, if one type of interaction dominated, the overall effect might be diminished. The following analysis illustrates that student behaviors in different types of interactivity are affected significantly by the linguistic factor.
The Language Barrier

It seems reasonable that over 70% of students use only English (30% use both) to communicate on the Web [SQS, Part III] as the medium of instruction is English. According to Hanna et al (2000), the language issue is critical in order to benefit from the WBC interaction and there are perceived advantages concerning students' ability to communicate in English for online learning. However, it is surprising that for students with better English ability there does not seem to be an improvement in their WBC grades. The situation is more acute for non-native English speaking countries like Hong Kong because over eighty percent of the world's computer information is in English (Philson 1998). Indeed, there are critical debates whether the asynchronous communications on the Web can benefit non-native English speakers (Driscoll 1998, Ishii 1993, Philson 1998).

How does the linguistic factor affect teaching and learning in the WBC?

From the correlation matrices, it was found that the effects of the English performance on student participation in different types of non-human interactions were not obvious. This is consistent with the finding that non-human interactions did not correlate with student performance. Table 4.11 summarizes the correlation between English grade and different types of human interactions.
Table 4.11  The Effects of English Language

<table>
<thead>
<tr>
<th>Group</th>
<th>C_{PE}</th>
<th>C_{TE}</th>
<th>C_{CE}</th>
<th>C_{CE}</th>
<th>C_{OE}</th>
<th>C_{OE}</th>
<th>C_{GE}</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/D</td>
<td>0.18</td>
<td>-0.41</td>
<td>-0.27</td>
<td>0.78</td>
<td>0.51</td>
<td>0.61</td>
<td>0.39</td>
</tr>
<tr>
<td>D1</td>
<td>0.34</td>
<td>-0.03</td>
<td>-0.14</td>
<td>0.42</td>
<td>0.40</td>
<td>0.42</td>
<td>0.33</td>
</tr>
<tr>
<td>FD</td>
<td>0.10</td>
<td>0.07</td>
<td>0.01</td>
<td>0.40</td>
<td>0.33</td>
<td>0.44</td>
<td>0.33</td>
</tr>
<tr>
<td>D2</td>
<td>0.09</td>
<td>-0.24</td>
<td>-0.27</td>
<td>0.50</td>
<td>0.32</td>
<td>0.49</td>
<td>0.31</td>
</tr>
</tbody>
</table>

There is no direct relationship between students' English ability and their WBC grade. Students with better English ability are unlikely to communicate more with teachers but are highly likely to do so with their peers.

Table 4.11 shows that there was no obvious relationship between the English grade and the WBC module grade (C_{GE}). Students with better English ability were more likely to send messages than receive (C_{OE} & C_{OE}). Previous findings showed that interactions with teachers were likely to improve student grades. However, the negative correlation (C_{TE} & C_{CE}) showed that students with better English performance were unlikely to communicate with teachers. Instead these students preferred to communicate with peers (C_{CE} & C_{CE}). The observation [OB] affirmed that communication with peers could be a distracting element. This may explain why the English proficiency does not help to improve student grade in the WBC.
Do students prefer to use Chinese as communication medium on the Web?

There are difficulties to communicate in the WBC using Chinese

The student questionnaire [SQS, Part I] showed that over 90% of students preferred a bilingual WBC platform. Only around 30% [25,29,35,31] used both languages to communicate on the Web [SQS, Part III]. Some students expressed difficulty to key-in Chinese characters and there were browser problems to view Chinese characters [SQS, Part III]. The student representatives explained [UIS]:

"It is not easy to enter Chinese as most computer laboratories are not equipped with Chinese writing pens." [HD/D]

"Chinese type writing is difficult and time-consuming." [FD, D1]

"Netscape is not as good as Internet Explorer in term of supporting Chinese. Some characters are missed when browsed with Netscape." [HD/D, D2]

"A major drawback of WebCT is that it does not support Chinese." [D1, D2]

"Sometimes we use short-form English mixed with Chinese to chat with our classmates and friends using ICQ." [FD, D1]

"The advantage of short-form English is that we don't have to remember the exact spelling." [FD, D1]

Students used Chinese to discuss with teachers and classmates in f2f communication but used English to communicate with them on the Web [OB]. The observation affirmed that a large proportion (50%) of D1 and FD students use short-form English in private emails with peers. The student representatives explained the meaning of Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change.
some frequently used short-form English listed below [UIS]:

<table>
<thead>
<tr>
<th>Short-form English</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
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According to Philson (1998), the problems faced by students to communicate in Chinese on the Web are mainly technical. This included the misinterpreted Chinese characters found in a student email captured during the observation:
Does the English standard of students serve as a major barrier to the development of the WBC?

There is great concern from employers in Hong Kong about the poor English standard of our graduates (Mingpao 2000). An online training developer also warned that the language could be an impediment to the development of online learning in Asia (Hong Kong iMail 2000). This study revealed that the majority of teachers [SIT] and students [SQS, UIS] perceived that English deficiencies could be a major barrier to communicate on the Web.

Students' inability to express their problems in English could be one of the reasons why online technical support was rarely used [UIS]. Many FD students expressed difficulty to communicate in English on the Web [SQS, Part III]. It was found that students weak in English were the most inactive WBC users. Most FD students (over 98%) come from secondary schools with Chinese as their MOI [SQS, Part I]. These students were weak in English (over 90% failed in HKCEE English subject,
VTCD, SGRS). FD students were found to be the most inactive WBC users (Table 4.1). The previous findings showed that active students were likely to perform better.

Most teachers perceived that the poor English standard really prohibited virtual interaction with students on the Web. They expressed concerns on student language deficiencies [SIT]:

"Due to language problems, students may not be able to fully understand the materials posted." [FD, D1]

"It is difficult to elaborate and explain to them on the Web." [HD/D, D1]

"Some students are rather passive due to poor English ability." [D1, D2]

"Most students are not good at reading and writing in English. Hence they cannot understand the online materials and express their problems properly." [FD, D1]

Evidence shows that the language deficiencies are significant barriers that undermine student participation in the WBC

Although communications with teachers are likely to enhance the performance of the students, students with better English ability are more likely to communicate with peers on the Web through private emails. Laurillard (1993) states that one of the successes for computer conferencing is to provide fruitful dialogue for students to make their contributions in their own time. However, the low participation rates in an open forum for all four groups of students (Table 4.1) and the low or negative coefficient coefficients (Table 4.11) indicate that the language barrier made the students lacking confidence to discuss openly on the Web forum and with teachers.
It was observed that students tended to use short-form English to share ideas which were unstructured and irrelevant to their studies [OB]. Peers communication on the Web could be a distracting element (Collins 2000, Brain 1998). Most problems expressed by students involving Chinese character are technically oriented (Phison 1998). Indeed, the difficulties encountered by the non-native speakers for online learning have already been elaborated by many writers (Driscoll 1998, Philson 1998, Hong Kong iMail 2000).

The common language curriculum policy is a significant barrier that undermines student participation in the WBC.

Language deficiencies appear to have undermined student participation in the WBC. It is envisaged that language proficiencies are likely to enhance student participation in WBC activities. However, the research results showed that this was not the case. The SQS [Part I] revealed that a large proportion of HD/D students (over 50%) had matriculation standard (i.e. Form 7). This group of students had the best results in the HKCEE English subject [VTCD, SGRS]. However, they were the second most inactive WBC users out of the four groups (Table 4.1).

Unlike the western countries and other non-native English speaking countries, Hong Kong has very distinct language policy since its reversion to China in 1997. Since then, Hong Kong has adopted a bi-literate (English and Chinese) and trilingual (English, Cantonese and Putonghua) policy. There were corresponding changes in the IVE curriculum. The Course Scheme [VTCD] showed that there was a substantial increase in training for spoken and listening skills of English and
Putonghua. The proportion of writing skills in the English syllabus was reduced from 50 to 25 percent. There was only one English module common for all year one students in the nine disciplines [VTCD]. All year one students adopted a common English curriculum even for different disciplines. They took a common assessment and examination.

The common English curriculum placing less emphasis on the reading and writing skills could be a significant barrier for student participation in the WBC. Some students expressed difficulties in using English to communicate on the Web and demanded more Chinese writing tools to facilitate the use of Chinese in Web-based communication [SQS, Part III]. Teachers were discontented about the common language policy [SIT]:

“The language syllabus is too generic and cannot meet the specific needs of our discipline.” [HD/D, D1]

“To encourage more participation and communication on the Web, we need to build up the confidence of the students to read and write in English as well.” [FD]

"The specific needs of different groups of students on language training might be suppressed by the common language curriculum." [HD/D, D1]

"The language syllabus must emphasize the English read/write skills required by the WBC." [FD, D1]

Indeed, there are strong debates in Hong Kong (SCMP 2000) and elsewhere (Lumby 1995, Young 1993, Finch and Crunkilton 1999) whether the unified curriculum can meet the individual need of students. This issue will be further explored in the section on managing the curriculum change.
Carswell et al (2000) reported that one of the benefits of an electronic tutorial session was "you could see other people's ideas". Because of language barriers, IVE students were more likely to communicate with fellow classmates using short-form English mixed with Chinese characters privately. However, they were reluctant to share their ideas using English openly in the Web forum and with teachers. The study of Carswell et al (2000) reported that the biggest obstacle to Internet presentation was inexperience and cultural inexperience had presented tougher obstacles than technical inexperience. Indeed, the change from a traditional curriculum to WBC requires a cultural shift. As the change process itself is socially complex, it is crucial not only to identify the problems but also find out possible solutions for sustained change (Fullan 1989, Lofthouse et al 1995).

Managing Change

In transforming to the new flexible paradigm of WBC, how do IVE teachers and students manage to cope with the change?

The documentary research showed that the new IVE curriculum was less prescriptive and more responsive to change. The class contact hours were reduced by nearly forty per cent leaving more room for students to learn at their own pace using the WBC. It was expected the new IVE curriculum and the WBC could mutually support each other. However, the research findings from the perceptions of students and teachers seemed to be less than satisfactory in this respect. According to the WBC Change Model, the analysis will start with managing the curriculum change.
Managing Curriculum Change

What major changes are incurred from the new IVE curriculum?

The documents [VTCD] depicted the major curriculum changes subsequent to the recent reform of IVE. For HD/D, D1 and FD groups, the most dominant change was to adopt a common curriculum for different courses within the same subject group offered by different campuses. They belonged to different subject groups. D1 students adopted the same curriculum as HD/D with separate assessments. D2 students studied the old curriculum.

The common assessment strategy and progression policy may impose extra pressure on students.

The documents [VTCD] revealed that the progression for the HD/D and FD students to higher level of study (HD and D courses respectively) was purely depended on the results of the common assessments. Due to a limited quota, less than half would be successful. In order to ensure impartiality, a common assessment strategy was adopted. Subsequent to that, students had to follow the same schedule using the same teaching materials, take the same amount of assignments and tests and continuous assessment simultaneously. The common assessment strategy could impose extra pressure on these groups of students.
Does the new IVE curriculum support the development of the WBC, or vice versa?

Both teachers and students perceive that the WBC can support the development of new IVE curriculum. However, there are diverse views whether the new curriculum can facilitate the change from the traditional curriculum to the WBC.

The student questionnaire survey [SQS, Part IV] showed that the majority of students believed the WBC could support the development of the IVE curriculum. However, they had diverse views about whether the IVE curriculum could facilitate the change to the WBC. The majority of HD/D and FD students were negative. Some of them expressed concerns that the new IVE curriculum was rigid and lacking of flexibility. Although D1 students also studied the new common curriculum, their views were quite positive. The majority of D2 students were neutral, and the rest had equivocal views whether the IVE curriculum could facilitate the change to WBC.

The common curriculum could be problematic

The Web forum showed how teachers perceived the common curriculum as problematic [WFT]:

"Rigid schedule, bureaucratic management and confusing guidelines for delivery of common curriculum across campuses have limited the flexibility for teachers to cater for the specific needs of their students to learn at their own pace."

"Teachers are hesitant to release any extra materials to their students on the Web."

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Interviews with teachers [SIT] revealed that they welcome the change to WBC as they believed that the WBC could support the future development of the IVE curriculum by providing more choices for students and more flexibility to augment classroom practice. However, they had diverse views about whether the unified curriculum could facilitate the change to WBC. Although they perceived that the new IVE curriculum left more room for students to study on their own, some of them had negative views on the new curriculum with reduced class contact hours and blamed this on the side-effect that the WBC encouraged students to escape classes. Teachers were quite positive that changing to the WBC was the right direction, but they expressed concerns about the new curriculum in relation to the future development of the WBC.

How does the curriculum change affect the development and implementation of the WBC?

According to Finch and Crunkilton (1999), the central focus of the curriculum is the student and there is an obligation for a curriculum to meet the individual needs of the students. In this respect, a unified curriculum may not be suitable to address the needs of individual students. Perhaps this is the reason why a school-based curriculum is supported by the Curriculum Development Council and many educators in Hong Kong (SCMP, 2000). However, Young (1993), Jackson (1995) and Lumby (1995) expect that a unified and integrated curriculum will prevail in the 21st century. The impact of the unified curriculum on the development of the WBC is critical.
D2 teachers explained how the old curriculum affected the development of the WBC [SIT]:

"The curriculum is too prescriptive and rigid for the development of the WBC. It has not been updated for six years. Some of the teaching methodologies may not match the requirement of the WBC."

"The class contact hours are too long and it is difficult for students to find time to explore on the Web."

The old curriculum was too rigid and not responsive to change as perceived by both D2 teachers [SIT] and students [SQS, Part IV]. This is the reason why the new IVE curriculum was introduced (Consultant Report 1996). The major drawback of the old curriculum was that it was too rigid and lacking flexibility.

The Web forum [WFT] revealed that postings of WBC materials for common curriculum modules were restricted. Teachers found it difficult to find extra time to prepare their WBC materials due to frequent moderation meetings, cross markings and horizontal markings across campuses. Online assessments were disabled because teachers had doubts about their impartiality and security. Teachers were reluctant to develop WBC materials to be posted online so as to save unnecessary argument and moderation.

Some HD/D and FD teachers did not agree that the new unified IVE curriculum could support the development of the WBC [SIT]:

"The over-emphasis on fairness and commonality in delivery across campuses for common year-1 courses forbid us to tailor-make our WBC materials to suit the needs of
"The adoption of standardized teaching materials on the Web limits the degree of flexibility in teaching such as providing supplementary materials to help slow learners."

"The common curriculum is too rigid. It is difficult to implement across seven campuses."

They criticized the rigidity and inflexibility of the new common curriculum. However, there are also positive views on the future development of the common curriculum on the Web [SIT]:

"Consistent teaching materials on the Web ensure the uniform standard across campuses.” [HD/D, D1]

"The new curriculum has reduced over 30 per cent of formal class contact hour. Students have more free time to explore on the Web.” [HD/D, FD]

"A unified curriculum could save up a lot of development time for the common WBC material.” [D1, D2]

Joint effort can be used to develop common WBC materials shared by both teachers and students, the unified IVE curriculum supports the development of the WBC if it can provide flexibility to cater for the specific needs of different groups of students.

A unified curriculum requires flexibility. The majority of D1 teachers supported the views that the new common IVE curriculum could facilitate the development of the WBC in the IVE if flexibility could be provided to cater for the specified needs of their students [SIT]:

"A unified curriculum does not hinder the development of the WBC if it provides flexibility to cater for the individual needs of students. Consistent core materials of the WBC ensure basic requirement for the course whereas supplementary WBC materials
can help individual group of students with different academic background."

"By means of common curriculum, teachers can work collaboratively to develop
different pieces of WBC materials shared by their students."

"We have the flexibility to design online assessment for our students."

The perception of D1 teachers were echoed by their students [UIS]:

"The learn server provides more flexibility for us to learn at our own pace."

"The online assignment provides more opportunity to practice. It helps to monitor
our progress and develop better understanding of the concept."

"The WBC with different levels of difficulty help to develop our confidence and study
at our own pace."

It is critical for a curriculum to provide flexibility to cater for the specific needs of
students. Lumby (1995) has warned that there is a tension in providing flexibility
for an integrated curriculum. Cooperative approaches with flexibility are required
for a cross curriculum so as to address the needs of different subject areas (Jackson
1995, Young 1993). Although HD/D and D1 students studied the same curriculum,
D1 group had more teaching and learning flexibility in the WBC. D1 teachers and
students were allowed the flexibility to discuss and post additional teaching materials
to address their specific needs provided by the WBC. Other groups of teachers
mainly criticized the rigidity and inflexibility of their curriculums. Their perceptions
help to identify the major barriers for the change to WBC.

**What are the major barriers to curriculum change?**

A unified curriculum is criticized as it restricts the flexibility of students to learn and
absorb at their own pace (SCMP 2000). However, a unified curriculum itself may not be a barrier to change. The study revealed that the common assessment strategy had imposed much restriction on teaching and learning, whereas the associated progression policy had imposed much examination pressure on students.

The common assessment strategy, restricting the flexibility to cater for the specific needs of individual student, is a major barrier to the future development of the WBC.

The IVE Academic Handbook [VTCD] clearly indicated that students needed to take a common final examination and have continuous assessment for common subject groups like HD/D and FD. These students had to follow the same schedules. The Web forum had the following findings about common assessment [WFT]:

"Too many assignments and tests clustered together, quite a large number of students were unable to meet the deadlines which were too rigid due to common assessment."

"Rigidity of teaching practice due to common assessment. Teachers are not allowed to give supplementary notes to their students in order to help elaborate difficult and abstract concepts on the Web."

The common assessment strategy restricted the flexibility to cater for the specific needs of individual student group. The majority of HD/D and FD teachers perceived that the common assessment strategy had adversely affected the development of the WBC [SIT]:

"The common assessment strategy is detrimental to the development of the WBC. The use of standardized WBC materials across seven campuses is extremely difficult especially when a module is taught by some thirty lecturers across seven campuses."

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
"Because of the common assessment strategy, all WBC materials must be fully moderated by all lecturers concerned before releasing." [HD/D]

"It's too rigid. Students have to follow the same schedule, teaching methods, same set of WBC materials and same amount of assignments and tests." [HD/D]

"Making up class is difficult as we have to follow the same schedule of assessment. We'll try our best to avoid canceling a class." [FD]

"Because of common assessment, lecturers are reluctant to give out additional info to their students, avoiding others being disadvantaged." [HD/D, FD]

HD/D and FD teachers also explained why online assignment were restricted by the common assessment strategy [SIT]:

"All online materials must be moderated due to common assessment which is extremely time consuming." [HD/D]

"We decided not to include online exercises on the Web in order to avoid students complaining about the different computer configurations in different campuses." [HD/D, FD]

"Online assessment are discouraged as the assignments and assessments have to be moderated by colleagues from seven campuses before they are posted on the Web." [FD]

The questionnaire survey [SQS, Part IV] showed that majority of students from the HD/D and FD groups disagreed that the IVE curriculum could facilitate the change from a traditional curriculum to the WBC. Some HD/D and FD student representatives indicated that the problems arose from the common assessment [UIS]:

"The assessment schedule is too rigid and tight." [HD/D, FD]
"Because of the common assessment, we seldom share ideas with our classmates on the Web." [HD/D]

"We have no flexibility to learn at our own pace." [FD]

The majority of D1 students had positive views on their curriculum [SQS, Part IV]. It is curious that the D1 students held different views from their HD/D counterparts although they were taking the same curriculum. The documents showed that the common assessment strategy did not apply to standalone D1 courses [VTCD]. Both students and teachers from D1 group had no such perception as did their HD/D counterparts. D1 teachers had much flexibility to teach using the WBC as they were not bound by the common assessment strategy [SIT]:

"Flexibility is allowed for common assessments provided they are comparable in standard."

"We can develop our own online assignments and assessments for our students."

"We have the flexibility to develop our WBC materials in the learn server to cater for the individual needs of students."

"There are different schedules for different groups of students."

"Some assignments are essential for core concepts. Some are optional for widening and deepening the insights of students."

The progression policy has imposed much pressure on teachers and students.

There are different progression routes for common subject groups (HD/D and FD) and standalone courses (D1 and D2). The statistics [VTCD] showed that 90% of D1 and D2 students progressed to the next stage of study and graduated respectively. Due to limited places, only half of the FD graduates could be promoted to next stage
of study in the IVE. For the HD/D students, less than half progressed to HD2 and forty per cent progressed to new D2 courses. There are keen competitions for HD/D and FD students. The interviews with student representatives revealed that HD/D and FD students were under more extreme examination pressure than their counterparts due to the progression policy [UIS]:

"IVE should increase student places to reduce our exam pressure. Hence we will have fun to enjoy the WBC." [HD/D]

"We've spent all our time to prepare for assessment and improve our grades. We simply cannot find enough time to explore on the Web." [FD]

"Most of us want to further our study in IVE but the chance is slim." [HD/D, FD]

HD/D and FD teachers had the following criticisms about the progression policy [SIT]:

"The high exam pressure de-motivates students to use the WBC for communication. They simply do not trust each other." [HD/D]

"Students are very serious about the marking." [HD/D, FD]

"Teachers had to be very careful about their marking in order to ensure impartiality. Sometimes an assignment marking has to be moderated by six lecturers." [FD]

The common assessment strategy and the associated progression policy for common subject groups should be reviewed to allow more flexibility for future development of the WBC

Because of the common assessment strategy and associated progression policy, both the HD/D and FD teachers and students were under extreme pressure. Students
should strictly follow the learning and assessment schedule. This has restricted their flexibility to study on the Web. Teachers could not post additional materials and discuss freely with their students on the Web. The common assessment strategy limited the flexibility to share and develop materials on the Web thereby restricting teachers and students to teach and learn at their own pace. On the other hand, students were under extreme pressure due to keen competition. The common assessment strategy and progression policy should be reviewed to allow more flexibility for teachers and students and reduce the pressure of examination and undue competition.

What are the perceptions of teachers and students on the pace of change? Does the WBC save any learning or teaching time?

Students have diverse views on pace of change and workload. Teachers perceive that pace of change is too fast and the WBC cannot save their time

Students had diverse views about the pace of change and workload incurred from the WBC [SQS, Part IV]. The majority of HD/D and FD students perceived that the pace of change was too fast. The WBC could not save their learning time nor reduce their workload. The majority of D1 and D2 students perceived that the pace of change was acceptable and too slow respectively. They believed that the WBC could save their learning time.

Most teachers perceived that the pace of change was too fast and the WBC could not save their teaching time [SIT]. The WBC brought about an additional workload
mainly due to development and preparation of online materials. HD/D teachers perceived that their increased workload was partly due to extra moderation work which arose from the common assessment strategy.

According to Barnes et al (1989), the amount of work associated with the assessment may make the whole system unworkable if both teachers and students are under pressure.

**How does the implementation of the WBC affect the workload of teachers and students?**

**Students need time to adapt to the fast changing technology**

Some students explained why the WBC could not save the learning time nor help to reduce their workload [SQS, Part IV]:

"WBC incurs additional workload as I have to find extra time to get used to it." [FD]

"Extra time is needed to set up and learn the skills for the WBC." [HD/D, D1]

"The technology is changing too fast. It's difficult to get used to it." [HD/D, FD, D1]

"WBC is demanding. Web-based communication is time consuming." [HD/D, FD]

Many junior students tended to believe that the WBC had imposed an additional workload on their study due to fast technological change. They need time to master the new technology. Technology is changing rapidly (Philson 1998, Male 1997). McCormack et al (1997) warn that students can feel the burden of increased workload if they move from passive to active learners for online courses. This process cannot be achieved instantly (Tracey et al 1999, Melody 1985). The WBC provides
students with another choice but could not save their time as they needed extra time to acquire the new skills before they could adapt to the fast changing technology [UIS]. The D2 student representatives explained why senior students were more adapted to technological change [UIS]:

"We have already acquire the basic skills and knowledge to master the new technology for the WBC."

Many year one students expressed that their problems were related to fast technological change in the questionnaire [SQS, Part VI]. Some of them were concerned with the fast changing pace of the WebCT version from 1.3 to 3.1 in less than one year, requiring additional effort to learn and master the new technology. Senior students were more adapted to technological change.

The additional workload incurred from the WBC for teachers is related to fast technological change and degree of interactivity

Teachers need additional time and effort for learning and use of the WBC course development tools (Kostopoulos 1998). There was evidence that the fast changing technology had imposed an additional workload for teachers from two aspects: training and migration of online materials [WFT, SIT]. The Web forum [WFT] revealed that the fast and ever changing technology had posed additional stress to teachers. Extra time was required to acquire new skills and to migrate the old WBC materials to the new platform [SIT]. Some teachers even perceived that arranging the migration from old-fashioned teaching packages to WBC were non-academic duties [SIT].
The increased workload for teachers is also related to the degree of the WBC interactivity. D1 and D2 teachers had more flexibility to make use of supplementary WBC materials and alternative means (like the VPN and Intranet) to improve the interactivity of the Web servers and address the specific needs of their students. However, most of them perceived that these alternatives had significantly increased their workload [SIT]. Rigid assessment strategy increases the pressure of moderation and limits both the interactivity and creativity (Bruce, 1995) of the WBC. However, flexible or more alternate forms of assessment will increase the degree of interactivity of the WBC, thereby increasing the workload of the teachers (Grey 1999, Hulme 1999). Using a highly interactive approach could increase teachers' workload significantly (McCormack et al 1997).

An appropriate IT strategy is deemed necessary to deal with the fast technological change. This is tackled in the final section of managing change. According to the WBC Change Model, the second critical issue on organizational change will be analyzed.

**Managing Organizational Change**

Carnall (1993) and Lofthouse et al (1995) emphasize the importance of establishing a management structure to implement change, encouraging wide discussion of related issues. However, the new IVE management structure is found to be far from satisfactory for the implementation of the change to WBC.

*Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change*
The recent reform of VTC consequently drives IVE to adopt a form of matrix management system, does it encourage active participation of students and teachers in the WBC?

The documents [VTCD] revealed that the new IVE management structure looked like a multi-tier matrix system at discipline, nexus and campus level; both horizontally and vertically. This new structure did not apply to D2 courses. Under the new structure, there were student representatives in various high level committees like the IVE Academic Board and Nexus Board to participate in the discussion on academic matters. The course documents indicated that student feedback on courses was solicited from questionnaire surveys and student representative meetings. The minutes showed that attendance of student representatives in various high-level committees was very low. Sometimes all student representatives were absent from the meetings.

The matrix management structure does not encourage student to participate actively in the WBC. In fact, most students are indifferent to the management structure.

The questionnaire survey [SQS, Part V] revealed that majority of students were quite neutral to the management structure. Some students did not perceive that the management structure encouraged them to participate actively in the WBC. The student representatives explained why [UIS]:

"Many classmates are indifferent to the management structure because it does not affect their learning using the WBC." [FD, D1, D2]
Meetings are too frequent both inside and outside the campus. The schedule of meetings and tests are not properly planned. There are frequent clashes in schedules."

[HD/D, FD]

"Those high-level committees have nothing to do with the WBC." [D1]

The alienated double matrix management structure of IVE had led to confusing policies, roles and responsibilities for teachers

Although students are indifferent to the management structure, most teachers expressed concerns about the matrix management system. The situation seemed to be more acute for the HD/D and FD teachers. They perceived that the matrix arrangement was rather confusing [SIT]:

"The matrix arrangement of IVE makes the authority and responsibility rather confusing." [HD/D, FD]

"The complexity of coordination and synchronization were acute on subject which has a large number of staff teaching." [HD/D]

"The hierarchy of the WBC team is complicated. It represents the interests of different departments, nexuses or disciplines." [FD]

The documents [VTCD] showed that the new IVE management structure created a double matrix systems each with two levels of hierarchy. One matrix system involved the horizontal (discipline-wise) and vertical (campus-wise) level while the other involved another horizontal (nexus-wise) and vertical (campus-wise) level. This management structure has already created some confusion for teachers.
The Web forum affirmed the perception that teachers were confused about their roles in the new academic structure [WFT]:

"The new academic structure is not well defined. Teachers are confused about their new roles as different disciplines and campuses have different interpretations."

"The nexus board and discipline board seem to have equal power. Who can make the final decision when conflicts arise?"

The policies and guidelines appeared to be rather confusing to teachers [WFT]. Both the nexus and discipline wanted to grasp more control over academic decision. This, together with the common assessment strategy, had imposed further restrictions and rigidity on the development of common WBC materials.

How does the new management structure affect the development of the WBC in the IVE? Can it foster changes or provide enough support to teaching and learning using the WBC?

The management does not provide enough technical support for students

The majority of students disagreed that the management provided enough support for the WBC. Some students commented [SQS, Part V]:

"There are set up problems. We have not enough technical support." [HD/D, D1]

"The training on basic skills for the WBC is not enough." [FD, D1]

"Most committees only discuss academic issues. Those technical issues are simply ignored." [HD/D, FD]

"There are insufficient computing facilities and support for the WBC." [FD, D2]
It was found that students were mainly concerned about technical support for the WBC, not the management structure itself. Interviews with student representatives affirmed that there was a perception of not enough technical support for students [UIS].

**Prompt decision cannot be achieved if conflicts arise. The matrix management structure will undermine the future development of the WBC**

The majority of teachers except D2 perceived that the matrix structure would undermine the future development of the WBC [SIT]. Very often prompt decisions could not be made under the double matrix system due to conflicting views. Some teachers criticized [SIT]:

"Normally an important decision on a common WBC module has to be endorsed by the Discipline Board, different course boards horizontally across nexuses; and by the Nexus Boards, campus principals and heads of department vertically. Sometimes a decision made by a discipline may not be supported by nexus or vice versa due to discrepancies among campuses." [HD/D]

"The WBC team is composed of members from discipline horizontally across seven campuses. Their decisions may not be supported by their respective campus principal in the vertical management structure, especially concerning the resource issues. Different campus principals have different considerations and order of priorities." [FD]

"The course team does not has the autonomy to decide on small issues on the WBC to meet the needs of specific group of students." [HD/D, FD]
The matrix management system imposed a further restriction on the inclusion of online exercises for the WBC. A HD/D teacher stated that [SIT]:

"It is difficult to make decision for online materials under the existing matrix management system when the course is operated by seven campuses. The horizontal and vertical hierarchy cannot always make a compromise. The best way to avoid conflict is to keep the components of the WBC at a minimum. This is why we propose not to include online assessment at this stage."

Indeed, the matrix structure is facing a challenge raised by Bates (2000). The challenge is to develop a system that encourages teaching units to be innovative and able to respond quickly to changes in subject matters, student needs and technology. King (2000) emphasized the importance of an organization structure to accommodate prompt decision-making within a framework that supports quality operations in areas of core business.

The matrix management structure fails if it cannot move closer to uncoupling staff from departments and viewing them as a resource to be used flexibly to meet the needs of individual students. In order to facilitate the development of the WBC, the complexity of the new management structure should be simplified and the level of hierarchy reduced.

The new matrix management did not work properly as authority was not devolved to the teaching unit. The responses from D2 teachers testify the need for flexibility in the organizational structure and delegation of authority for future development of the WBC. Some D2 teachers praised the new management structure for the old courses.

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In fact, in a large organization like the IVE, the development of flexibility in the organizational structure is problematic (John O’Neill 1994). A matrix organization should move closer to uncoupling staff from departments and viewing them as a resource to be used flexibly to meet the needs of individual learners (Turner 1991, Lumby 1995). However, what is more important is the flexibility to cater for individual needs (Lumby 1995) and delegation of authority (Lewis 1994). No two organizations are the same, any implementation strategy must match the culture and structure of the organization (Herson et al 2000). To facilitate the innovative use of technology in education, redundancy and conflicting standards and policies across the institution must be avoided (Bates 2000).

The Web forum [WFT] revealed the problems of managing the WBC module accounts. It depicted the complexity of the change to the WBC concerning control and ownership, linking the issues of management and technology. As the common curriculum spread across nexuses and campuses under the same discipline, the double matrix management structure could not clearly spell out the responsibility of the WBC module team. When a single WBC account was shared by lecturers and students of as much as nine campuses, the question of who had the final responsibility to update...
and maintain the WBC content remained a problem.

The documents [VTCD] indicated that the control of module account involved authority (assignment of access rights) and accountability. The management concern was that if two lecturers owned the same account, who was accountable for the final responsibility? If one lecturer was allowed to own more than one account, a huge amount of WBC accounts had to be created, thereby posing further demands on both management and technology (e.g. storage and bandwidth). To simplify the management issue, the module leader was assigned the ownership of the WBC account. To relieve the demand on technology, one lecturer was only assigned to one account in the central server. The situation would be extremely acute when the lecturer was the module leader of more than one module, and one WBC module account might involve more than one group of users. Lecturers have to struggle between the demands of management and technology. To solve the problem, there should be a compromise between technology and management. The issue of managing technological change is prominent.

**Managing Technological Change**

What are the critical factors perceived by teachers and students for managing technological change?

critically important for online courses. Indeed, they are the issues most concerned the IVE teachers and students.

Bandwidth and Browser compatibility are critical success factors for effective implementation of the WBC

From the student questionnaire survey [SQS, Part VI], the rank for different technological factors perceived by different group of students are summarized in Table 4.12. The table shows that speed and compatibility were the two most important factors perceived by students. D2 students perceived "Compatibility" as the most important factor. The major problems for this group of students were [UIS]:

"Unable to open/browse the file, some character missed and misinterpreted, and no corresponding plug-in software."

Table 4.12  Critical Technological Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Rank (1-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HD/D</td>
</tr>
<tr>
<td>Compatibility</td>
<td>3</td>
</tr>
<tr>
<td>Standardized Platform</td>
<td>2</td>
</tr>
<tr>
<td>Scalability</td>
<td>7</td>
</tr>
<tr>
<td>Cost</td>
<td>5</td>
</tr>
<tr>
<td>Updated</td>
<td>6</td>
</tr>
<tr>
<td>Speed</td>
<td>1</td>
</tr>
<tr>
<td>Reliability</td>
<td>4</td>
</tr>
</tbody>
</table>
The Web forum revealed the concerns of teachers on technology. They shared the experience of having technical problems intermittently. It showed that the major concerns of teachers were related to speed, compatibility and reliability [WFT]:

"Most technical people are used to under-estimate the bandwidth and other technical requirement of the infrastructure required by the WBC."

"The fast changing technology has triggered the problems of compatibility. Normally files created by new software may not be fully read by the old software."

"Sometimes new versions of technology are not reliable. System may clash due to new release. This will affect the performance of the WBC. Users may lose their confidence."

The majority of teachers in different groups had consistent views about the three critical technological factors in order of priority [SIT]:

i) Speed

ii) Compatibility

iii) Reliability

The most critical factor as perceived by different groups of teachers is the bandwidth or the response time. A FD teacher aborted using web-based teaching due to slow response of the network. The teachers explained their difficulty in the development of the WBC due to slow response time [SIT]:

"Uploading to the central WBC site is terrible. My PC was hung up on many occasions." [HD/D]

"Speed is very important. I have aborted the use of the Web presentation during my tutorials with students twice in one week due to extremely slow response." [FD]

"I need half an hour to download a five minute video on the Web. It's terrible.
Eventually I give up the idea of mounting a CD on the Web." [D2]

Both teachers and students perceived "compatibility" as another important technological factor. According to Grey (1999) and Jefferies et al (1998), browser capabilities are critical; otherwise, they may lead to temporary confusion. The research findings showed that "browser compatibility" was vitally important especially for experienced and frequent users like the D1 and D2 students [SQS, Part VI].

Some teachers made the following comments [SIT]:

"We should avoid using different plug-in software due to compatibility problems. My PC was hung up on many occasions due to incompatible plug-ins." [HD/D, D1]

"Browser compatibility is critical. The pre-requisites of using more advanced browsers or plug-ins should be stated and their downloading be provided, otherwise some students may encounter unexpected difficulties in browsing." [D1, D2]

A D2 teacher offered a solution to address the problem on compatibility [SIT]:

"Compatibility is a major technical issue. Features requiring plug-in, such as Flash used at the entry page with animation, though visually attractive, may be an obstacle for students to enter the WBC site. This can be addressed by testing through use of various popular browsers and providing an alternate entry point, e.g. version without animation, so that the student can still enter the site without downloading the plug-in. Furthermore, a "skip" option should also be provided in case the students do not wish to wait for the playing of the entire animation program."
Due to resource constraints, the demands on bandwidth and interactivity are normally under-estimated

Jefferies et al (1998) and Katz et al (1997) have iterated the key concern of bandwidth as an inhibitor to the use of the Internet. In order to minimize the effect of bandwidth, the D1 teachers built up a supplementary Intranet server [SIT]:

"With the use of an Intranet from the mirror site, we can make use of the transfer rate to its full speed within the campus network. The speed is increased from 50K to 10M, i.e. 200 times faster. With this speed in mind, immediate response can be achieved for simple graphics and animation on campus."

Meanwhile, the D2 teachers used a Virtual Private Network (VPN) to improve the speed [SIT]:

"By means of the technology of the Virtual Private Network (VPN), we can make full use of the campus network (ATM 155). Hence our WBC is able to support video through a CD tower. The response of home access is much improved."

The use of Intranet or VPN within the campus could be a good solution for bandwidth problems. This will also enhance the accessibility of home users and allow more flexibility for students and teachers. However, it demands more technological resources. Due to resource constraints, it was impossible to keep up with the pace of fast technological change. The documents [VTCD] revealed that:

"Computer facilities need to be upgraded or replaced every two years in order to keep up with the pace of the fast changing technology. However, due to resource constraints, it is recommended not to replace any computer facilities with less than four years service time."
The demands on bandwidth are very often under-estimated or neglected by the management due to resource constraints. The teachers explained why:

"Normally we are not allowed to replace any computing facilities with less than five years' service, unless there is very good justification." [HD/D, FD]

"The demand on bandwidth very much depend on the quality and interactivity of the WBC. Due to resource constraints, these factors are very often neglected by the management." [HD/D, D1]

"Since the development of the WBC is in its infant stage, most of the WBC modules are purely text-based. The quality and level of interactivity of the WBC are often under-estimated by the management." [D1, D2]

Perhaps resource constraints is one of the factors that slow down the development of the WBC and explain why "traditional institutions are often remarkably slow to respond and change, much less adapt, to technological change" - an important point that is often neglected (Philson 1998).

**What kind of Web-based development platform should be supported?**

A standardized Web-based development platform with flexibility to address the individual needs of students should be adopted for the development of the WBC.

A standardized platform is critical for junior students (Table 4.12). The questionnaire survey [SQS, Part VI] revealed that the FD students perceived a standardized platform to be the most important technological factor. The questionnaire showed that the major problems for this group of students were related to the skills to master the WBC fast changing technology. As they are less confident to master the WBC skills, they prefer a standardized platform. Senior students were more adapted to the changing technology and perceived the standardized platform as less important (Table 4.12).

Indeed most teachers supported the use of a standardized Web-based development platform like WebCT for future implementation of the WBC [SIT]:

"A standardized WBC platform is easier for me to migrate the WBC files to other sites as they are compatible with each other." [HD/D]

"Variations for the WBC should be allowed to cater for the needs of different subject groups. However, to allow the sharing of information on the WBC, the development platform should be standardized and compatible." [FD, D1, D2]

"By means of a standardized WBC platform, students can save up a lot of time to pick up the skills for using the WBC." [D1, D2]

A standardized platform can reduce the problem of incompatibility and facilitate information sharing. Teachers also demanded a structured guideline for them to put their WBC materials in the WebCT server to avoid duplication of efforts, allow
flexibility and maintain consistency [SIT]:

"WBC modules are categorized by discipline, by campus and by module. Different lecturers in different campus can develop a different WBC for the same module. There is a risk of duplication of effort and inconsistency." [D1]

"A structured guideline for the WBC is necessary. It allows everyone involved to follow the agreed standards. This will ensure compatibility, interoperability and consistency." [HD/D, FD]

"A structured guideline for the core WBC materials can reduce the duplication of efforts. It can contain some open standard guideline to allow for flexibility to develop the specifics." [D2]

However, Driscoll (1998) and Bates (2000) criticize how a standardized platform hinders the academic freedom. Some teachers explained why flexibility is extremely important to cater for the needs of individual students [SIT]:

"A standardized server or platform is too restricted. It should allow flexibility for different groups of students." [HD/D]

"The central server for storing common WBC materials is too rigid and not that interactive." [FD]

"The central WebCT platform is too limited. Some WBC platform like 'QuestionMark' could be a better solution for online assessment." [D1]

"The WebCT platform cannot support synchronous online chat for project discussion and collaboration." [D2]

Both D1 and D2 teachers built a supplementary server to cater for the specific needs of their students and facilitate sharing of information on the Web [SIT]:

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"A learn server can provide flexibility to address the specific needs of my groups of students. They can be shared in the WBC simply using designated Web links." [D1]

"Students are willing to share their ideas with smaller interest group in the learn server." [D1]

"A standardized platform is desirable for the core server, whereas flexible platforms are expected for supplementary servers." [D2]

"We have a common server for core materials. On top of that, we develop a learn server to serve the specific needs of different project groups." [D2]

McArthur et al (1998) emphasize the importance to foster a culture of sharing in online communities using a common infrastructure. Previous finding showed that due to the language barrier, students were reluctant to share information openly on the Web. As students are willing to share ideas with smaller interest group in the supplementary server, a flexible approach like this could help students to build up their confidence and develop a culture of sharing in the WBC.

To effectively implement the WBC in IVE, what strategy (centralization or decentralization) should be adopted?

There were diverse views concerning centralization and decentralization. Nunan (2000) suggested a centralized framework for supporting IT-based teaching and learning. The documents [VTCD] showed that senior management favored the centralization strategy for the WBC to ensure uniform standard across the nine campuses and save resources through centralized maintenance and support. From the document, a centralized technical support center was recommended by senior
management because:

i) To enhance the quality of technical support for teaching and learning by means of installing the video conferencing facilities in a centralized technical support center in order to align with the Council's Enhancement of IT Infrastructure and Services Projects;

ii) To facilitate end-users such as teachers, students and staff of various departments/sections to access the centralized IT-related help services;

iii) To improve user-to-technician communications between computer rooms and centralized technical support center;

iv) To enable effective and efficient use of the scarce technical support resources.

Nearly thirty per cent of students did not answer the question related to centralized and decentralized technical support/resources [SQS, Part VI]. The rest of them had equivocal views. The D1 and FD student representatives suspected that they might not fully understand the two terms [UIS]. Some of them preferred localized (decentralized) support mainly because problems could be fixed immediately. However, the majority did not object the provision of centralized WBC resources as they could be shared on the Web [UIS].

Some teachers perceived that decentralization required teachers and students to be able to master different Web technologies and demanded more resources [SIT]. It was difficult to ensure standardization and compatibility for decentralized servers. Problems arose from maintenance, up-keeping and migration of common WBC materials. The efforts could be tremendous. Hence the centralization strategy for WBC support was expected.
However, many teachers preferred the decentralization strategy. They explained how the localized (decentralized) technical support could benefit the use of WBC [SIT]:

"Localized technical support provides immediate response. It is crucial for implementing the WBC." [HD/D, FD]

"With the centralized support in the head campus, it is often impossible to ask for immediate help because we don't know who should be approached." [D1, D2]

Centralization and Decentralization: A mixed IT strategy is recommended for effective implementation of the WBC

Fullan (1993) and Bates (2000) explained why a mix of centralized and decentralized technical support services was required to cater for flexible technology-based teaching and learning. Some teachers perceived that a mixed approach would allow for better utilization of the WBC resources and the flexibility to share the WBC materials on the Web [SIT]:

"Some common WBC resources should better be shared, like the core server and central maintenance." [HD/D, D1]

"The decentralized unit may duplicate services and compete for resources. However, a centralized unit may simply wasting resources as nobody is being able to make use of its services." [HD/D, FD]

"Some common WBC resources should be globally shared (centralized) while the more specific ones locally shared (decentralized)." [D1]

"In order to better utilize the scarce resources, some of them can be shared to save up the effort of development and maintenance." [D2]
The problems of the ownership of the WBC accounts also depicted the weakness of centralization concerning control and accountability that undermined the academic freedom [WFT]. Teachers explained how a mixed strategy could help to resolve the problems [SIT]:

"A supplementary (decentralized) server allows for flexibility to address specific needs of teachers and students. It also allows IVE teachers and students to share their WBC materials across subject groups." [FD, D1]

"The central server contains static information whereas the supplementary servers can be more interactive depending on the needs of students." [D1, D2]

"Decentralized servers increase the sense of ownership. It is more flexible and autonomous." [FD, D1]

"The centralized server contains a single account for core materials. Multiple accounts for different groups of students can be created in the decentralized servers." [D2]

The above findings lead to a conclusion that it is necessary to strike a balance between centralization and de-centralization due to the following considerations:

i) Ownership problems

ii) Flexibility and control

iii) Technical support and resources

A mixed strategy is appropriate for the future development of the WBC. A centralization strategy is essential for assuring the standard and quality of the core WBC materials for common subject groups, which rely on unified policy and control. It fosters a culture of sharing common resources. It also facilitates the up-keeping
and maintenance of the WBC with commonality and avoids duplication of effort. A decentralization strategy is required to meet the specific needs of individual groups. It also increases the sense of ownership essential for encouraging academic freedom and releasing creativity (Bruce 1995). The 'ownership' of change is vital if reforms are to be more than superficial (Lofthouse et al 1995).

The research demonstrates that flexibility, interactivity and technology are interacting with each other in the WBC, supporting the use of the WBC Change Model as an effective framework for the research on the WBC. It has given a balanced consideration to the technological issues relevant to effective implementation of the WBC. The above analysis leads to the final chapter on conclusions and recommendations.
Chapter Five

Conclusion and Recommendation

Previous research in foreign countries reported both success and failure of using IT in education. Research studies on Web-based education about its effectiveness on learning outcome are highly controversial. Most related studies in Hong Kong (Kwong 1999, James 1999) were launched in 1998 after the HK Government advocated the use of IT in education in its Policy Address (1997). These research and evaluation results are either superficial or yet to be completed. Hence, it is extremely difficult, if not impossible, to simply compare the research to findings in similar situations.

This is the first research study about the WBC in the IVE context, based on a WBC Change Model (Figure 5.1) derived from the literature. This model provides a central framework emphasizing the importance of managing change concerning the flexibility and interactivity in the context of the WBC. It focuses the investigation on three major areas. The first one is the effectiveness of a Web-based model of curriculum delivery, in terms of its impact on students' attitude, performance, interaction and pedagogy. The second is to identify the critical factors in the development of the Web-based courses. The third area of investigation is the impact and management of change as this new way of delivering the curriculum is introduced.
This study shows that the analysis of the impact of different types of virtual interaction on teaching and learning are complicated. The overall effect can be zero or destructive if the positive and negative components cancel each other. If this is the case, the theory of 'No-significant difference' prevails but eventually fails to reflect the true picture. This case study uniquely addresses the issue of language policy for the WBC for the native-Chinese students in Hong Kong. To relieve the concern that the failure of using technology in education may be due to academic and technical divide (Betts et al 1998, McCormack et al 1997), the study gives a balanced
Conclusion and Recommendation

consideration to both educational and technological issues.

The conclusions are summarized according to the WBC Change Model. From the conclusion, recommendations are consolidated and proposed for effective implementation of the WBC in the future. These recommendations have significant and far-reaching effects on the formulation of academic policy, organization structure and IT strategy, not only for the IVE, but for all higher and tertiary institutions in Hong Kong. Finally, the limitations of this research and future research areas are discussed and suggested respectively.

Conclusion

Although students behave differently in the four target groups (HD/D, D1, FD and D2), there are consistent findings that students perform better than average in their WBC modules. The research shows how various kinds of virtual interactions are affecting student performance and illustrates how the technology, flexibility and interactivity are driving each other, highlighting the importance of managing change in technology for the WBC. It shows how the WBC contributes to student learning and serves the new needs in IVE; how teachers and students perceive the relationship between flexibility, control and standardization for successful implementation of the WBC. It also explains how strict control can stifle the growth of the WBC. Flexibility must be allowed to address the specific needs of different groups of teachers and students.

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Human interactions and interactive elements are likely to improve student performance as compared with non-human and static elements. The research also provides further evidence to support the theory of additional learning benefits for different types of interactions on the Web. The language barriers are very distinct for non-native English speaking countries using the WBC as the Internet is primarily designed for native English users (Philson 1998). The use of short-form English to communicate on the Web is not uncommon for IVE students and perhaps other students in Hong Kong. However, its impact on teaching and learning has never been evaluated in any previous research.

This study explains why and how the failure of the new IVE curriculum is related to the common assessment strategy. It depicts the condition to support the development of a unified WBC and illustrates why the educational institutions are slow to respond to technological change. Although the new IVE management structure provides a better opportunity for students to feedback their views on many important academic issues, most students are indifferent to it. The research shows why the new academic structure fails to meet the expectation of teachers in the process of implementation. Finally, the research also identifies those critical success factors related to technology and explains why a mixed IT strategy is suitable for effective implementation of the WBC.
Flexibility

Flexibility and Accessibility

Accessibility, technology and interactivity are driving each other in the WBC

The more accessible and interactive the WBC, the more demand for technology. The research demonstrated that home access was not important for on-campus students especially when they were not motivated by interactive nor assignment-related activities. Accessibility was also limited by technological factor such as poor response time and software compatibility. It shows how the flexible use of the Intranet and the VPN (Virtual Private Network) could improve the accessibility of the WBC for teachers and students. Although these technologies aim to improve online security for targeted users (Intel 2000), their significant improvements in the response time have been widely appreciated by both students and teachers. These technologies can support more interactive elements like online assessment and video clips that are more demanding in term of speed. Highly interactive materials demand faster technology and compatibility. Better technological infrastructure allows more flexibility and a higher level of interactivity, which enhances student participation and widens the accessibility through Web-based communication. Accessibility, interactivity and technology are three major components driving each other in the WBC (Figure 4.3).
Conclusion and Recommendation

The WBC can supplement the needs of the students requiring consultation during summer time and help to improve the pass rate of the supplementary exam.

The WBC has proved to be an effective means to improve the pass rate of the WBC modules by more than fifty per cent in the supplementary exam. In the past, most students sitting for the supplementary exam worked alone because most teachers were on vacation leave in the summer time. Despite the rare face-to-face communication, the WBC provides an effective means to enable and maintain the virtual electronic communication between the needy students and the tutors on the Web even in the summer time by removing the distance barrier. This is particularly crucial for the IVE as the pass rate is one of the important performance indicators presented to the Government by the VTC.

Flexibility, Control and Standardization

The more flexible the WBC, the more standardization is required to ensure its quality and standard. There should be a balance between management control, user control and flexibility for effective implementation of the WBC.

Both teachers and students perceive that the more flexible the WBC, the more choices should be provided to users. However, to ensure the standard and quality of the course, they expect more standardization in terms of format, and appearance, policies and technological infrastructure for the WBC. They expect a direct relationship between flexibility and standardization for the WBC. This is also advocated by Betts et al (1998) as far as the curriculum is concerned.
Betts et al argued that there should be a direct relationship between control and flexibility (i.e. more management control for more flexibility). However, teachers and students have different views on this. Two types of control are identified: user control and management control. They perceive that there should be more user control and less management control to ensure academic freedom and make room for innovation and creativity. Flexibility should be directly and inversely proportional to user control and management control respectively to address the specific needs of different user groups for effective implementation of the WBC. Betts et al (1998) assert that more management control must be used to ensure the quality of the course. There should be a balance between control and academic freedom (Bruce 1995). The project management strategy for managing change advocated by Carnall (1993) also emphasizes flexible controls that focus on solutions to problems and encourage innovation and risk-taking. Hence, there should be a balance between management control, user control and flexibility for the WBC.

**Tight control stifles the growth of the WBC**

The research demonstrates how tight management control has already made the development of the WBC stagnant. Strict control incurred from the common assessment policies has restricted the choices of online assessments and limited on-campus accessibility of the WBC. The Course Boards intend to control everything in minute detail and keep tight control on all information including the teaching and learning materials for the WBC. Strict management control also undermines the interests of teachers to pose additional online materials on the Web and restricts the freedom to use supplementary servers to cater for the specific needs
of individual groups of students. Teachers prefer more clear and standardized WBC policies rather than strict control for future implementation of the WBC. Indeed, the research results affirm the two rules about control that stifle change and growth of the new curriculum as stipulated by Kanter (1983).

Flexibility and Active Learning

The WBC requires students to be more active and it should have a higher level of interactivity in order to bring about substantially greater learning success.

Online learning requires students to be more active and independent (Brooks 1997, Lewis 1994, Alden 1998, Windschitl 1998, Driscoll 1998). Although Brooks (1998) and others advocate that active learning is likely to bring about substantially greater learning success, there is no strong evidence from previous research to support the argument that students actively involved in the WBC perform better. The study shows that all four groups of students perform better than average for their respective WBC modules. But this cannot show whether active students really contribute to enhanced WBC grades by simply comparing the results of homogeneous groups without identifying the number of active students.

Correlation analyses demonstrate that students who actively participated in virtual human interactions are likely to perform better, but this is not the case for non-human interactions probably due to their low level of interactivity. The WBC requires students to be more active. Passive human interactions and static non-human interactions are unlikely to bring about learning success. Computer interactions with
a low level of interactivity have no effect on student performance but the more interactive elements (like the online assessments and learn server) are found to be more related to enhanced student performance. The WBC is likely to bring about substantially greater learning success with higher level of interactivity for the WBC.

**Interactivity**

**Different Types of Interactivity**

When the interactions include both human and non-human types, their overall effects on student learning are complicated. The effects of Human Interactions and Computer (Non-human) Interactions on student learning must be evaluated separately.

The research illustrates the complexity of predicting the overall effects of different types of interactivity on student learning. There is no relationship between student participation in human and non-human interactions. Interactive, structured and assignment-related Web-based activities are critical and have a positive effect on student performance. The learn server provides more flexibility and interactivity for students to regulate their own learning for the purpose of developing a flexible and unique understanding of the subject matter. Its effect on student performance is quite significant. Computer interaction with a low level of interactivity does not correlate with student performance. Passive human interactions are not as effective as active ones. Active virtual interactions with teachers are more likely to improve students' performance as they are more relevant to their studies. The above results
could only be evaluated if different types of interactions are measured separately.

The quality and nature of interactivity on the Web are closely bound together (Ryan et al. 2000). However, those for human and non-human interactions are quite different. Hence the two types of interactions cannot be simply added together and it is difficult to predict their overall effects on student learning. They may counteract with each other to give zero effects, or one type of interaction may dominate the other. This helps to explain the unexpected outcome that the overall WBC participation for active D2 students is not related to their grades, but that for the inactive FD students it has a substantial effect. This may explain why most research that involves both types of interactions often ends up with “no significant differences” or “controversies” on learning outcomes as their conclusions.

**Additional Learning Benefits**

There is evidence to support the argument that structured interactive WBC elements (like the supplementary server and online assessments) could provide additional learning benefits to students. Additive learning benefits are apparent for active virtual human interactions (HI) as interactions with teachers and peers are complementary.

The non-human interactions have no effect on student performance probably due to their relatively low level of interactivity. The content pages are found to be rather static. Although they have the highest frequency of student participation, their contributions to student learning are rather disappointing. However, interactive
elements like structured online assignments and the supplementary server are found to have much greater impacts on student performance. Structured interactive WBC elements are likely to contribute additional learning benefits.

There are critical debates on the theory of additive learning benefits for different learning media (Clark and Craig 1992). Additive learning benefits are apparent for virtual interactions with peers and with teachers. As interaction with teachers is more relevant to the study, its effects on student performance are much better than those with peers. Even though the individual effects of the two types of interactions on student learning are found to be moderate, their overall effects are substantial, illustrating the additional learning benefits for these two types of virtual human interactions. The two types of virtual interactions are found to be complementary with each other. Students who communicate less with teachers tend to discuss more frequently with their peers on the Web, or vice versa. However, if one type of interaction dominates, the overall effect of additive learning benefits could be diminished. In order to avoid the criticism of face validity, it is essential to analyze separately the effects of different types of virtual interactions of the WBC on teaching and learning.
Conclusion and Recommendation

The Language Barrier

There is no direct relationship between students' English ability and their WBC grades. However, evidence shows that the language deficiencies and common language curriculum are significant barriers that undermine student participation in the WBC.

The research shows that the majority of IVE students use English to communicate on the Web. This is reasonable as the medium of instruction is English. As eighty percent of the world’s information on computers is in English and the vast majority of online communications are conducted in English (Philson 1998), the English language abilities of students are crucial for students to take part in the WBC. D2 students have the highest participation rate in the WBC, but the effects on student performance are rather disappointing. It is found that their language deficiencies have discouraged them from open discussion on the Web, but encourage the use of mixed short-form English and private discussions with peers which are found to be irrelevant to their studies. However, it is still uncertain about the impacts of short-form English on student learning. Probably it may be another distracter from the WBC.

The common language curriculum puts emphasis more on Putonghua and English listening skills, reducing the proportion of training time on English reading and writing skills significantly by one half. However, many teachers and students perceive the latter as the basic communication skills for successful implementation of the WBC, especially when most human interactions for the WBC are text-based. Therefore the common language policy should be reviewed to strengthen the English reading and writing skills required by the WBC.
Managing Change

Managing Curriculum Change

A unified curriculum supports the development of the WBC if it can provide flexibility to cater for the specific needs of different user groups. It promotes collaboration to develop commonly shared WBC materials and fosters a culture of sharing which is essential for the development of the WBC.

The IVE adopts a common curriculum for different courses within the same subject group although there is a strong debate about whether a unified curriculum is able to meet the needs of individual students. The study reveals that the common curriculum is criticized not because it cannot address the individual needs of students, but because of its rigidity incurred from common assessment. The common assessment strategy has suppressed the motivation of teachers to provide more teaching and learning flexibility for their students. It also suppressed the motivation of students to share their ideas on the Web.

The majority of teachers welcome the use of a joint effort to develop common WBC materials in the centralized servers shared by teachers and students in different campuses. They perceive that a unified curriculum can promote collaboration among teachers to develop more interactive online materials. However, this must be accompanied by the use of decentralized servers to allow more flexibility to address the specific needs of different groups of students. Teachers and students can simply access and share these physically segregated resources through designated Web links.
According to McArthur et al (1998), it is important to foster a culture of sharing in online communities of higher education. A unified WBC curriculum fosters a culture of sharing if it can provide teaching and learning flexibility.

The common assessment strategy and the associated progression policy, restricting the flexibility to cater for the specific needs of different groups of students, are the main barriers for future development of the WBC in IVE.

The common assessment strategy and the associated progression policy for common courses impose much pressure on teachers and students. In order to ensure impartiality, senior management has laid down strict regulations for students and teachers to follow. Subsequently, all WBC materials must be moderated by teachers from as many as nine campuses, creating undue criticism and additional workload for teachers. It is found that strict control for common courses has already stifled the development of the WBC. This phenomenon does not exist for standalone courses, where teachers have the flexibility to develop their own teaching materials and students need not follow a rigid pattern of a teaching and learning approach.

Students need time to adapt to fast technological change. The additional workload incurred from the WBC for teachers is related to fast technological change and interactivity.

The majority of senior students perceive that the pace of change is rather slow. They can cope with the increased workload. They are more adapted to technological change as they have already been equipped with the basic technical skills for the
WBC. The majority of junior students have different opinions. They need time (e.g. training time to acquire the basic skills for the Internet and Web course tools) to cope with the fast technological change. The fast changing technology has imposed further difficulties for teachers to maintain and update the WBC materials. They feel the burden of increased workload due to higher level of interactivity. The study provides further evidence to explain why 'traditional institutions are often remarkably slow to respond and less adapt to technological change' (Philson 1998) and 'IT initiatives cannot be expected to come to fruition overnight' (Melody 1985). Time is critical. Students perceive that Web-based communication is rather time consuming. This together with their difficulties to communicate on the Web in English explains why the majority prefers f2f to Web-based communications. In fact, students need time to adapt to fast technological change whereas teachers require additional time to develop and upkeep the interactive WBC materials.

Managing Organizational Change

A complicated matrix management structure can lead to confusing policies, roles and responsibilities for teachers and undermine the future development of the WBC. A streamlined management structure with flatter hierarchy must be adopted to facilitate the development of the WBC.

Although the new IVE management structure provides more opportunities for students to participate in many high level committees that involve setting policies and regulations for various important academic issues, it does not provide enough technical support for students nor encourage them to actively participate in the WBC.
In fact, these committees seldom deal with matters concerning the WBC. Even though student feedback on teaching and learning are solicited from various high-level meetings with student representatives, the low participation rates show that students are not interested in academic policies and expressing views in these meetings. Most students are indifferent to the management structure. Perhaps students brought up on a force-feeding education method may have difficulties to adapt to any new method of education (McCormack et al 1997) which requires them to be more active.

The matrix management structure fails if it cannot move closer to uncoupling staff from departments and viewing them as a resource to be used flexibly to meet the needs of individual students and teachers. The double matrix management structure (nexus-wise and discipline-wise) undermines collaboration among teachers and makes the authority and accountability of the WBC rather confusing. The nexus boards and discipline boards strive to grasp more control and power, thereby creating redundancy and conflicting standards and policies across campuses. Prompt decision cannot be achieved if conflicts arise. The new structure has already ignored the original proposal to streamline the management structure suggested in the Consultant Report (1996). On the other hand, the management structure for the old D2 courses has been streamlined with two levels of academic boards merged into one. The board in turn delegates the authority for most academic issues to different teaching units. The D2 teachers have the autonomy to decide on their own WBC materials and computing facilities. They have an increased sense of ownership which is vital for any change or reform to be more than superficial (Lofthouse et al 1995). It demonstrates how a streamlined management structure with a flatter hierarchy can nurture a culture of
sharing and collaboration and provide the autonomy and flexibility to facilitate the development of the WBC.

Managing Technological Change

Bandwidth and browser compatibility are critical success factors for effective implementation of the WBC

No one can deny that technology is a critical factor for successful implementation of technology-based curriculum. However, different people have different expectations of technology. As most IVE students come from the middle/lower class, there is a belief that cost could be a crucial element for successful implementation of the WBC because it could increase the gap of the digital divide especially for students with acute financial difficulties. However, the survey finds that over ninety per cent of students own their computers and most of them do not consider cost as an important issue. Although the primary aim for the VPN is for secure network access and trusted connection through the Internet (Intel 2000), security and reliability only ranked after four in the priority list. However, VPN is welcome by both teachers and students not because of its security and reliability, but the fast response time. Poor response time could be the major barrier for home access.

Compatibility is perceived as the second critical success factors for the WBC. Browser incompatibility can lead to temporary confusion (Grey 1999). The fast changing technology creates problems on compatibility. The compatibility problems are more critical for a higher level of interactivity.
The demands on flexibility, interactivity and technology for the WBC are normally under-estimated by the management due to resource constraints.

The research reveals that the demands of the WBC are normally under-estimated in three major areas due to resource constraints:

i) The teaching and learning flexibility for the WBC demands more resources in technology, educational institutes usually respond slowly due to resource constraints and the huge investment in technology

ii) Higher interactivity poses further demands on technology

iii) Fast changing technology creates the problems of incompatibility, further limiting the flexibility and interactivity provided by the WBC

The higher level of flexibility and interactivity pose more demands on technology. The best solution, of course, will be enhancing technological infrastructure for the WBC indefinitely but this usually can never be achieved due to resource constraints. For the same reason, these demands are normally under-estimated by the management.

Centralization and Decentralization: a mixed strategy for effective implementation of the WBC

A centralized Web-based development platform can soothe the demands on flexibility, interactivity and technology due to resource constraints. Structured guidelines can be used to develop commonly shared WBC materials on centralized servers by different groups of teachers. A centralized strategy minimizes the problems of
incompatibility for increasing demand on flexibility, interactivity and technology. It also saves the scarce resources for up-keeping and maintenance of sharable WBC materials, avoids duplication of efforts and fosters a culture of sharing essential for the WBC.

However, flexibility must be allowed to cater for the specific needs of individual groups. Decentralized servers allow flexibility to adopt different pedagogies and address different needs. Supplementary WBC materials for different groups of students can be mounted onto the decentralized servers. These online resources can be shared by different people irrespective of distance, simply by adding appropriate Web links. A decentralized strategy increases the sense of ownership essential for encouraging academic freedom and releasing creativity (Bruce 1995). The 'ownership' of change is vital if reforms are to be more than superficial (Lofthouse et al 1995). The research illustrates how successful a mixed strategy can be used to provide better technical support, solve the ownership problems for the WBC module accounts, and strike a balance on flexibility and control for the WBC.

**Recommendation**

The research shows that flexibility, interactivity and technology are really driving each other in the WBC, supporting the use of the WBC Change Model in research related to online teaching and learning. According to the research outcomes, the following recommendations (in italics) are proposed. They focus on critical issues concerning the flexibility and interactivity for managing change in technology-based
curriculum, where balanced considerations are given to educational and technological issues. They are not only useful within the context of IVE or vocational education, but could be extremely useful for administrators, curriculum developers, teachers and the others to formulate strategies to deliver quality courses on the Web in the arena of formal and informal education.

*There should be a balance between flexibility and management control for effective implementation of the WBC*

The research shows that tight control stifles the growth of the WBC. Tight management control due to the common assessment strategy and its associated progression policy has restricted the flexibility to cater for the specific needs of individual students. It imposes extreme pressure on teachers and students, discouraging students' motivation to participate in the WBC and limiting the freedom of teachers to post and share materials on the Web. Hence, both teachers and students expect more teaching and learning flexibility in terms of user control and less management control. The flexibility provided by the WBC during summer time demonstrates how it helps to improve student performance. The supplementary server for the WBC provides more teaching and learning flexibility. Indeed, the WBC should provide flexibility for students to regulate their own learning for the purpose of developing flexible and unique understanding of the subject matter. However, to ensure the standard and quality of the WBC, there must be a balance between flexibility and management control.
The effects of different types of interactivity on teaching and learning must be evaluated separately

The WBC requires students to be more active and to have a higher level of interactivity in order to bring about substantially greater learning success. A higher level of interactivity has a more positive effect on student performance. However, when the interactions contain those of both human and non-human nature, their overall effects on student learning are very complicated. The influence of one type of interaction may dominate the others. When the effects of different types of interactivity are evaluated separately, additive learning benefits are apparent for active virtual human interactions especially when interactions with teachers and peers are complementary.

As the quality and level of interactivity for various types of virtual interactions are different, the overall effect on teaching and learning may not reflect the true picture. This conclusion helps to explain the 'no significant difference' phenomena in previous research.

The English reading and writing skills required by the WBC especially for non-native English students must be strengthened in the language curriculum

The language policy is critical for success implementation of the WBC. The study reveals that language deficiencies could severely hinder student communication on the Web even for senior students. Students are lacking confidence to discuss openly
Conclusion and Recommendation

Conclusion and Recommendation

on the Web. They tend to use short-form English mixed with Chinese characters. The common language curriculum, ignoring the importance of the English reading and writing skills required by the WBC, is a significant language barrier that undermines student participation in the WBC.

A unified Web-based curriculum with appropriate teaching and learning flexibility is a strategy to foster a culture of sharing

A unified curriculum promotes collaboration among teachers to develop more interactive and commonly shared online materials in both centralized and decentralized servers. Decentralized servers allow more teaching and learning flexibility for specific groups of students. Online materials can be shared simply by adding appropriate Web links. Joint effort can reduce the workload of teachers incurred from developing highly interactive WBC materials and the fast technological change.

A streamlined management structure with a flatter hierarchy must be adopted to facilitate the development of the WBC

A complicated matrix management structure leads to confusing policies, roles and responsibilities for teachers and students and undermines the future development of the WBC. It hinders collaboration among teachers to develop the WBC. Prompt decisions cannot be achieved if conflicts arise. The matrix management structure
fails to move closer to uncoupling staff from departments and viewing them as a resource to be used flexibly to meet the needs of individual students and teachers. A streamlined management structure increases teachers' sense of ownership, nurtures a culture of sharing and collaboration and provides the autonomy and flexibility to facilitate the development of the WBC.

Mixed strategy on technology for effective implementation of the WBC: centralization and decentralization

Bandwidth and browser compatibility are critical success factors for the effective implementation of the WBC. They are normally under-estimated by management due to resource constraints. The situation is more acute due to fast technological change. A centralized strategy, using a standardized approach, can alleviate the problems by sharing expensive resources and thus avoid duplication of efforts. It also fosters a culture of sharing essential for the WBC. However, a standardized approach may pose certain limitations that undermine academic freedom and creativity. A decentralized strategy for the WBC allows more autonomy and flexibility and increases the sense of ownership. This is vital if reforms are to be more than superficial. There should be a balance between centralization and decentralization. A mixed IT strategy for the WBC is more responsive to the fast technology change. This study reveals how a mixed strategy on technology, using a centralized WBC development platform running on decentralized servers, can be adopted for effective implementation of the WBC.
Limitations of the Research

The chief criticism leveled at the case study approach is lack of scientific rigour and its possible uniqueness (Johnson 1994). This research attempts to use both qualitative and quantitative approaches to analyze the research data. The use of multiple target groups serves the purpose of multiple case studies aimed at non-uniqueness. Different research tools are used to solicit the perceptions of teachers and students, serving the purpose of methodological triangulation protocol (Stake 1995, Yin 1994). Quantitative data are analyzed by phases and gathered under different circumstances (e.g. computer logs and questionnaires), serving the purpose of data source triangulation (ibid). Limitations of questionnaires are compensated by group interviews with student representatives.

However, the research takes place in a computing department where the populations have computing talents and are equipped with better IT skills for the WBC. The outcome could be different if similar research is conducted in other non-IT disciplines. Since this research has been focused on the diploma level courses, its findings may not be able to represent different level or mode of studies. Generalization in some instances like the part-time mode is perhaps difficult, if not impossible.

In order to analyze the effects of different types of virtual interactions on student learning, separate mail-boxes were designed to send and receive messages for peers and teachers respectively to differentiate different types of interactions from the WebCT logs which provide very accurate measures for the quantitative data. However, this set up needs some special technical expertise possibly lacked by many
academics. Perhaps this is the reason why there has seldom been any previous research that evaluates accurately the effects of various types of virtual interactions on student performance.

The WBC Change Model provides a good starting point for research concerning online teaching and learning. However, one important area is missing - the curriculum design for the WBC. This area is emphasized in both the OLE framework (Dringus and Terrell 1999) and the ACTIONS model (Bates 2000). In order to select the best technologies for supporting the teaching and learning of the WBC, it will be necessary to determine what kinds of learning are needed and what instructional approaches will best meet these needs.

**Future Research Areas**

Despite the limitations mentioned above, the WBC Change Model provides an effective framework for research related to online teaching and learning. The model can be applied to other cases such as non-IT courses and part-time courses for different level of studies.

When virtual interactions contain those of both human and non-human nature, the overall effect on teaching and learning can be very complicated. Higher quality and level of various types of virtual interactivity impose an additional workload for teachers and a demand for huge IT investment. Adopting new technology is not an altruistic behavior, people want to know that there is a definite benefit in spending
time grappling with technology (Tracey et al 1999). Hence it is worthwhile to predict the effects and impacts of different level, quality and types of virtual interactions on teaching and learning. Further research is suggested to explore these areas before teachers and curriculum managers can decide on what type, level and quality of interactions should be introduced for the inevitable development of the Web-based curriculum.
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Appendices

Appendix A: WBC Module Observation Checklist

Group/class size: _____ / _____  Date: _____ Jan / March / May 2000  

Total no. of students present: _____

Teaching Approach: WBC Tutorial  
Individual project / Group project

| Student no. Activities | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | Total |
|------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|------|
| Email with teacher     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Email with classmate   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Discussion Forum       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Use Chinese to communicate |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Reading news           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Browse content page    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Doing online exercise  |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Reading FAQs and user guide |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Seeking online technical support |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Home/other Web page    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Discussion with teacher (f2f) |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Discussion with classmates (f2f) |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |
| Other non-WBC activities |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |      |

Remarks: ____________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________
Appendices

Appendix B: Student Questionnaire on Web-based Curriculum

Module code: ________________

Please tick as appropriate.
① Strongly Agree  ② Agree  ③ Neutral  ④ Disagree  ⑤ Strongly Disagree

Note: Web-based curriculum (WBC) is defined as a curriculum delivered on the Web.
The Web-based module is part of the WBC.

Part I: General Information

Gender:  □ Male  □ Female  
Education:  □ Form 5  □ Form 7

No. of years using computer  □<1  □<3  □<5  □<10  □>=10

Medium of instruction in your Secondary School Education  □ Chinese  □ English

You are familiar with using the Web-based learning environment  ① ② ③ ④ ⑤

Web-based Curriculum (WBC) is interesting  ① ② ③ ④ ⑤

WBC helps to improve your grades  ① ② ③ ④ ⑤

What percentage (%) of the IVE curriculum should be delivered on the Web?  □<20  □<40  □<60  □<80  □<=100

Web-based Curriculum (WBC) is:  □ Optional or Supplement  □ Essential

Which Web browser you prefer?  □ Netscape  □ Internet Explorer  □ Other: ________________

Which language version you prefer the WBC to support?  □ Chinese  □ English  □ Both
Appendices

Part II: Flexibility

Do you own a computer at home? □ Yes □ No

The frequency (per month) you use computer to access the WBC: (please enter a number)

At home ________ per month
On campus ________ per month

Home access to the WBC is important
Why? __________________________________________
__________________________________________

The WBC can enable you to become a more independent learner

Students actively participate in the WBC perform better

The existing WBC provides the following learning flexibility: (Please tick as appropriate)

☐ 1. More choices on course content
☐ 2. More choices on test and assignment
☐ 3. More flexible schedule to learn at your own pace
☐ 4. More flexible learning path for individual student
☐ 5. More flexible teaching approach to cater for individual needs
☐ 6. Access course materials anywhere, anytime
☐ 7. Contact tutor anywhere, anytime

You expect the following learning flexibility provided by the WBC is important:

More choices on course content
More choices on test and assignment
More flexible schedule to learn at your own pace
More flexible learning path for individual student
More flexible teaching approach to cater for individual needs
Access course materials anywhere, anytime
Contact tutor anywhere, anytime

Flexibility and Interactivity in the Context of Web-based Curriculum: Managing Change
Part III: Virtual Interaction

For participation, please enter the total number from November 1999 to May 2000. You may refer to your WebCT logs (leave blank if not available). For usefulness, please indicate whether the following type of interaction is useful for your study (you are required to tick as appropriate even if not available).

Section A: Interaction with human

<table>
<thead>
<tr>
<th>Participation</th>
<th>Usefulness</th>
<th>Not useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Email send, reply or forward to teachers (exclude those you received from teachers)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. Email received from teachers</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Email send, reply or forward to classmates (exclude those received from classmates)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. Email received from classmates</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Post message in the Discussion Forum</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Please explain why if you consider any of the above not useful:
________________________________________________________________________

Please specify and explain if you take part in other form of communication:
________________________________________________________________________

The language used to communicate in the WBC is:
☐ Chinese ☐ English ☐ Both

What kind of interaction you preferred: (Please tick only one)
☐ Face-to-face communication
☐ Communication on the Web

Section B: Interaction with computer

<table>
<thead>
<tr>
<th>Participation</th>
<th>Usefulness</th>
<th>Not useful</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Course content and Course guide</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>b. News</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>c. Assignment or Test</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>d. FAQ and User guide</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>e. Online technical support</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Please explain why if you consider any of the above not useful:
________________________________________________________________________

Please specify and explain if you frequently access other Web page:
________________________________________________________________________

Are there any problems for you to participate in the WBC? ☐ Yes ☐ No

If yes, please specify: ________________________________________________
### Part IV: Curriculum

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC can support the development of IVE curriculum</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>IVE curriculum can facilitate the change from traditional Curriculum to WBC</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>WBC saves your learning time and reduces your workload</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Pace of change to WBC is:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Too fast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Acceptable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Too slow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you have any problems or disagree with any of the above issues, please explain why:

________________________________________________________________________
________________________________________________________________________

### Part V: Management Structure

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVE management structure encourages you to participate actively in the WBC</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>The management provides enough support for the WBC</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

If you have any problems or disagree with any of the above issues, please explain why:

________________________________________________________________________
________________________________________________________________________

### Part VI: Technology

The following are important factors for effective implementation of the WBC (Please tick as appropriate, 1 is Most Important; 5 is Least Important. Please leave it blank if it is not important to you.)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Most Important</th>
<th>Least Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatibility</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Standardized Platform</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Scalability</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cost</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Updated</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Speed</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Reliability</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

What kind of technical support/resources you prefer?  □ Centralized  □ Decentralized

Are there any major problems faced with the WBC due to technological change?  □ Yes  □ No
If yes, please elaborate: ____________________________________________________
________________________________________________________________________