Doctoral Dissertation

# Research on Learning Support Systems for Web-based Self-directed Learning

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*To my parents, my wife*

# Abstract

The world is now developing so fast that today's knowledge is quickly becoming outdated. This requires us to constantly conduct self-directed learning in order not to be lagged behind. With the fast renovation of internet technologies, it has become really convenient for us to use the internet as an important tool to facilitate our learning. Hence, the field of web-based learning has been drawing attentions from fields of researchers. Compared with before, the World Wide Web has, without any doubt, made our learning, especially self-directed learning more and more efficient and fruitful. No longer does one need to worry about no accessing to needed information which is expected to be found on the internet whenever needed. And no longer does one have no ways of reaching to another people with similar learning interests who are expected to be connected by a cable wherever. Therefore, it has become possible to overcome the restrictions of time and space for people who are learning by themselves.

The most recognizable feature of self-directed learning is that the learners are given full control of their learning activities, which also means that they are completely on their own. Ordinarily, they are expected to be more motivated, persistent, independent, self-disciplined, self-confident and goal oriented than other people. In the reality, however, fulfilling such expectations prove to be very difficult. Since the self-directed learners are in charge of all aspects of learning from deciding what should be learned to the methods and resources used to the evaluation of the success of the effort, the challenges are the lack of external validation for learning content, methods and outcomes. It is true that fast development of information technologies especially the ones on World Wide Web have greatly increased the learning situations for self-directed learners nowadays. However, as always, the conveniences new technologies bring to us often come with new difficulties and challenges needed to be addressed in order to take better advantages of Internet technologies. Firstly, it has become difficult for us to locate suitable learning resources that the Internet provides. We easily lose sight of the learning goals and get drowned in the ocean of information. Even we might finally manage to find the resources we want, how to get them organized is not easy either. Moreover, learning skills (also referred as cognitive skills) have been recognized as important especially in self-directed learning. How to learn the things we need from piles of learning information effectively by ourselves is perceived quite demanding. When at school, we can learn from teachers or skilled classmates. But on the Internet, where all are virtual existence, getting our learning skills polished seems really difficult. Thirdly, as the final stage of learning, we extracted and absorbed the knowledge from piles of learning resources. But without appropriate forms of recording it down, the learnt knowledge can be easily faded away. This is probably why we take notes, doing after course exercises at school as a way of constructing knowledge. But when faced with the useful information scattered here and there in various forms on the Internet, how to build up perceivable knowledge structure proves to be challenging. All of these problems limit learners engaged in web-based self-directed learning from effective control and assessment of their learning activities.

In order to address these issues, the purpose of this research is to further improve the learning situations for web-based self-directed learners in the three major aspects of learning: Resource Finding & Organization, Learning Skill Cultivation and Knowledge Constructing In the context of this research: resource organization means

arranging one's learning resources found from the web in a way to facilitate later learning activities such as reviewing or revising. Learning skill cultivation means improving learner's cognitive capabilities (how to learn) in order to attain knowledge or abilities in a more effective way; Knowledge Constructing means creating one's knowledge structure from various types of learning resources. Since mapping theories have been prevalently studied in many research in both the educational and learning setting and have been proved to be effective in knowledge attainment and reflection, I proposed a Multi-layer Map-oriented Model (MLM)-a model to offer multi-dimensional management over concepts/topics with hierarchical relations via superposed layer representations, by introducing the concept of Topic Maps through considering the characteristics of self-directed learning on the web and its challenges. And then designs and develops three learning support systems in an attempt to tackle these issues. Finally, the according cased studies were carried out to evaluate the effectiveness of the developed systems.

Topic Maps are an ISO standard for describing knowledge structures and associating them with information resources. Because of the numerous factors and elements of various kind being involved in the self-directed learning on the web, this model not only offers one-dimensional management over the concepts/topics in the same categories/domain through associations, but also other concepts/topics with hierarchical relations via superposed layer representation (occurrences). I put this model into practical use by basing it to develop three learning support systems: (a). A resource organization system enabling leaners to quickly locate their wanted learning resources and organize the resources to facilitate later learning activities via multi-layer map visualization; (b). A strategy object mashups system enabling learners to build up their own effective learning environment while being made aware of the application of the related learning strategy and tactics; (c). A note-taking systems enabling learners to take non-linear, map-oriented notes for better revision and reflection in VOD (Video on Demand) based learning. These attempts are meant to explore the chances of exploiting this model in the three major aspects of resource finding/organization, learning skill cultivation and knowledge constructing in self-directed learning.

Keywords: web-based learning, self-directed learning, multi-layer map model, topic maps, strategy object mashups

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When I started to write this this thesis, I could not help looking back the six years I spend in JAIST firstly as a master student, and then as a doctoral candidate. A lot of things had happened during this 6 years, good or bad, which have completely changed the course of my life. From an ignorant young man who just quit his job in China, I have grown in to an adult who not only learnt how to be responsible but also figured out what he wants in his life. Here I want to thank this great school, it offers me the spectacular learning environment, and also the peaceful mind which appears really rare in nowadays society. When thinking about leaving this place after graduation, I cannot help feeling a little sad in my heart for this school has changed me into a better human being which I shall never forget.

It is not possible for me to finish the doctoral course without the help and kind support of many people. I would like to mention their names to express my great gratitude.

Firstly, I would like to give my greatest thanks and gratitude to my supervisor-Associate Professor Hasegawa who has been so kind and patient walking me through these six years, who is always patient and enlightening with my research. He is the one who led me into the world of learning engineering which greatly open my horizon and broaden my way of logical thinking. He has done far more than enough as my supervisor. Without him, there is no way that I can smoothly walk through these six years of research life.

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# Chapter1
# Introduction

## 1.1 Motivation

With the rapid development of today's world, the knowledge learnt at school becomes outdated at a tremendous speed. In order to catch up with the fast developing society and not to be legged behind both professionally and personally, attendance to constant self-directed learning becomes more and more inevitable and important. In those days without the Internet, people go to libraries or book stores to find learning materials for self-improvements. The problems mainly were the shortage of learning contents, not knowing who to consult to when questions arise, and also the lack of companionship with like-minded one to discuss interesting topics. For a long time these three major difficulties are the main obstacles for people who are eager to learn by themselves until the advent of the Internet.

After entering the 21st century, the Internet technologies are moving forward rapidly, causing the contents of the World Wide Web growing exponentially day by day. Along with the cost of computers and other kinds of terminals lowering down, more and more people now have access to the Internet. No exception, the way of learning and receiving information are also greatly changed. The three major problems in the days without the Internet seems to have been resolved. We can now literally find any information we want from the World Wide Web, not only text contents, but also videos, pictures and even sometimes forms beyond imagination. We no long worry about having no wise ones to answer our questions, because the Web is loaded with anything we want to know. Meanwhile, the Internet also enables us to connect easily with millions of people around the world who are just as interest as we are in certain topics of learning and willing to communicate and share happily. Self-directed learning has evolved to another level with adequate learning materials, largest learning communities and wiser guidance.

However, like other new technologies, while they are making our life more convenience, we are also faced with new problems and challenges. There are three inevitable aspects in learning theories: learning resources (materials), learning skills (cognitive skills) and learning outcome (knowledge constructing). Translating into understandable phrases, they are: what to learn, how to learn and what have learnt. Firstly, we need to find proper learning materials in order to satisfy our learning interests; secondly, we need to exercise our learning skills in order to obtain more knowledge and abilities; and finally we need to come up with a knowledge structure after learning which can best illustrate our learning outcomes and also can serve as effective reminders when we come back later for knowledge review. In the meantime, since the Internet has connected billions of people around the world, a largest ever learning community has been formed and, inevitably, the involvement with other people sharing similar learning interests has become an important element in the learning process. How to efficiently take advantage of this phenomenon presents another challenges. Although the technologies have made the learning situations much better, there are still some issues we need to address. For example, with more than enough information loaded on the Web, Internet users are required not only to navigate web pages to search for useful information but also to control the navigation

all by themselves, which proves to be very troublesome. Supposed that they have found the proper learning materials, but no one will teach them effective learning skills to improve the learning efficiency. The learners are all on their own and easily to be fall in some ineffective customs of learning. Furthermore, the knowledge learnt must be from various learning sources from the Internet, which proved to be difficult to construct a visible yet understandable structures while connecting all the sources for an efficient later review. All of these problems prevent web-based self-directed learners from conducting a more effective, and productive learning activities. In order to address these difficulties, this research is aiming to design and develop several learning support systems which are expected to improve the current learning situation and provide some assistances to learners on web-based self-directed learning combined with community-based learning whose definitions will be explained in next chapter.

## 1.2 Research Objectives

The purpose of this doctoral research is to further improve the learning situation for web-based self-directed learners in the three major aspects of learning: Resource Finding & Organization, Learning Skill Cultivation and Knowledge Constructing. In the context of this research: resource finding & organization means finding appropriate learning resources more effectively and quickly, and then arranging one's learning resources found from the web in a way to facilitate later learning activities such as reviewing or revising. Learning skill cultivation means improving learner's cognitive capabilities (how to learn) in order to attain knowledge or abilities in a more effective way; Knowledge Constructing means creating one's knowledge structure from various types of learning resources for the purpose of enabling learners to revise and reflect the things they have learnt in a more enlightening way. Considering the characteristics of self-directed learning on the web and its challenges, I proposed a Multi-layer Map-oriented Model (MLM) by introducing the concept of Topic Maps. Mapping theories have been prevalently studies in many research in both the educational and learning settings and have been proved to be effective in knowledge attainment and reflection. Among those, Topic Maps are ISO standards for describing knowledge structures and associating them with information resources. Because of the numerous factors and elements of various kind being involved in the self-directed learning on the web, this model offers not only one-dimensional management over the concepts/topics in the same categories/domain through associations, but also other concepts/topics with hierarchical relations via superposed layer representations. And then I put this model into practical use by basing it to develop three learning support systems: (a). A resource organization system enabling leaners to quickly locate their wanted learning resources and to organize the resources to facilitate later learning activities via multi-layer map visualization; (b). A strategy object mashups system enabling learners to build up their own effective learning environment while being made aware of the application of the related learning strategy and tactics; (c). A note-taking systems enabling learners to take non-linear, map-oriented notes for better revision and reflection in VOD (Video on Demand) based learning. Finally, the according cased studies are carried out to evaluate the effectiveness of the developed systems. These attempts are meant to explore the chances of exploiting this model in the three major aspects of resource finding/organization, learning skill cultivation and knowledge constructing in self-directed learning.

## 1.3 Thesis Outline

The thesis is divided into seven chapters as follows:

Chapter one will firstly describe the motivation of doing this research. It firstly describes the current situation for self-directed learners who are either eager young students at school wanting learn more by themselves or those having left school but hope to keep up with the fast developing society by self-directed learning. Secondly, what are the main obstacles presented to the web-based self-directed learners and then it briefly the main purposes of this research and the outline of the whole thesis.

Chapter two is mainly about the background of the research. It will firstly introduce the definition of web-based learning, self-directed learning and community-based learning. Especially the details of the characteristics of web-based self-directed learning combined with community-based learning will be discussed. For example, what has become convenient and helpful because of the advent of World Wide Web, and what are the new challenges which have emerges with the development of web technologies. And then this chapter will generally describe the common difficulties existing in self-directed learning combined with community-based learning over three aspects of resource organization, learning skill cultivation and knowledge constructing, especially in the scenario of web-based learning, and then reveal the research questions of this thesis.

Chapter three is for the introduction of the research methodology. It firstly introduce the base/inspiration of this research—Topic Maps: definition, history for application, features and etc. And then it introduces the concept of multi-layer map model based on the topic maps standard. It only describes the basic features of this model and how this model would visualize the self-directed learning behaviors to improve the learning situations. In the end, it leads to the introduction of the three learning support systems developed to improve resource organization, learning skill cultivation and knowledge constructing, based on the multi-layer map model proposed only with minor changes respectively. The changes will be generally discussed in this chapter.

Chapter four introduces the learning support system of resource organization. In this chapter, there are five main sections. The first section is related work. It mainly describes the research in improving resource finding and organization in the field of self-directed learning especially those using mapping technologies combined with the points they failed to emphasize which would be addressed in my research (such as failing to consider the seamless combination of learning activities such as resource fining and organization). The second section is approach. It mainly describes the model of this system (based on the concept of multi-layer map model described in chapter three), and how the model applies in the system development. The third section is system review. In this section, the main functions of the system will be introduced. The fourth section is evaluation. This section introduces the case study conducted to assess the effectiveness of the developed system and to validate the hypothesis. In this section, the data gathered in the case study will be analyzed and also what the results indicate.

Chapter five introduces the strategy object mashups system for learning skill cultivation. In this chapter, there are five main sections. The first section is related work. It mainly describes the research in improving learning skills in the field of self-directed learning. As I chose the academic listening skills as the subject for learning skill cultivation, the literature would be mainly the field of CALL system (Computer Assisted Language Learning) and those focusing on adaptations, and also the novelty of this research (offering effective learning environment with strategy and tactic information). The second section is approach. It mainly describes the model of this system (based on the concept of multi-layer map model described in chapter three), and how the model applies in the system development. The third section is system review. In this section, the main functions of the system are introduced. The fourth section is evaluation. This section introduces the case study conducted to assess the effectiveness of the developed system and to validate my hypothesis. The final section is discussion. In this section, the data gathered in the case study will be analyzed and also what the results indicate.

Chapter six introduces the learning support system for knowledge constructing. In this chapter, there are five main sections. The first section is related work. As I chose note-taking in VOD based learning as the subject for supporting knowledge constructing, the literature related in VOD based learning will also be included and how this research addresses several points which have not been realized currently but are expected to be useful (for example, providing non-linear way of note-taking, managing note over multiple learning resources, enabling community-based note-taking and etc.). The second section is approach. It mainly describes the model of this system (based on the concept of multi-layer map model described in chapter three), and how the model applies in the system development.

Chapter seven is about conclusion and future work. It will firstly conclude the current research situations from the results of case studies of the three learning support systems. And then it discusses the possibilities for practical applications of topic maps based multi-layer map oriented model in the development of learning support systems. In the end, it sums up the future work left both in the pilot system developments and further explorations in the use of topic maps in the field of learning support engineering.

# Chapter2
# Background

## 2.1 Web-based Learning

First of all, what is learning? It may seem very unreasonable to ask such question, but as a matter of fact, there are many learning theories which keep evolving with the passing of time. Driscoll (2000) defines learning as "a persisting change in human performance or performance potential which must come about as a result of the learner's experience and interaction with the world". This definition encompasses many of the attributes associated with behaviorism, cognitivism and constructivism—three broad learning theories most often utilized in the creation of instructional environments, attempting to address how it is that a person learns. Behaviorism states that it is impossible to understand what goes on inside of a person. It stresses on the learning behaviors other than internal activities (Gredler, 2005). On the contrary, Cognitivism views knowledge as symbolic mental constructs in the learner's mind, and the learning process is the means by which these symbolic representations are committed to memory (Buedell, 2004). Constructivism suggested that learners create knowledge as they attempt to understand their experiences (Driscoll, 2000). However, these learning theories were developed in a time when learning was not impacted through technology. Especially with the occurrence of the internet, which has reorganized how we live, how we communicate, and how we learn. Furthermore, including technology and connection making as learning activities begins to move learning theories into a digital age. This gives rise to a new learning theory—Connectivism. Siemens (2004) defines Connectivism is the integration of principles explored by chaos, network, and complexity and self-organization theories. He stressed that since new information is continually being acquired, the ability to draw distinctions between important and unimportant information is vital. Based on the principles of this new learning theory, I assume that web-based learning is actually belongs to the realm of Connectivism.

We have to admit the fact that with the advent of the Internet and the fast renovation of information technology which has made the content of the Internet more colorful and adequate, our life and way of doing things have completely changed. Particularly in the way of learning, for the access to needed information has become easiest ever. Equipped with a computer connected with the Internet, we can literally learn anything we want. From that time, the information loaded on the Web has been growing exponentially with constant upgrade and renewal. At the beginning, only text-formed information took a main share on the Internet which practically played the role of substituting paper-formed information only with much better accessibility. But later on, pictures, audios and videos exploded on the Internet becoming an indispensable parts of learning materials. Furthermore, the prevailing of portable tablets and smartphones recently unexpectedly made learning on the Web ubiquitous. Invariably, we have gradually changed our habit of turning to wised ones or related books whenever having questions, to surfing on the Internet, feeling sure that the needed information could be found sooner or later. Easy accessibility and stability make the learning on the Web popular, which enable us to surpass the restriction of time and

space which are once great obstacles to us (Thuering, Hannermann, and Haake, 1995). Therefore, in recent decades, Web-based learning is drawing lots of attentions and expected to play much more positive role in enriching human's knowledge repository. Web-based learning is one way to learn, adopting Web-based contents or technologies in a learning process. To put it in another way, in Web-based learning, learners use mainly computer or the likes (Figure 1) to interact with other people with similar learning interests and learning materials such as watching videos, sharing knowledge, taking e-courses and so on (Jolliffe, Ritter and Stevens, 2001). This form of learning has been adopted in various educational and learning scenarios such as blended learning, but in this research, we only focus on the web-based self-directed learning.

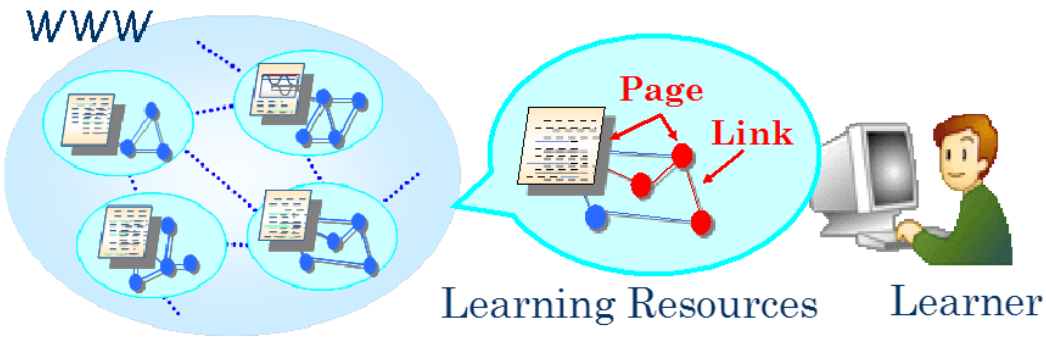


Figure 1. Web-based Learning

## 2.2 Web-based Self-directed Learning

After graduation from school, it has become impossible for us to sit in a classroom to listening to lectures. And it is also not always convenient to have some wise ones around to consult whenever we have questions needed to be answered. In order not to be legged behind by the fast developing society, people need to conduct self-directed learning constantly to fulfil their dreams and be useful to the society. Knowles (1975) described self-directed learning as a process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify the learning resources, select and implement learning strategies, and evaluate learning outcomes. For identifying learning resources nowadays, learners can navigate a vast volume of web-based resources to achieve their individual learning goals. Such resource usually provide them with hyperspace which enables them to navigate in a self-directed way by following links among the pages (Figure 2). After finding the right learning resources, learners need to extract the knowledge from them by following a certain way of learning known as learning methodologies or skills. Finally, they are expected to come up with a concrete knowledge structure as their learning outcomes. Self-directed learning on the web is expected to enhance their information literacy by encouraging the selection of suitable resources, each of which may have a different credibility and/or view point of the same topic (Hasegawa, Kashihara, and Toyoda, 2003; Dabbagh and Kitsantas, 2004). The most recognizable feature of self-directed learning is that the learners are given full control of their learning activities which also means that they are completely on their own. Ordinarily, they are expected to be more motivated, persistent, independent, self-disciplined, self-confident and goal oriented. In the reality, however, fulfilling such expectations prove to be very difficult. Firstly, it has become difficult for us to locate suitable learning resources that the Internet provides. We easily lose sight of the learning goals and get

drowned in the ocean of information. Even we might finally manage to find the resources we want, how to get them organized is not easy either. Moreover, learning skills (also referred as cognitive skills) have been recognized as important especially in self-directed learning. How to learn the things we need from piles of learning information effectively by ourselves is perceived quite demanding. When at school, we can learn from teachers or skilled classmates. But on the Internet, where all are virtual existence, getting our learning skills polished seems really difficult. Thirdly, as the final stage of learning, we extracted and absorbed the knowledge from piles of learning resources. But without appropriate forms of recording it down, the learnt knowledge can be easily faded away. This is probably why we take notes, doing after course exercises at school as a way of constructing knowledge. But when faced with the useful information scattered here and there in various forms on the Internet, how to build up perceivable knowledge structure proves to be challenging. All of these problems limit learners engaged in web-based self-directed learning from effective control and assessment of their learning activities. As a result, the typical scenario for self-directed learning in this research is like this: firstly, a learner needs to decide what to learn and set his/her learning goals; secondly, he/she need to find suitable learning resources in various digital forms from the internet; lastly, he/she learn the learning resources found all the oneself and construct his/her knowledge structure. Consequently, as Connectivism requires, they are expected to connect their learning topics, learning resources and other aspects in their learning in a meaningful way.

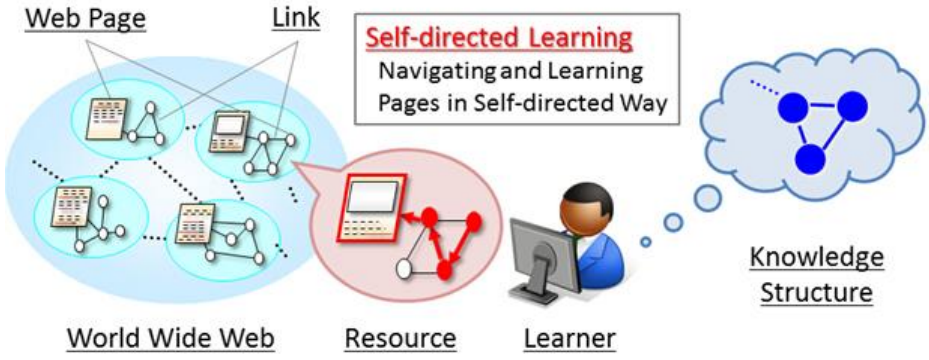


Figure 2. Self-directed Learning

## 2.3 Community-based Learning

There is a famous saying made by Chinese Confucius, it is “there must be at least one person out of three who can serve as your teacher”. This wise saying indicates that collaboration with other people can greatly boost the efficiency of whatever you are dedicating to. As Self-directed learning is not always an easy job since one can often get lost or frustrated by studying alone, receiving instructions, advises, well-organized knowledge and encouragement from other like-minded people become really necessary. Since the internet has made reaching out for people worldwide possible, Community-based Learning has also been drawing attentions from fields of researchers. In this research, community-based learning is defined as the process of communication by community members who share the similar learning goals for the purpose of encouraging each other’s self-directed learning activity. Figure 3 shows the process that involves not only sharing resources, but also learning skills, peer-

review of the resources found, and the sharing of knowledge. Ordinarily, it is not so easy for self-directed learners to obtain adequate supports since the learning resources and the processes vary from learner to learner (Ota, Kashihara, and Hasegawa, 2005). However, community-based learning makes it possible for the learners to engage in informal communication as feedbacks in their individual self-directed learning processes (Cook and Smith, 2004). But in reality, how to get effective contact with the other people with similar learning interest on the web proves to be difficult. Furthermore, the feedbacks among shared learning information, perceptions of learning skills of effective learners and the sharing of learning outcomes of each other are ought to have positive effect on self-directed learning yet hard to be implemented on the web. In this research, how do the community members of different levels contribute/benefit from community-based learning? Firstly, let us suppose that there are three types of learners—high level, middle level, and low level. The low level or the novice learners are the complete benefiters, because at the beginning, they are only getting support or guidance from experienced middle/high level learners without contributing anything to the community. For higher level learners, they are both benefiters and contributors for they are both getting helped and contributing to the leaning community by introducing effective learning resources or outcomes. And eventually, novice learners will evolve into experienced learners who not only contribute but also provide guidance for new comers. Actually this learning scenario of community-based learning is an example of "Legitimate peripheral participation", a concept brought up by Lave and Wenger in 1991. It describes how new comers become experienced members and eventually old timers of community of practice or collaborative project. According to this concept, newcomers become member of a community initially by participating in simple and low-risk tasks that are nonetheless productive and necessary and further the goals of the community. Through peripheral activities, novices become acquainted with the tasks, vocabulary, and organizing principles of the community.

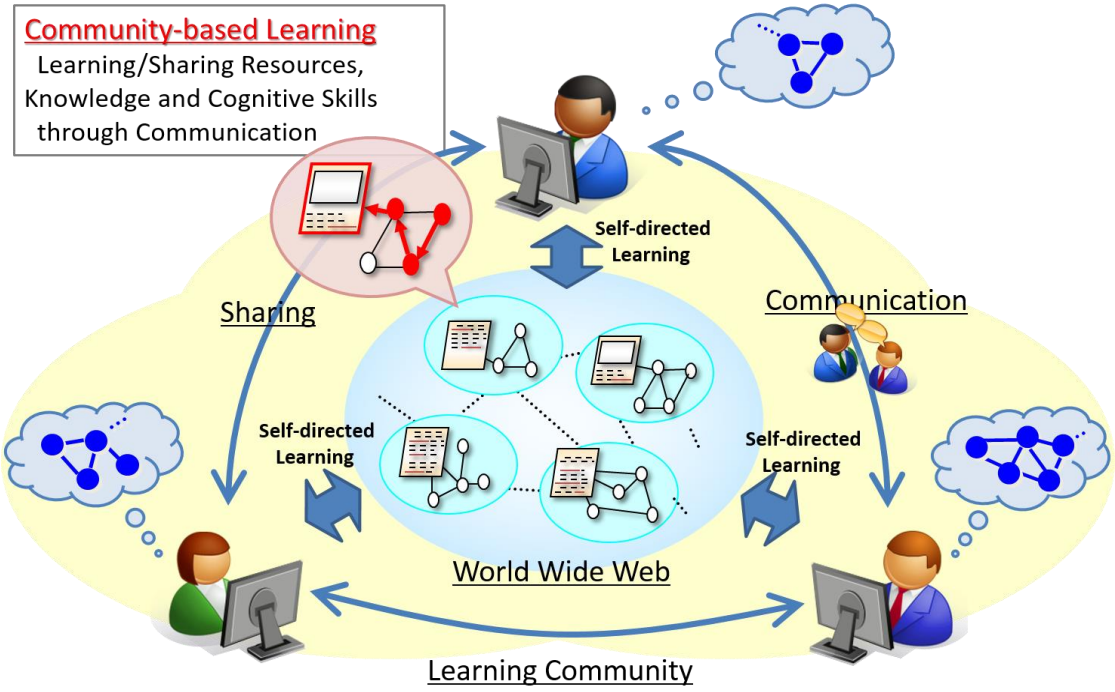


Figure 3. Community-based Learning

## 2.4 Research Questions

In this research, I have identified three major research questions:

Firstly, how to improve the resource finding & organization situation of the Web-based Self-directed learning? In the past, we often complained about not having enough learning materials. But now, the large amount of information available on the Web makes it very difficult for us to locate suitable learning resources, let alone having them organized. We have long passed the information shortage, instead we are now embracing the information flooding in this new era. Without help, finding the right learning materials on the Web can be really difficult, and the reasonable management of the found learning resources is not easy either.

Secondly, how to cultivate the cognitive skills of learners though Web-based Self-directed learning? When at school, the teachers always not only taught us the knowledge we need to know, but also instructed the way of conducting efficient learning—the learning skills. Faced with the insurmountable learning resources, it is better if we have a set of personally effective learning skills which could help us absorb more knowledge or strengthen our abilities. However, without proper guidance, knowing how to learn based on one's personal characteristics can be a bit of challenge.

Thirdly, how to build up knowledge structures as learning outcomes in Web-based Self-directed learning? The purpose of learning is to attain knowledge, but without appropriate forms of recording it down, the learnt knowledge can be easily faded away. As a result, we recite, take notes, doing after course exercises—any ways necessary, for reserve the knowledge permanently in our minds. However, on the Web where all the useful information is scatter here and there in various forms, it proves not easy to summarize the knowledge structures out of it. The knowledge structures need to be visual for later revision, and also be perceivable, making sure that learners later learning activities such revision or reflection can be conducted easily and effectively.

This research aims to address there three major research questions by presenting three learning situations: using the Web to collect and organize learning materials, using proposed systems to improve academic listening skills, and taking non-linear notes combined with collective note-taking in VOD based learning. Accordingly, we proposed three learning support systems which will be discussed in later sections.

# Chapter3
# Research Methodology

## 3.1 Introduction to Topic Maps

Topic Maps are ISO standard for describing knowledge structures and associating them with information resources (ISO/IEC 13250, 2002). Michel Biezunski described Topic Maps in the book "XML Topic Maps" like this:

"*The World Wide Web enables us to create virtually unlimited quantities of information and to make it immediately available to the world. We do not suffer from lack of information availability, but we do have hard time trying to locate the information we really need. Finding aids are therefore becoming highly desirable. Topic Maps provide a standard approach to creating and interchanging finding aids.* "

Topic Maps were originally designed to handle the construction of indexes, glossaries, thesauri, and table of contents, but their applicability extends to various fields of practical uses. For example, Lu, Feng, and Chen (2010) adopted Topic Maps standards to realize efficient knowledge acquisition, representation, exchange and sharing in the field of data mining. Mase, Yamada, and Nitta (2008), on the other hand, proposed a framework to extract topic maps from a set of web pages for information retrieval. In the field of education, this ISO standard also were adopted in constructing e-learning repositories (Dicheva and Dechev, 2006) and digital course libraries (Dicheva, Dichev, Sun and Nao, 2004). Although Topic Maps are complicated yet practical technologies possible to represent immensely complex structures, this research only borrows three basic concepts—Topics, Associations, and Occurrences (TAO) which are easily grasped (Pepper, 2000). Although by comparison, Wisse (2006) raised questions towards Topic Maps for its isolation resulted from unfamiliar wordings to members of the new information professions, we focus on its capability of representing complex structures in the context of learning which only involves learners with similar learning interests and goals.

### Topics

Topics are the main parts of Topic Maps. The word topic is originated from the Greek word topos, which means both location and subject. In the widest generic sense, topics can represent any subjects with meanings perceived by their creator. Every topic has a name that represents it. A name is a string which is privileged in the sense that the knowledge that it is a name for the topic.

### Associations

Associations connect topics with each other. The definition of the association semantics is left to the Topic Maps creators, which represent relationships between topics.

### Occurrences

Occurrences are subordinated to topics. They can be properties of the topic stored as strings inside the topic map, or they can be references to information resources that are considered relevant to the topic.

Figure 4 illustrates how the three basic concepts relate to the Topic Maps. Topics represent concepts of a certain field which a learner is concerned. Association links represent hyper-graph relationships between the topics. Occurrence links represent the actual learning materials or knowledge points relevant to a particular topic. In Figure 4, there are three topics of the learners' interests: Learning Technology, ICT and E-learning. The solid lines among these three topics are associations which depict the various relationships the three topics have with each other. The dotted lines under these three topics are occurrences which represent the actual web contents in various digital forms. Topic maps can be used to qualify the contents and/or data contained in information objects as topics, to enable navigation tools and to link topics together with multiple, concurrent views on sets of information objects.

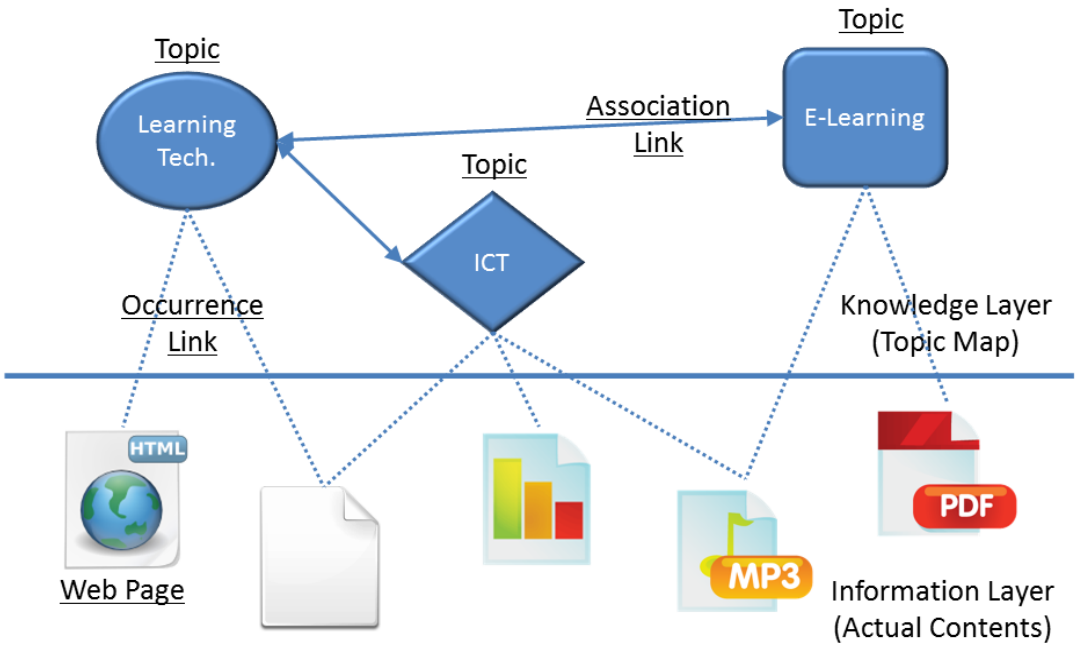


Figure 4. Basic Concept of Topic Maps

## 3.2 Topic Maps based Multi-layer Map-oriented Model

Considering the characteristics of web-based self-directed learning and its challenges, I propose a Topic Maps based multi-layer map-oriented model. Mapping theories have been prevalently studied in both the educational and learning settings and have been proved to be effective in knowledge attainment and reflection. The reason for adopting the concept of Topic Maps is because it properly meets all of my requirements. We encounters lots of subjects (such as learning resources of different kind, knowledge points and other learners of similar learning topics) while learning on the Web. Topics can represent various subjects, while Associations can describe complex structures among topic and finally Occurrence presents a good explanation/definition for each topic. Although Topic Maps can represent immensely complex structure, to present all topics of various kind with different features could be really unrecognizable. Especially in the case of Web-based self-directed learning, we are often faced with numerous subjects of different domains, categories or features, which means different levels or kind of topics that are needed to present subjects appeared in the Web-based self-directed learning. Furthermore, there are various

relationships among topics not only within the same level but also different levels. For example, in history learning, normally we usually learn who did what at what time, meaning people, event and time. These three subjects are three different domains of topic with different characteristics. There were many people did many historical events at different time periods. Meanwhile, there were relationships of different kinds among those people and events, meaning there are relationships needed to be managed not only at the horizontal level but at vertically levels. Apparently depending only on Topic Maps cannot solve this problem. Therefore, I propose to group one category of topics based on some roles on one layer, other categories of topics can be grouped on other layers. The relationships among layers are represented by certain associations or occurrences. I believe a model of this kind can more clearly represent a structure of concepts so that I come up with this multi-layer map model (MLM) which not only offers one-dimensional management over the topics in the same categories but also other topics with hierarchical relations via superposed layer representation. Figure 5 describe an example of knowledge constructing by adopting the multi-layer map-oriented model. It depicts the historical knowledge about World War I. During the war, there were some battles occurred among several countries, which were led by some great people. Moreover, among those countries involved, there were allies, enemies and neutral nations. Meanwhile, among the battles, which battle were the prelude to the other one, or which one is essential were all important knowledge points to represent. The proposed MLM model can be used to visualize this knowledge structure. The country layer contains all the countries involved in this war. On the layer we can see what countries are allies, what countries are enemies, and what countries declared neutral. The people layer is where all the key persons that affected this war would appear. From the connection between these two layers, we can see where these people came from, the combat layer describes all the battles happen during this war, and from its relationship with countries layer and people layer, and we can see what countries or people got involved. Of course the number of layers can grow depending on the coming up of new categories of topics. The right part of Figure 5 describes that at each layer, not only the associations among the topic, but also the occurrences of each topic also can be represented. This model is expected to be of assistance in visualizing the basic learning behaviours in Web-based self-directed learning.

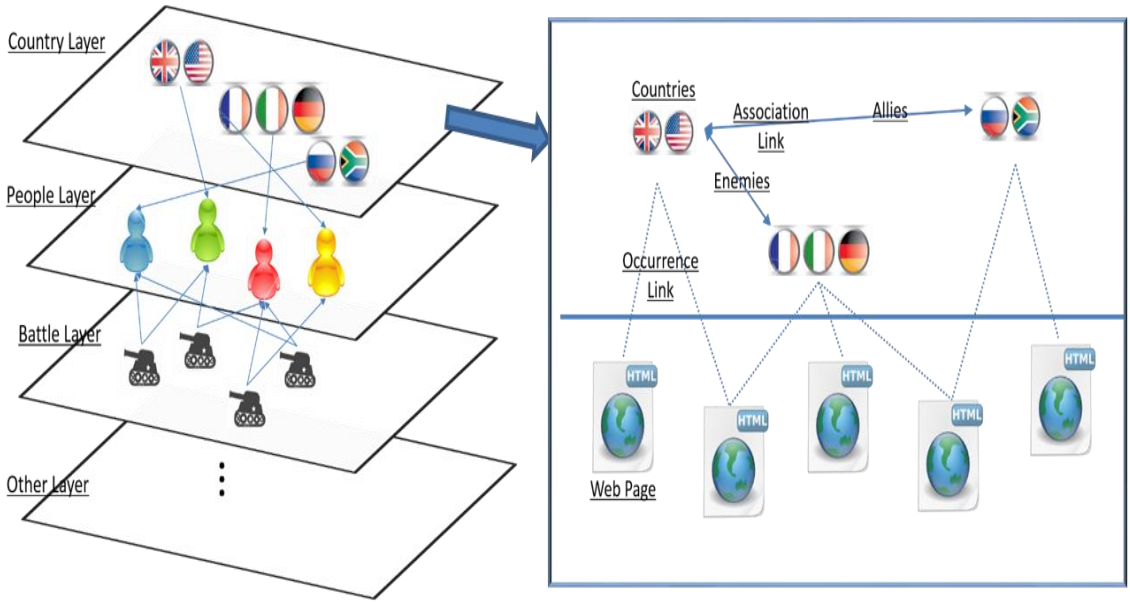

Figure 5 Multi-layer Map Model (temporary)

This research not only originally proposed this MLM model, but also put this model in practical use to improve the learning situations for web-based self-directed learners in the three major aspects of learning: Resource Finding & Organization, Learning Skill Cultivation and Knowledge constructing, I propose three learning support systems: (a). A resource organization system enabling leaners to quickly locate their wanted learning resources and organize the resources to facilitate later learning activities via multi-layer map visualization; (b). A strategy object mashups system enabling learners to build up their own effective learning environment while being made aware of the application of the related learning strategy and tactics; (c). A note-taking systems enabling learners to take non-linear, map-oriented notes for better revision and reflection in VOD (Video on Demand) based learning. These attempts are meant to explore the chances of exploiting this model in the three major aspect of resource finding/organization, learning skill cultivation and knowledge constructing in self-directed learning. The following three chapters will discuss the three systems in details.

# Chapter4
# Resource Finding & Organization—A Resource Organization System for Web-based Self-directed Learning

## 4.1 Introduction

In order to enrich one's knowledge repository, people need to conduct self-directed learning constantly. With the occurrence of the World Wide Web, accessing to needed information has become easiest ever. From that time, the information loaded on the web has been growing exponentially along with the constant rise of internet technologies. Therefore, it has been believed that the needed information can be accessed on the web conveniently. Consequently, it has become possible to overcome the restrictions of time and space for self-directed learning which has been demonstrated to enhance the learning process (Thuering, Hannermann, and Haake, 1995), but often requires learners not only to navigate web resources to construct knowledge learned from the resources but also to control the navigation and knowledge construction processes (Schnackenberg, Sullivan, Leader and Jones, 1998; Kashihara and Hasegawa 2005). As a result, web-based self-directed learning has become an important research area in the past decade. In order to address this issue, my approach is to integrate self-directed learning into community-based learning through which the learners are able to have informal community-centered communications (Fujimoto, Hasegawa, Miura, and Kunifuji, 2006; Farooq, Canoe, Xiao, Merkel, Rosson and Carroll, 2007). Community-based learning also attracts attentions along with the rapid growth of the web technology. In particular, there are number of researches on social bookmarking which indicate that the community-based learning resources organized by community members with a similar learning interest are expected to be valuable and effective (Noll and Meinel, 2007; Millen, Yang, Whittaker and Feinberg, 2007). However, it is difficult for the learners to access suitable learning resources from community-based learning since the learning goals vary from learner to learner, which leads to the necessity of proper recommendation for community learning resources. In order to address this problem, I have designed the proposed model, the Multi-layer Map Model (Li and Hasegawa, 2010) based on an ISO standard named Topic Maps (ISO/IEC 13250, 2002). This model enables the learners to visualize common learning behaviors employed on the web, such as locating learning resources, categorizing found resources and sharing the resources among community members. I have proposed a resource organization system (Li, Hasegawa, and Kashihara, 2012) which connects web contents and learning topics by means of multi-layer map visualization. A case study intended to determine whether the learners could improve the efficiency of their self-directed learning was conducted to assess the effectiveness of this system (Li, Hasegawa and Kashihara, 2013). After analysis of the experiment data, some encouraging conclusions were drawn which indicated that through topic map representations provided by the system, learners were able to locate appropriate learning resources

faster, organize learning resources in a more meaningful way, and collect learning resources inside their learning community more easily and effectively.

## 4.2 Difficulties in Resource Finding and Organization of Self-directed and Community-based Learning

The large amount of information available on the web makes it very difficult for the learners to locate suitable learning resources for particular topics of interests. They may have experienced the tedious job of trying to find a link out of pages of listings triggered by Google. Even in some websites exclusively designed for learning, the numbers of pages are so large that it normally takes a learner so much time to find his/her needed information. Traditional search engines only generate lists of pages ranked according to a matching algorithm. The learners therefore often have to click into certain web pages to find out whether they are appropriate or not to achieve their learning goals, and may miss the opportunity to learn if, after two or three useless clicks, they give up. If the learners do finally successfully locate sufficient learning resources from several URLs as a learning hyperspace, they have to organize these resources and to construct their knowledge by navigating the hyperspace. Inexperience self-directed learners sometimes lose sight of their learning goals because of the complexity of the hyperspace. Such navigation problems have been recognized as major issues, and have been discussed in the context of educational hypermedia/hypertext system development (Brusilovsky, 1996). It has indeed become easiest ever to find like-minded people as community members on the web, and the learning resources organized by them seem more reliable and beneficial to self-directed learners since they share the same learning interests, the benefit of which has been proved more than once by social bookmarking (Carmel, D., Roitman, H. and Yom-Tov, E, 2010). However, from the perspective of community-based learning which, from the point of view of this research, means people with similar learning interests who are willing to review and share learning information on the similar learning topics, it is difficult to pass on learning resources and get feedbacks among members, for redundancy of learning information is hard to detect, and the viewpoints of each community member is often different.

## 4.3 Related Work

As web-based self-directed learning has become more and more eye-catching, attentions from many researchers are being drawn. Being aware of the fact that it is difficult to provide adaptive learning resources to self-directed learners, Pythagoras (2005) introduced a methodology which generated all possible learning paths while matching the learning goals, enabling the learners to select the desired resources from the paths proposed; on the other hand, Kashihara, Hasegawa and Toyada (2002) proposed a similar approach of providing the learners with the adaptive preview of a sequence of web pages as potential navigation path. Dragan (2006) adopted a different method of mapping ontology for the improvement for resource searching from a semantic web. For resource managing, there were tools for constructing local indexes for learning resources found from the web (Hasegawa, Kashihara and Toyada, 2003), in which a framework for reorganizing existing web-based learning resources with indexes representing their characteristics was designed, which consist of “How

To Learn" indexes and "What To Learn" indexes, in order to build a learning resource database. As for community-based learning, the learning opportunities of social bookmarking service have also been discussed (Liu and Chang, 2008).

Although these research relating to web-based learning have greatly enhanced the learning situation on the web from various points of view, they either targeted an enclosed learning environment, or certain educational hypermedia which involved not only the learner but also the instructor. Meanwhile, the basic learning behaviors of web-based self-directed learning usually occur in procession, but these research only focused on one or two learning situations and did not take into consideration the seamless combination of learning activities such as resource finding and organization.

Concept map (Novak and Gowin, 1984) and knowledge map (O'Donnell, Dansereau and Hall, 2002) are diagrams that represent ideas as node-link assemblies which has been prevalently studied in many research. Back in the late 90s, Dansereau and Newbern (1997) pointed out that semantic displays, such as knowledge maps, were becoming more prevalent in educational settings, and an experiment conducted by Chmielewski and Dansereau (1998) indicated that training participants on the construction and use of knowledge maps made participants recall more macro and micro level ideas from text passages than those without taking the training. Not only in educational setting but in learning contexts, there were also research proving the concept/knowledge map to be more effective for attaining knowledge retention and transfer than reading text-based learning contents (McCagg and Dansereau, 1991; John and Olusola, 2006), and more beneficial working as navigational aids than a contents list (Sharon and Rosemary, 1998). Meanwhile, there were also research indicating that the use of concept map can facilitate meaningful learning (Coffey, Carnot et al., 2003) and be of value as a knowledge acquisition and sharing tool (Coffey, Hoffman, et al., 2002). From the perspective of community-based learning, Fischer et al. (2002) found that by being provided with a content-specific visualization tool, both the process and out of the cooperative effort improved. Furthermore, collaborative concept mapping in a digital learning environment was also proved to be effective in overall learning gains and knowledge retention (Lin, Wong and Shao, 2012). As a result, the concept/knowledge mapping, as a visualization tool, has proved to be effective in both self-directed and community based learning. For these reasons, in order to help those who constantly use the web for resource finding and organization, this research is setting off from the basis of visualizing the basic learning behavior of the learners such as searching for suitable information, organizing found learning information, and getting easier access to community-based well-organized learning resources through super-imposed map representations. We target the open-ended learning resources on the web, with the purpose of providing learners with a user-friendly interface which intends to integrate self-directed into community-based learning.

## 4.4 Research Requirements

By analyzing these three difficulties described in previous sections and the contexts in which the self-directed learners regularly occur, I come up with three corresponding requirements, which if satisfied, could greatly enhance the current learning situation. These requirements are:

(1) More semantically structured representations for web resources in order to locate the candidates of learning resources more swiftly and correctly.

(2) More sophisticated methods of resource organization. The learners often use web browsers for information management by simply adding interesting links to their favorite lists; however this does not facilitate later learning activities such as reviewing to build knowledge structures. Here, one point needed to be stressed is that supporting learners with the process of building knowledge structure is not the focus of this research, as it requires considerations such as the attitudes, skills and competences of the learners as well as reflection and self-construction which will be considered in my future work. I simply provide the learners with a meaningful structure of the learning resources as a visual aid for their knowledge constructing while reviewing the learning resources they have organized.

(3) A visual space not only where the status of other learners' resource collections can be explicitly represented, but also where sharing resources and exchanging feedback can take place.

The following sections discuss how difficulties arising from the three requirements can be effectively addressed.

## 4.5 Multi-layer Map Model—for Resource Finding & Organization

Visualization is one of the keywords in this research, for its advantages of making complicated things seem simpler and easy to understand. As the purpose of this research is to visualize the basic learning behaviors of web-based self-directed learning, I proposed a model called Multi-layer Map Model aiming to realize basic learning behaviors on the web via map representation. The Multi-layer Map Model is the core of the proposed learning environment, which is intended to perform as a GUI for self-directed and community-based learning. Figure 6 shows the four layers of the model; each has different functions, yet is dependent on the services provided by their nearest layer. The contents layer is the lowest layer of this model, where actual web contents in various digital forms are located. The resource map layer is the place where the structure of the web contents is visualized as learning resources. The personal map layer is where the learners engage in their self-directed learning. They can define topics, build up connections between topics, and include the learning resources represented on the resource map layer in the topics they create. The community map layer merges the personal topic maps with those of other community members by displaying bubble charts based on their features and relations.

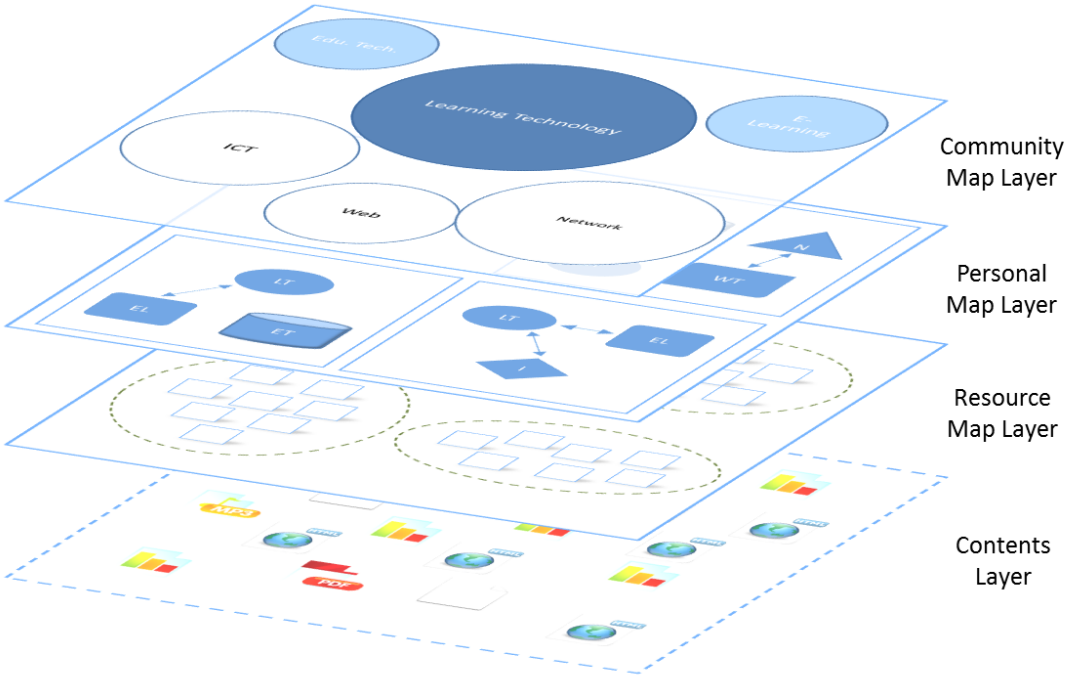


Figure 6. Multi-layer Map Model for Resource Finding & Organization

The model provides members of the community with a communication basis via superposed map representation. It primarily focuses on visualizing the structure of the learning contents in terms of a resource map, and then enables the learners to edit or reconstruct their personal maps according to their learning processes. Moreover, this model includes a community map where the personal maps are merged, viewed and used by other community members who have similar interests. The following sections will describe each layer in more detail.

### *4.5.1 Contents Layer & Resource Map Layer*

Contents Layer is the lowest layer of this model. It means the actual web contents such as web pages, documents, and media files of the web-based learning resources. Resource map layer is the place to visualize structures of the web contents by a bunch of nodes in a one-to-one manner as shown in Figure 7. This map is intended to provide the learners with an overall perspective of the learning resources which is expected to enable them to grasp the main content of web information more swiftly and precisely (Herman, Melancon, G and Marshall, 2000; Roto, Popescu, Koivisto and Vartiainen, 2006). Every node will be labeled with a typical word such as the title of the web page existed. The learning behaviors of searching for suitable learning resources and categorizing selected ones are conducted at this layer.

### *4.5.2 Personal Map Layer*

Personal map layer is aimed to support the learner's self-directed learning. It helps the learners to edit and reconstruct their personal topic maps based on the spatial maps created on the resource map layer. At this layer, the learners are capable of defining the topics, adding/deleting the occurrence links under the certain topic, building up

the association links among the topics and navigating organized learning resources using the semantic structures of their personal topic maps..

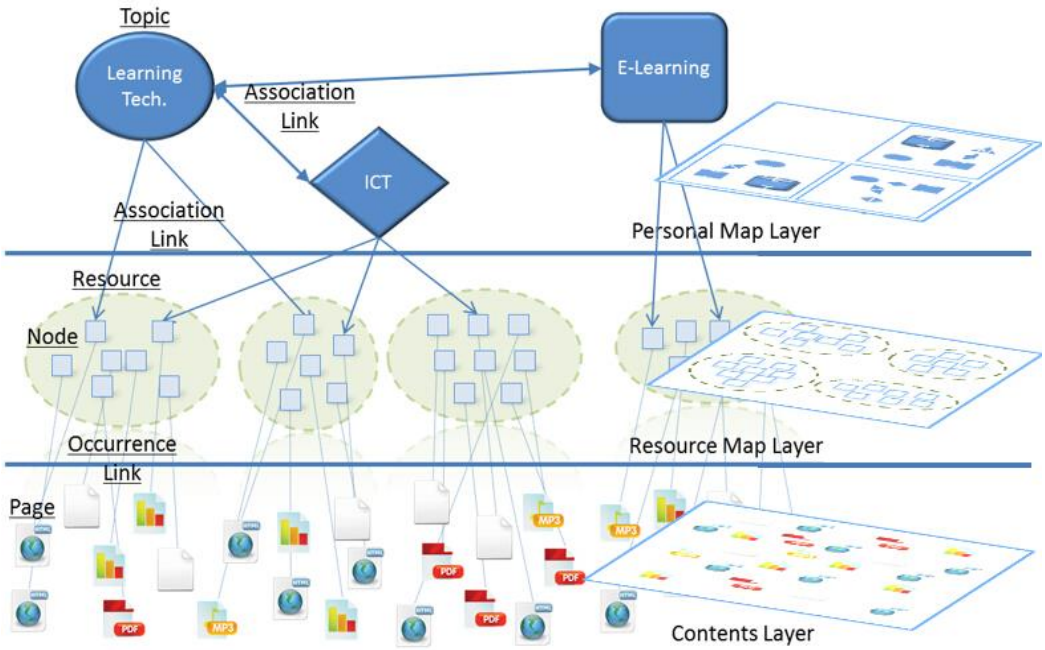


Figure 7. Relationship diagram among the layers of Personal Map, Resource Map and Contents

### *4.5.3 Community Map Layer*

For the purpose of sharing the learning resources in the community, community map layer merges the personal topic maps with that of other community members by displaying bubble form charts based on their features and relations as shown in Figure 8. For the purpose of providing the learners sufficient information on community-based learning resources, the features of the bubble are containing useful information. The size of each bubble represents the number of occurrence links in a topic. The relative positions of the bubbles are calculated by the number of the association links among the topics, and the color of each bubble represents the relevancy to that of the learners' learning topics. As the effectiveness of sharing and managing community-based knowledge through the application of knowledge map has been indicated in the related research (Lin and Hsueh, 2005; Lin, Wang and Tserng, 2006), in this research, all the topics and learning resources in the community will also be presented in map-oriented manner which is expected to enable the learners to locate and compare useful learning information more conveniently. The size and color of each bubble can be easily managed. However, the distance among the bubbles and the position of each bubble are difficult to calculate. As the bubbles represent the topics created by the learners, the distances among them are perceived as the level of relevancy among the topics. The closer the bubbles are, the more related the represented topics might be, which is expected to give the learners hints of priority for reference. In the next section, I introduce how to position the bubbles by adapting a spring model approach.

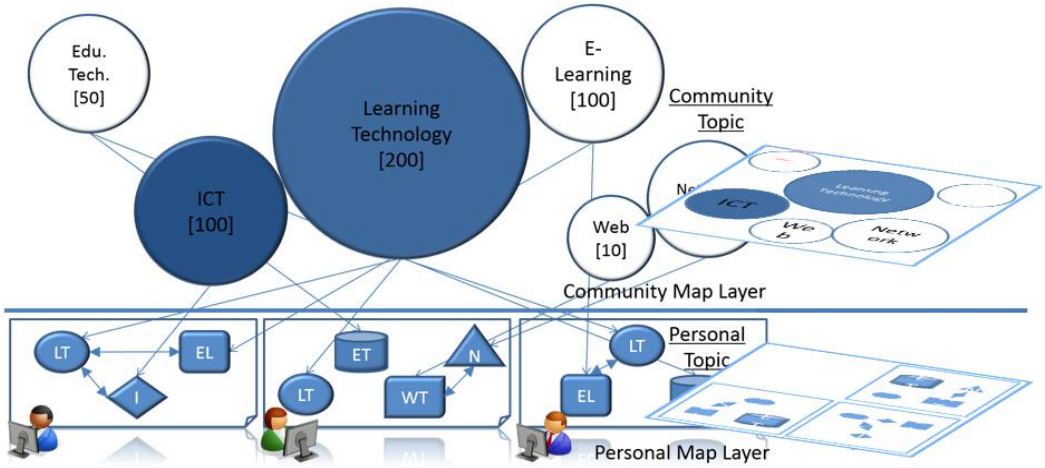


Figure 8. Concept of Community Map

### *4.5.4 Sequential Spring-Model Map for Visualization of Community Map Layer*

In this section, I introduce how to visualize the topics as a concept map for the community by adapting the spring model approach sequentially. This is expected to inform the learners of the relationship among the topics in terms of community map generated automatically, which has multi-dimensional input without explicit links.

***General Spring Model Algorithm***

As the distances among the bubbles are affected by the ever-changing personal topic maps of each individual, the relevance among the topics is constantly changing all the time. Sometimes they might be closely related with each other and need to be brought nearer, but sometimes they might turn out to be less related and need to be brought further from each other. As a result, I adopted Eades Peter's (1984) spring model to satisfy this need. This model is based on force-directed graph drawing algorithms which are a class of algorithms for drawing graphs. It aims to position nodes of a graph by assigning forces among the set of edges and the set of nodes, based on their relative positions. In this spring model, spring-like attractive/repulsive forces based on Hooke's law are used to attract pairs of endpoints of the graph's edges towards each other, and by using related algorithms, the places for all the nodes can be decided. I believe that by using this method, maps with fewer number of nodes and edge lapping are possible to be generated in a higher speed. However, as there are no edges in the community map and the necessity of calculation time, I have made changes to the original method Eades proposed to meet the needs of this research.

***Proposed Arranging Algorithm***

By referring to a related research on sequentially applying the spring model for fast node arrangement, in this research, I firstly set the importance of each node, then take into account of "no explicit edge among the nodes", and finally propose the arranging algorithm for the community map. As I used bubble form chart in the community map, I refer the nodes as bubbles in the following paragraphs.

- Calculating the importance of each topic

First of all, as the quality of an object is an important factor in Hooke's law and the need for assigning importance to each topic, I decide each bubble's quality and size by using the following formula. The importance $W_i$ of topic $i$ in the community map can be calculated by the following formula.

$$W_i = \sum \alpha_j \sum C_{i,j,k} \qquad (4.1)$$

$C_{i,j,k}$ is used to standardize parameter $j$ which is related to the topic $i$ created by a learner $k$. $j$ represents the frequency of topic appearance and the number of webpages contained in the topic $i$. On the other hand, $\alpha_j$ indicates the weight which is set beforehand according to each parameter. This formula calculates the size and quality of every bubble in the community map, indicating the popularity and information volume of each topic.

- Calculating the relevancy among topics

After deciding the quality of each bubble, I need to place the bubbles into proper position to show the relevancy among the topics. The nearer they are, the more related the two topics might be. The relevancy $R_{m,n}$ among the topics can be calculated using the following formula.

$$R_{m,n} = \sum \beta_l d_{l,m,n} \qquad (4.2)$$

In this formula, $d_{l,m,n}$ is used to standardize parameter $l$ which is related to the relevancy between topic $m$ and $n$. $l$ represents the types of parameters which could be perceived as the relevancy among the topics. It could be the number of web pages mutually contained in different topics and the number of the association links among topics. I use the number of association links among topic to indicate the relevancy. $\beta_l$ stands for the weight set initially for each parameter. This formula is used to calculate the distance among the bubbles in the community map.

- Setting the initial position for each bubble

Firstly, the bubble with the biggest importance value calculated by the formula 4.1 will be put in the center of the community map. Then the other bubbles will be placed sequentially according to their importance (which means from the second largest bubble), and the distances among all the bubbles are calculated by the formula 4.2. As to attain their exact positions, the following equations of motion are applied.

- Approximate Calculation of Motion Equations based on Eular's Method

Because there are no explicit edges among the bubbles in the community map, I suppose that all the bubbles are linked with invisible springs. By following the Hooke's law (4.3), the spring that has both ends attached to two bubbles, the free end is being pulled by a force that magnitude is F. Suppose that the spring has reached a state of equilibrium, where its length is not changing anymore. Let X be the amount by which the free end of the spring was displaced from its "relaxed" position (when it is not being stretched or compressed).

$$F = KX \qquad (4.3)$$

As a result, I have come up with the below equation with which the force moving bubble $m$ and $n$ can be calculated.

$$F_{m,n} = -K(D_{m,n} - R_{m,n}) \quad (4.4)$$

K is the spring coefficient, and $D_{m,n}$ is the distance between bubble *m* and *n*, and $R_{m,n}$ is the desired distance between *m* and *n* calculated by the formula 4.2. From the motion equation I have learnt as the following, I can deduce the equation to calculate the position of the bubble pulled or propelled by the force F.

$$F = ma \quad (4.5)$$

$$a = v' \quad (4.6)$$

$$v = r' \quad (4.7)$$

$$r'' = F / m \quad (4.8)$$

Here, supposedly bubble *i* is pulled/repelled by the force $F_i$, while the position of *i* is $X_i$, and the quality of the bubble is $W_i$. I can repeatedly use the following motion equation to decide the proper position of the bubble *i*.

$$W_i X_i'' = F_i \quad (4.9)$$

However, because I do not need to complete a perfect physical simulation, I approximate the speed and position during Δt for t+1. According to the Euler method (Euler, 1768) which calculates the approximate value of speed difference between the starting point and the end point of the time period Δt. I can get the following formulas to get the value of speed at the time of t + 1, and the according position at that time.

$$V_{t+1} = V_t + (F_t / W_t \cdot \Delta t) \quad (4.10)$$

$$X_{t+1} = X_t + (V_t \cdot \Delta t) \quad (4.11)$$

Moreover, in the actual calculation, to control the bubbles from overlapping and the non-stop motion, I adopt the frictions decided by the velocity of each bubble. When $R_{m,n}$ reaches a certain point at which the velocity of the bubble is near to zero or on the verge of overlapping with others, the calculation stops.

## 4.6 Resource Organization System for Self-directed & Community-based Learning (ROS)

### *4.6.1 System Architecture*

Figure 9 shows a block diagram of the whole learning environment which contains main functions of the system. The learners are interacting with the system through the user interface where the three Map Plug-ins (RM, PM and CM) are responsible for providing them with superimposed map representation. The local crawler is for collecting information from the web and store the information in the form of Topic Maps (XTM) into the database through data interface which, at the same time, is also the channel for data communication with RM. Among all the functions in the system, two distinctive ones which Local crawler and Map Controller are worth to be discussed here.

The traditional search engines like Google is the first thing I can think of using when it comes to searching information. Therefore, in order to find related lists of URLs, it is necessary to embed some common search engine into this learning environment. As soon as the embedded search engine outputs a bunch of related URLs, the learners can select the link with the most relevance. Local crawler gathers the information of URLs of the webpages contained in the selected link and their titles,

and then stores the gathered information to the database in the format of XML files according to the Topic Maps standard.

Map Controller is responsible for map editing and visualizing through layers of the resource, personal and community map. As maps created at the upper three layers have their own features, each layer has their own map plug-ins. Resource map plug-in (RM) generates spatial maps automatically based on the results from the local crawler. It shows the structure of the crawled URLs in the form of nodes labeled with the titles representing the actual contents of the selected link. By clicking each node, the learners can access to the actual web page. Personal map plug-in (PM) drafts the personal topic map initially. The learners can edit their own personal topic maps by adding or deleting certain nodes, building association and occurrence links. Several association types are defined in the plug-in as super-sub (is-a), related terms, synonym, antonym, etc. Community map plug-in merges the personal maps created by community members and represents the maps with conclusive bubble form charts. The representation itself is expected to provide hints to the learners about the relevance of all the topics in the community with their own learning topics and information volume of all topics created.

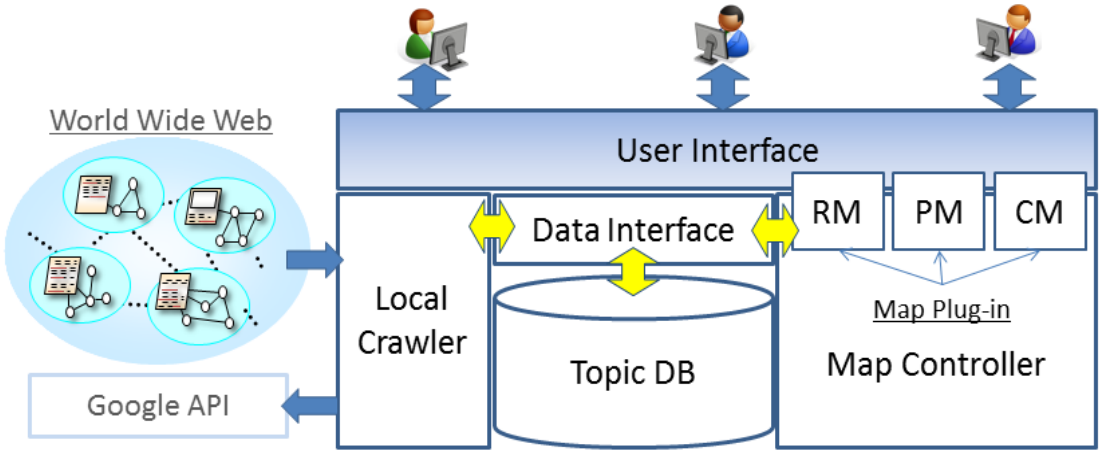


Figure 9. System Architecture

### *4.6.2 System Overview*

Based on the Multi-layer Map Model, I also developed a pilot system (ROS) using Microsoft.Net and Silverlight which visualized the basic learning behaviors when searching for information on the web. ROS is a supporting tool designed to assist web-based self-directed learning. It visualizes the basic learning behaviors when learners searching and organizing learning information from the web, and at the same time, making it possible to collect well-organized learning resources from a learning community.

***Interface of Contents and Resource Map Layer***

The spatial map introduced by Kashihara, Hasegawa and Toyoda (2002) in their navigation planning system visualized all the web pages contained in one web site in the form of nodes labeled with the titles. Brian and Mildred (1999) took a different approach which generated one node at a time following the learners clicking activity

on the web. I combined the both methods for generating the maps in my system. ROS not only provides the spatial map of the current selected links, but also expands the spatial map generated interactively by the learners' clicking activity. After logging into the ROS, the learners first use the embedded search engine API to select links with the most relevance to their interests from the web. Local crawler next gathers URLs and titles from the selected links. ROS subsequently generates the spatial map as a resource map automatically based on the results gathered by the local crawler. Figure 10 shows the interface of contents and resource map layer. On one side of the window (block 1), it shows both the structure of the selected Url in the form of nodes labeled with their page titles, and the actual web page of the selected link on the other side of the window (block 2). By checking the real webpages and their semantic representations at the same time, this arrangement is intended to increase the speed and accuracy of the learners' comprehension of the main contents of the links. On one hand, the learners can access the contents by clicking on a node as shown in Figure 11 by a pop-up window where the webpage of the selected node will display. While on the other hand, they can generate the corresponding resource map on the right correspondingly by clicking a link of the webpage on the left.

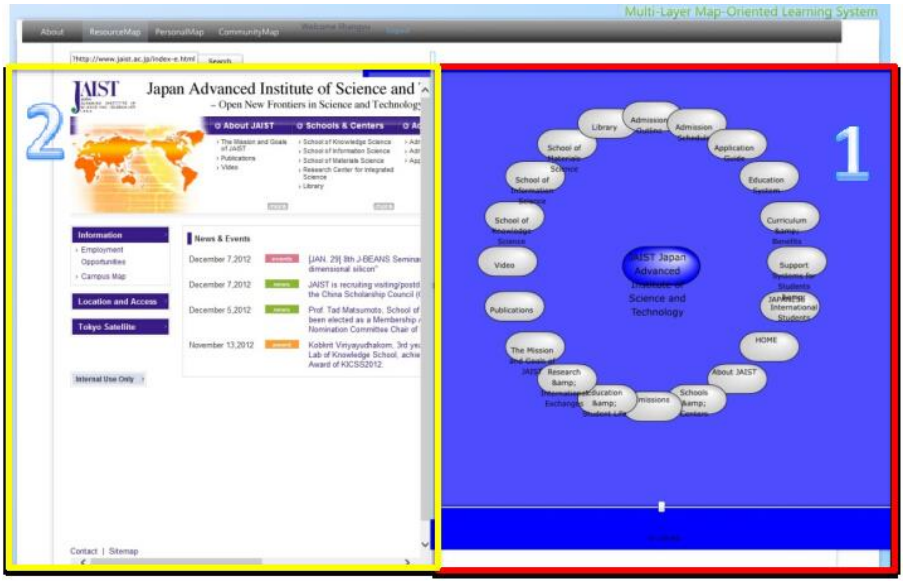

Figure 10. The Interface of the Contents and Resource Map Layer

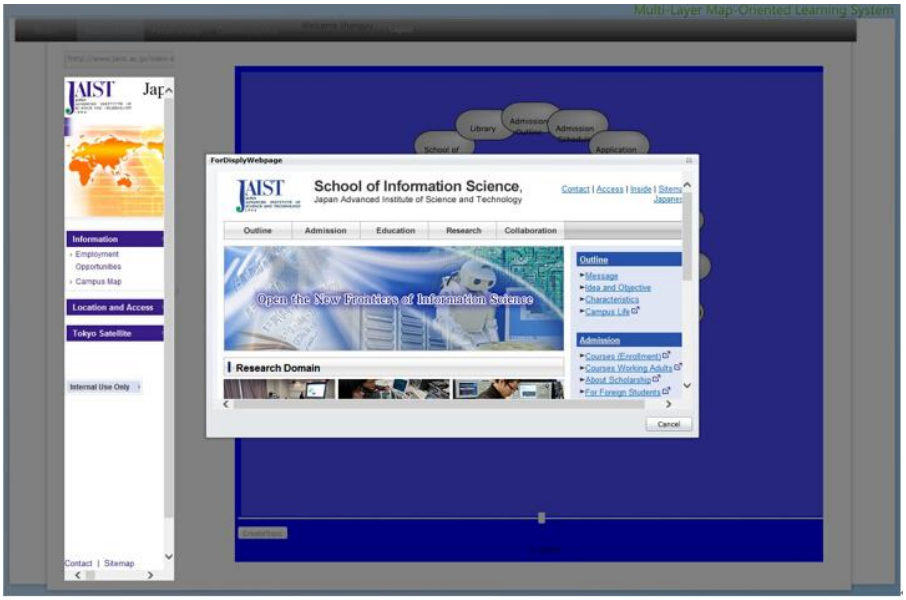


Figure 11. Viewing Contents at Resource Map Layer

When the learners have viewed enough, it is time for them to organize the web pages interested in them through the creation of personal topic maps. As Figure 12 shows, they can create new topics or use the existing ones, and build the associations among the topics. When they have decided on the learning topic, a little icon will appear on the left upper corner of the right block symbolizing the current learning topic, and they can drag and drop the nodes selected into the icon indicating that the chosen webpages have been stored and categorized as shown in Figure 13.

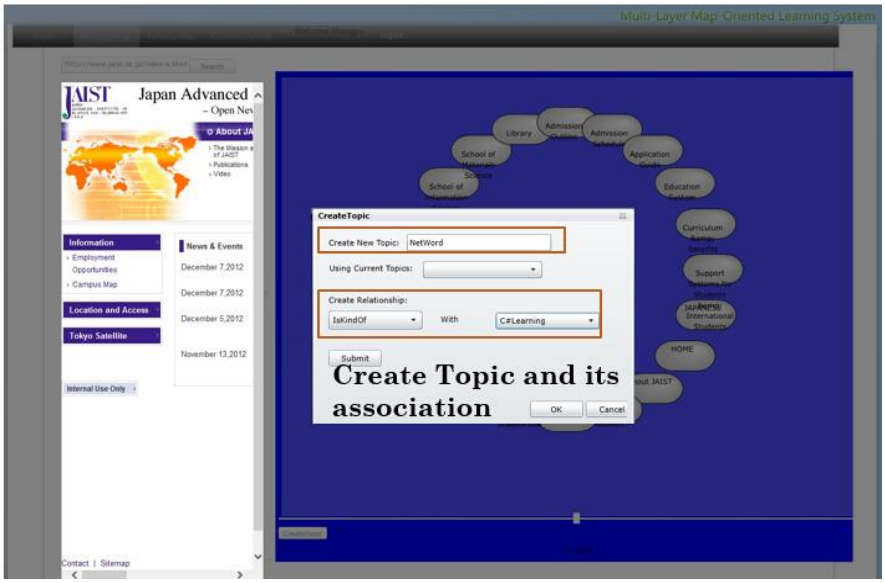


Figure 12. Creating Topic and its Association

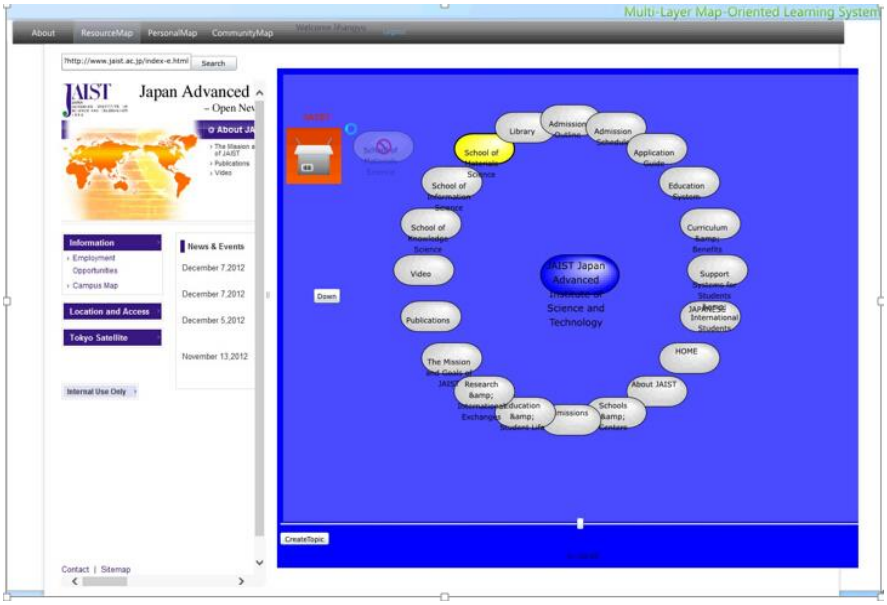


Figure 13. Store Links by Drag and Drop

***Interface of Personal Map Layer***

Personal topic map in this research bears resemblances to the concept of knowledge maps/concept maps which have been frequently adopted in other learning systems. However, it is neither automatically generated (Chen and Xia, 2009) nor created with the assistance of domain experts (Lin and Hsueh, 2005). In the ROS, the learners' conception of their learning goals and the learning resources prompt the creation of the topics which perform as both indexes and concepts/knowledge. The learners can view all the personal maps they have created as shown in Figure 14. Block 1 shows all the learning topics one learner has created. By clicking one topic in Block 1, the according personal topic map will appear in Block 2 where not only the chosen topic will be shown in the middle, but also the other topics related to the selected one and the types of the associations. By clicking into each topic in the personal topic map, the links the learner has stored in terms of nodes labeled with the link titles will appear as shown in Figure 15. The learner can also check the contents of the according web page by clicking into the selected node. The learners are expected to get to know the content of their chosen links by using this interface. The structures indicating relationships among the topics aiming to provide the learners with an options of checking the contents of other related topics beside the chosen one.

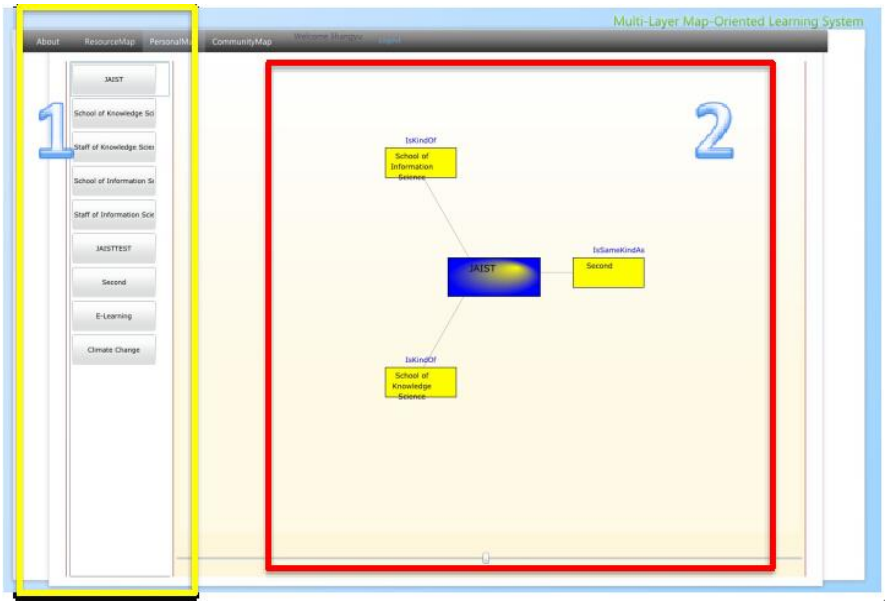

Figure 14. The interface of the personal map layer

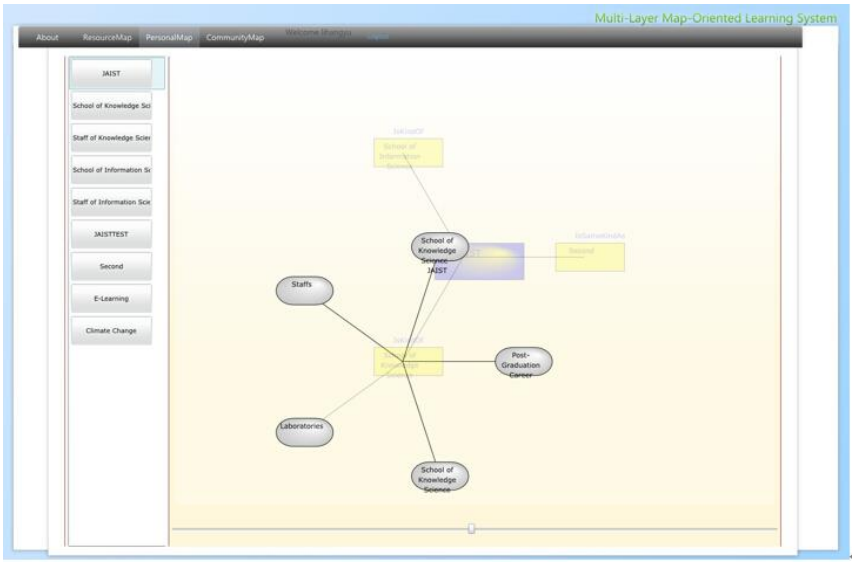

Figure 15. Viewing the Content of Personal Map

***Interface of Community Map Layer***

In a sense, Community topic map in this research can also be taken as some sorts of concept map. Unlike using concept map as a navigation tool in a hypertext environments (Puntambekar and Stylianou, 2003), or a means for measuring content understanding (Herl, O'Neil and Chung, 1999), I consider the community topic map of ROS as a conclusive presentation for community-based learning resources, combined with topics (concepts) existed among the learners of a learning domain. As shown in Figure 16, ROS merges necessary information (number of learners under a same topic, number of learning resources under every topic, and the number of shared learning resources and associations among topics) of the personal topic maps and presents them in the form of a community topic map. Relevance to the topics of the current learner (colors of bubbles), relevancy among topics in the community topic map (distance between bubbles) and the number of learning resources under one topic

(size of each bubble) give the learners hints for choosing learning resources of interest. I have applied the spring model discussed in previous sections for placing the bubbles which represent all the topics created in the learning community. After clicking a bubble, the learning resources will be presented in terms of nodes of a different shape labeled with their titles, which also can either be collected or ranked by the current learner as shown as in Figure 17. As a result, the learners create their personal maps by referencing both the resource map and the community topic map. Learners' personal topic maps contribute to the community topic map as well.

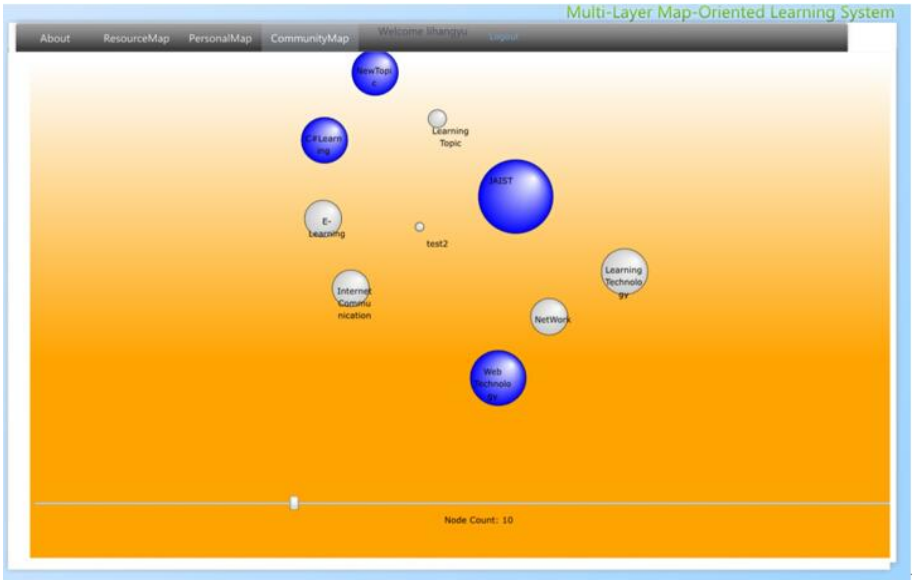


Figure 16. The interface of the community Map Layer


Figure 17. Viewing Learning Resources in Community Map

***System Flow***

To sum up, at the beginning, the learners input keywords into google API in order to get related search results so that they can look for the topics of interest at the content

layer. If they select an interesting link from the search results, the local crawler gathers information of the web page selected and has it presented as resource map where they can create topics, drag and drop the selected nodes to the topics they have created. As community-based learning, the learners search some topics from the community map where all the topics and the according learning resources will be shown. They can also drag and drop the nodes under certain topic, and at the same time, add new learning resources they have organized from the resource map. The system flow is shown in Figure 18.

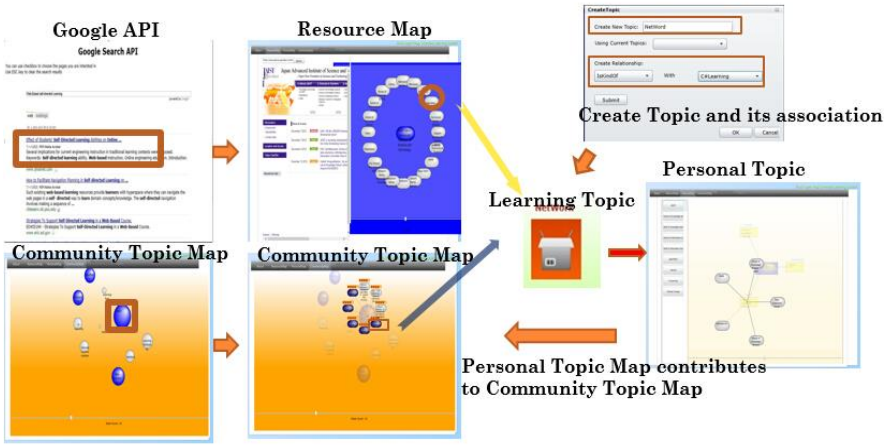


Figure 18. System Flow

## 4.7 Preliminary Case Study

In order to assess the effectiveness of this pilot system, especially by referencing the three requirements proposed, I conducted a quantitative case study followed by a qualitative one consisting of a questionnaire as an important component of this research. 16 graduate students participated in the case study. As the experimental environment (UI and experimental resources) is written in English, they are also required to have the similar level of English proficiency.

Table 1. The experiment arrangement (IE Vs ROS)

| | **Phase one** | **Phase two** |
|---|---|---|
| **Participant 1, 5, 9, 13** | ROS(E-learning) | IE(PE) |
| **Participant 2, 6, 10, 14** | ROS(PE) | IE(E-learning) |
| **Participant 3, 7, 11, 15** | IE(E-learning) | ROS(PE) |
| **Participant 4, 8, 12, 16** | IE(PE) | ROS(E-learning) |

### *4.7.1 Quantitative Case Study*

Given that many self-directed learners are accustomed to using Microsoft Internet

Explorer (IE) to search, organize and learn information on the web, I designed a contrast evaluation plan in order to compare the advantages of using ROS versus IE for resource searching, organizing and sharing activities. From a series of preliminary experiment for making the rules for the official one, I designed the evaluation to be: the participants were required to use both IE and ROS respectively to conduct web-based self-directed learning on two different learning themes---E-learning and Environmental Protection from two websites (previously prepared, working as learning resources) within a fixed amount of time (30 minutes each) as shown in Table 1. For the control condition, 20 keywords working as subthemes were prepared for each learning theme. There were at least 10 webpages available to be checked on average for each subtheme, which makes a total of more than 200 webpages in each website, ensuring the participants' impossibility to read through all pages within 30 minutes for the sake of control condition. One group containing four participants was required to complete their learning by using ROS or IE in different order to ensure adequate data samples were obtained (shown in Table 1). Since time for instruction for the participants and the refreshment time between phases was given, an extra 30 minutes were added to the experiment time, requiring a total of 1.5 hours for a complete session. As a result, each participant was asked to conduct self-directed learning by using either IE or ROS under the themes of both E-learning and Environmental protection within 1.5 hours.

***Experiment Procedures & Evaluation Factors***

The learning goals for each participant were: finding webpages and creating a knowledge structure based on the webpages found. The participants were first asked to find the webpages they considered appropriate from the two websites provided by using IE and ROS separately. In the case of IE, the pages found needed to be saved in the favorite list. In the case of ROS, by viewing the webpages and their generated resource maps simultaneously, the participants were asked to save the found pages in terms of personal topic maps by dragging and dropping the nodes to the topics created by themselves. Based on the contents stored in the IE favorite list or system's personal topic map, the participants were asked to draw keyword maps (it is a map created by extracting keywords from the webpages and making connections among them based on one's own understanding) on a paper; the keywords written were either extracted from stored content or created by the participants themselves while reviewing the webpages they had found. Here, I want to emphasize that those topics in the personal topic maps were created by the participants for categorizing found webpages; and that the keywords written in keyword maps were those extracted or summarized from the webpages stored to describe the learning content. Finally the participants were asked to review the webpages collected by the community members and add new keywords into the keyword map they had drawn previously. Here, as a control condition, I previously prepared two resource bases of community-based learning; All the subthemes were covered in the two bases, and each of them contained averagely 10 webpages which were all from the two previously prepared websites, making it impossible for the participants to read though all the contents within the time of community-based learning. As a result, only the situation of using community topic maps was evaluated in this experiment, not the function for

generating community topic maps, which will be considered in a future study. In IE, the pre-prepared community-based learning resources were represented in terms of bookmark lists, and in ROS they were represented in terms of community topic maps. In summary, the participants were asked to conduct three procedures for the learning of the two themes respectively while using IE or ROS. The three procedures are: "Finding learning resources (Procedure 1)"→Drawing Keyword Map (Procedure 2) →Supplementing Keyword Map (Procedure 3)" as vividly shown in Figure 19, there were evaluation factors indicating the learning effectiveness of the corresponding processes for each of these procedures.

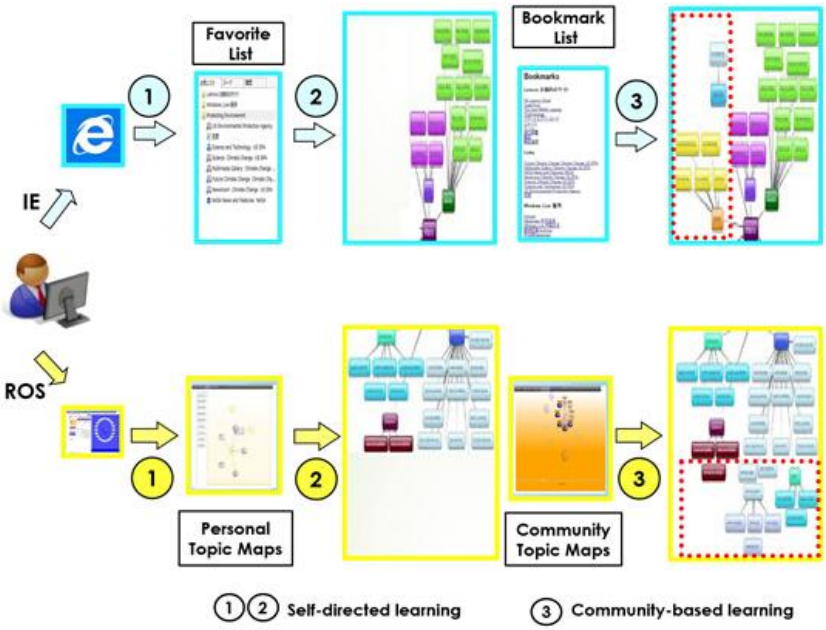


Figure 19. The experimental procedures and tasks

Number of Webpages Found in Procedure 1: this evaluation factor was chosen based on the first requirement listed in previous sections. The semantic representations of the resource map offered by ROS are supposed to help the participants more swiftly and accurately locate potential learning resources, and the number of webpages found in a fixed time can best illustrate the efficiency of doing so.

Number of Keywords Drawn and Web Pages Viewed in Procedure 2: The second requirement listed in previous sections suggests that the learners need a more sophisticated way to organize and review found learning resources than using the favorites list of a web browser. The personal topic maps in ROS provide the participants with a more semantic management and a representation of learning resources, which are intended to facilitate later review. Therefore, the number of keywords drawn by reviewing the found resources is believed not only to filter out the irrelevant pages accidentally stored due to the rush, but also to evaluate the accessibility of the found learning resources represented by the ROS's personal topic map. Moreover, by counting the number of webpages viewed from which the keywords were written, I can evaluate the efficiency of reviewing found webpages when using IE or ROS. One point that needs to be stated is that it must be the number of pages from which keywords are drawn, not those viewed without keywords having been extracted.

Number of Keywords Added and Webpages Viewed in Procedure 3: Based on the third requirement listed in previous sections, I designed the third procedure as community-based learning. The community topic maps in ROS give the participants overviews of the status of resource collections of other learners and the ratings (number of stars) as feedbacks for each learning resource. I considered the number of keywords newly added into the keyword map created previously and the webpages viewed for writing these new keywords valuable evaluation factors, in evaluating the efficiencies for resource sharing and searching in a learning community via map representation.

Number of Keyword Islands Drawn within Keyword Map Eventually: This evaluation factor was not initially considered. However, when viewing the keyword maps drawn by all the participants, I found that the number of keyword islands (cluster of keywords) by using IE and ROS was very different. This might best describe the difference between the knowledge structures generated while using IE or ROS.

### *Data Analysis*

Details are shown in Table 2. From the average data itself, I can see the difference in the use of IE and ROS in each group of data. However, I used a T-test to determine whether the means of the two groups were statistically different from each other and to assess whether the difference was meaningful or not. I can see from this table that *t Critical two-tail* < |T stat.| and $p < 0.01$ from every group of data indicated that differences within each group were statistically significant.

Table 2. Experiment Data with T-test (IE Vs ROS)

| | **Ave. (ROS)** | **Ave.(IE)** | **T Stat** | **T Critical Two-tail** | **P(T<=t) two tail** |
|---|---|---|---|---|---|
| **Webpages Found** | 64 | 17.875 | 19.654 | 2.131 | 4.06E-12 |
| **Keywords Drawn/Pages Viewed** | 48.312/14.437 | 21.6875/6.75 | 10.052/ 11.181 | 2.131/ 2.131 | 4.67E-08/ 1.13E-08 |
| **KeywordsAdded/ Pages Viewed** | 35.437/12.5 | 16.1875/6.5625 | 7.066/ 6.188 | 2.131/ 2.131 | 3.83E-06/ 1.74E-05 |
| **Islands** | 1.812 | 4.8125 | -7.745 | 2.131 | 1.28E-6 |

### *Discussion*

In this experiment, I evaluated the effectiveness of using ROS for the participants in their web-based self-directed learning combined with community-based learning. Before getting into the discussion of the experimental results, I need to address that although I have evaluated the community-related function which is using the community topic map of the ROS to support the participants' self-directed learning in resource searching and organization in a learning community, I did not examine the effectiveness of community-based learning which requires further evaluation of the process for generating community topic map. In this case study, I only used

determined expert data for condition control. In the future, I will take account of this factor to evaluate how the creation of community topic map affects community-based learning.

Based on the results of the data analysis, the following conclusions have been drawn:

ROS enables the participants to find more webpages. This conclusion indicates that the visualization of the explicit structure of selected links and enhanced semantic representation of its contents on the resource map of ROS enabled them to overcome the complexity and obtain learning resources they thought appropriate to their learning goals faster and more correctly.

ROS enables the participants to write more keywords from more webpages viewed. Due to the limitations of organizing information using browser's favorite lists, ROS simplified the process by enabling them to create personal topic maps, to which interesting webpages (Occurrences) were added and relationships among topics (Associations) were built. The data suggest that, due to its easy accessibility and meaningful structure, the personal topic map of ROS played a positive role in the process of reviewing the learning resources.

ROS enables the participants to write more keywords from more webpages viewed in community-based learning. The community topic map of ROS gave the participants overviews of all the learning topics and the learning resources of their learning community, which enabled them to quickly locate the necessary learning resources, and because of which, as the result indicated, more keywords had been written.

ROS enables the participants to draw less keyword islands eventually. This result was unexpected and thus had not been considered as an evaluation factor at the outset. However, when examining keyword maps drawn by every participant in aggregate, I found that the number of keyword islands was 62% less when using ROS than that of using IE, as shown in Figures 20 and 21. Not only that, the average number of keywords (drawn in Procedure 2) in every keyword island created using ROS was 26.66, greater than that of keyword islands created using IE which was only 4.50. There were relatively few connections among main keywords in the drawings created by IE users; however, when the meanings of most keywords were considered, it seemed reasonable to think that connections should have been made. Comparatively, ROS users performed well as indicated by the number of connections that had been drawn and the number of keywords added. This change, after consulting each participant about the reason those connections were being made, is due to the structure of personal topic maps where the basic connections (Associations among the topics) were already present. They were conducting self-directed learning with the awareness of the connections among topics; therefore the connections were made among keywords extracted in their learning. Take the example created by one participant (as shown in figure 21) for instance: in his/her personal topic map in ROS, there were topics of E-learning, Adult learning, M-learning, and Distance learning. E-learning seems to be the main topic and the others seem to be the topics related to it. I can see these connections among these topics in his/her keyword map, and the keywords around these topics were extracted from webpages stored in these topics in his/her personal topic map. This accidental finding indicates that semantically structured representation of learning resources can give the leaners positive impact while reviewing their learning materials for knowledge construction.

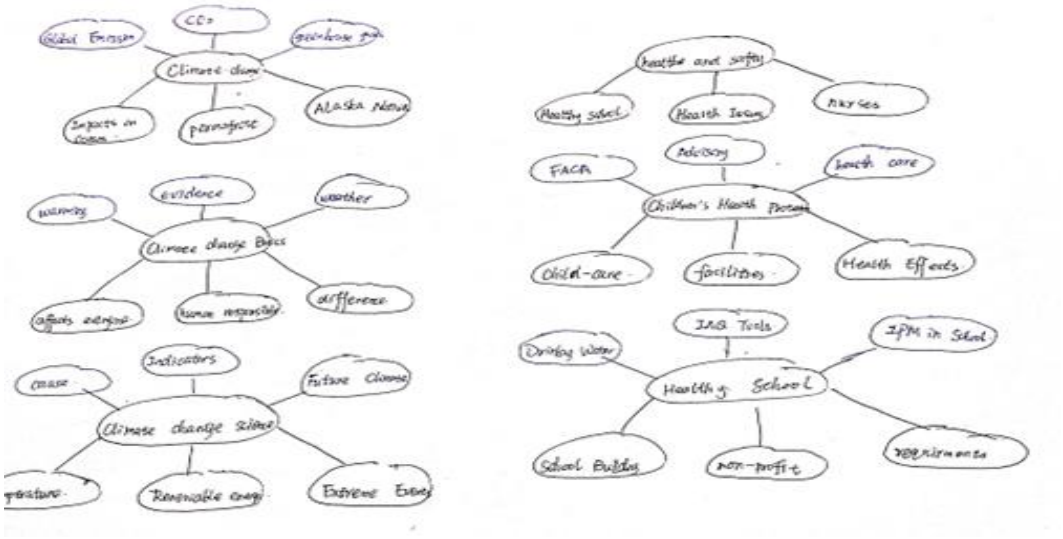


Figure 20. Example of Keyword map When Using IE

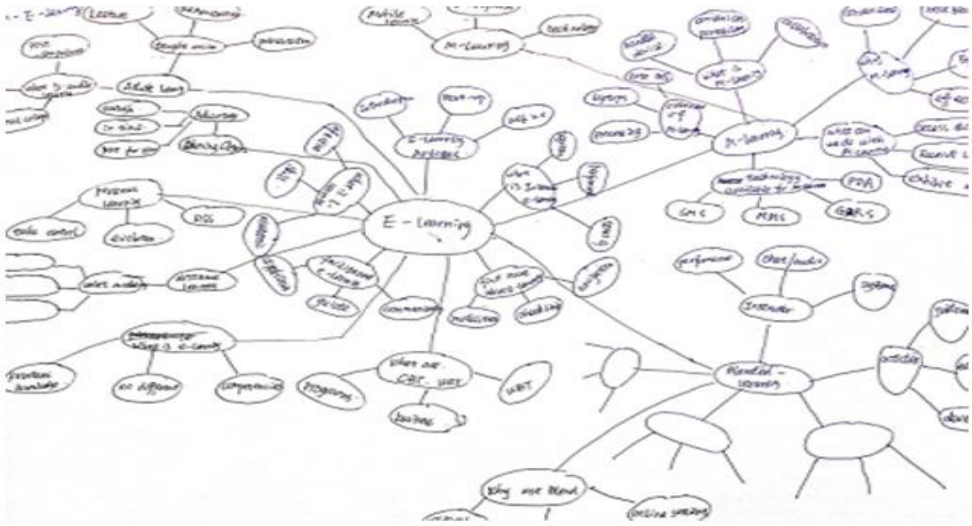


Figure 21. Example of Keyword Map When Using ROS

### *4.7.2 Qualitative Case Study*

Followed by the quantitative case study, I also conducted a qualitative one requesting each participant to fill a questionnaire after the quantitative experiment. The questionnaire was designed to investigate the participants' thoughts on their use of ROS and IE during their tasks and the reasons for their performance. Furthermore, their customs of searching and organizing learning resources on the web were asked to further address my research purposes. Meanwhile, their expectations on the improvement of system functions were also inquired in order to collect practical suggestions on future system development to ensure user acceptance.

***Questionnaire Content***

Table 3 shows all the questions in the questionnaire. Q1 to Q5 were designed to ask the participants' thoughts on their use of ROS and IE during their tasks and the

reasons for their performance. Especially, Q5 was aimed to reflect their future acceptance of the learning support system like ROS, which was intended to make us evaluate my research from the practical aspect. Q6 and Q7 were simply to investigate the participants learning habit when it comes to using IE or other browsers for resource searching and organization, basically to grasp the learning situations for web-based self-directed learners. Q8 was mainly to collect the participants' practical suggestions on system improvement, which will be taken into account for my future development and remedy of the system, aiming to ensure user acceptance of the system developed.

Table 3. Questionnaire (IE Vs ROS)

| | Content | Items |
|---|---|---|
| **Q1** | Which functions were more helpful for you in searching for webpages related? | A. Strongly ROS;<br>B. ROS;<br>C. Mildly ROS;<br>D. Similar;<br>E. Mildly IE;<br>F. IE;<br>G. Strongly IE;<br>Reasons for the choice:_____ |
| **Q2** | Which functions were more helpful for you for saving the links you find useful? | Same as above |
| **Q3** | Which functions were more helpful for you when reading pages for keyword drawing? | Same as above |
| **Q4** | Which functions were more helpful for you when reading pages in community-based learning for adding keywords to your keyword map? | Same as above |
| **Q5** | Are you willing to use ROS for searching and organizing webpages for self-directed learning? | A. Strongly yes;<br>B. Yes;<br>C. No;<br>D. Strongly no; |
| **Q6** | Did you always save the links you find useful into IE favorite list? | A. Yes;<br>B. Sometimes Yes;<br>C.Sometimes No;<br>D. No; |
| **Q7** | Did you always categorize the links you found in your IE favorite list? | A. Yes;<br>B. Sometimes Yes;<br>C.Sometimes No;<br>D. No; |
| **Q8** | What are your Suggestions for the improvement of ROS in the future? | A. About resource map:____<br>B. About personal map:____<br>C.About community map:__<br>D. Others:_____ |

***Data Analysis & Discussion***

Table 4. Result of Questionnaire (Item/Number of Participants)
Please be noted that the answers for Q4~Q7 only have four options (A, B, C, D)

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| **Q1** | **7** | **7** | **2** | **0** | **0** | **0** | **0** |
| **Q2** | **6** | **9** | **1** | **0** | **0** | **0** | **0** |
| **Q3** | **1** | **11** | **3** | **1** | **0** | **0** | **0** |
| **Q4** | **5** | **4** | **7** | **0** | **0** | **0** | **0** |
| **Q5** | **6** | **5** | **5** | **0** | | | |
| **Q6** | **1** | **5** | **10** | **0** | | | |
| **Q7** | **1** | **0** | **10** | **5** | | | |

From the results of the questionnaire as shown in table 4, I have drawn the following conclusions:

From Q1 to Q4 which were asked to evaluate the usefulness of ROS for executing the learning tasks regarding to the requirements as described in previous sections, I concluded: Firstly, all participants considered ROS more helpful for their searching for related webpages. According to the reasons written down by some of them, I can conclude that the ROS's resource map was playing a positive role in this procedure, and the two screens for displaying resource map and the actual webpage, pointed out by 3 participants, were helpful also. Secondly, all participants consider ROS more helpful when saving the links they found useful. Some participants noted that it was due to the easy operation of dragging and dropping nodes from resource map that facilitated the number of links stored using ROS surpassed that of using IE. Meanwhile, as a participant pointed out that the compulsive operation of creating topics and building connections among them made their search more targeted. Thirdly, 15 participants considered ROS more helpful when reading pages for keyword drawing. The reasons for this choice, according to some participants' comments, were for the structure of learning topics whose connections were built by themselves previously presented by ROS's personal topic maps. As a participant stated: "When I looked at the personal topic maps, I can recall the reasons for adding these learning resources to the topics, and also be reminded of the relationships among all the learning topics I had created. This helped a lot when trying to figure out the contents of the webpages, making the drawing keyword map easier." However, only one participant found it similar whether using ROS or IE, the reason for this was that he/she did not find it more convenient reading pages from personal topic maps than IE's favorite list as both needed them to selectively read through for keywords.

Finally, all participants considered ROS more helpful when reading pages in community-based learning resources for adding keywords to their keyword maps. For those who had written down the reasons for this choice, they attributed their better performance using ROS to the clearer representation of topics and learning resources of the community map.

The results of Q5 indicated that 11 participants were willing to use ROS for searching and organizing webpages for their self-directed learning based on their experiences in the case study. However, there were still 5 participants who clearly expressed their unwillingness towards the idea of using ROS for future resource searching and organization. They explained that it was true that using ROS proved to be better to perform the learning tasks designed in the experiment, but the ROS's supporting functions were not convenient enough to replace IE or the likes which they had been accustomed to use. The reasons were revealed in Q8 of the questionnaire.

From the results of Q6 and Q7, I can see that most participants (10/15) seemed that they seldom saved the links they considered useful to the favorite list of IE or other browsers they might be accustomed to use. Moreover, it also showed that most participants did not have the habit of categorizing the webpages they stored in the favorite lists. By mandatorily making the participants create topics and build relationships among the topics, ROS can improve learners' awareness for saving and organizing the learning resources found on one hand, but has the possibility of causing hesitations and anxieties in the learners having not decided on the topics and associations. I will add more flexibility in the future.

Finally, from the comments on the future improvement of ROS, I received several practical advices related to the changes and expected functions on the three map representations. As to the resource map, they thought it would be better to show more information on the map besides nodes and page titles; some suggested that it would be better if the system would recommend some related links by lightening up certain nodes; Some pointed out that it was necessary to provide the learners with the option of "dig deeper" into the links selected with more layers of nodes other than just one layer. As to the personal map, they wanted more supporting functions to take more actions such as taking node, viewing the whole picture of all the topics created and their relations, editing the content of the webpages by adding or trimming particular parts, and the option of viewing other learners personal topic maps. For community map, some pointed out that it was better if they were able to evaluate the learning resources by typing text messages besides using star icon, and if the system could recommend some related learning resources to them before getting started on viewing all the resources. I will take these suggestions into consideration and resolve to reflect them in my future development of the system.

## 4.8 Conclusion

This research proposed a Multi-layer Map Model by employing the methodology of Topic Maps to address several difficulties in web-based self-directed learning. I also developed a resource organization system by using Microsoft.Net and Silverlight which enabled the visualization of the basic learning behaviors of searching for and organizing information from the web. Based on the results of the case study presented, I am able to conclude that the learners using the proposed model performed better on tasks that required them to locate and organize learning resources. I can also

tentatively state that building connections among learning topics not only provides a better means of resource management but also is subconsciously helpful in the creation of knowledge structures. And the qualitative study further addressed that ROS helped the participants in every aspect during their execution of the learning tasks.

# Chapter5
# Learning Skill Cultivation—Cultivating Listening Skills for Academic English based on Strategy Object Mashups Approach

## 5.1 Introduction

Foreign students are faced with many challenges when studying in higher educational institutes abroad. One of the challenges lies in their academic English abilities which are considered far from being enough to meet the academic requirements in most of the cases, despite the fact that most of the foreign students entered the institutes after passing the targeted English proficiency tests required. As a result, they must constantly make efforts to improve the academic language abilities while proceeding their major studies. Among the other language tasks (reading, writing and speaking), listening tasks are acknowledged to take up most of the time in academic activities. Academic listening is complex, multi-faceted process that place enormous skill demands on the listeners (Richards, 1983). Furthermore, it has been shown in research that effective academic listening comprehension skills are essential for the student in their pursuit of academic successes (Benson, 1994; Dunkel, 1991; Vandergrifft, 2004). For this reason, my research focuses on the improvement of academic listening skills of the F/SL learners. In fact, in order to improve the academic language skills of F/SL students, learning strategies in second language learning, which play an important part in cultivating cognitive skills, have been studied throughout the years in the field of educational linguistics. As the essential part of learning strategies, listening strategies which are considered important in cultivating listening skills, are separately yet actively studied by many researchers. It has been stated that having a good command of listening strategies can improve the listening skills in a better way (Vandergrifft, 2004). However, ordinarily it is not easy for the learners (especially students studying abroad) to choose appropriate strategies on their own, because they tend to be persistent in their own ways of learning, let alone putting them into effective practice. In order to address this issue, I firstly proposed a strategy object mashups approach (Li and Hasegawa, 2014a) which was expected to enable the learners to practice their listening under the effective supporting functions while making them aware of their strategy application and how would they affect their learning. Therefore, unlike previous learning support systems which provide fixed identical functions to the learners, I entitle the learners with the flexibility of building up their effective learning environment by putting together functional units provided (Strategy Objects), while improving their listening skills through the strengthening of metacognitive awareness of their strategy choice and application. Based on this approach, I designed and developed several functional units, so as the mashups environment where the chosen units can be assembled and operated (Li and Hasegawa, 2014b). In order to make sure whether this new approach and the pilot system developed are useful in improving listening skills in academia, both the short-term and mid-term case studies have been conducted respectively to assess the effectiveness of the system. After analysis of the experiment data, some encouraging conclusions were drawn that the

participants' listening skills indeed were effectively improved by using the system. The case studies also indicated that it was necessary to offer the learners the flexibility of building up their personal learning support environments and, at the same time to inform their actual strategy applications combined with proper guidance for proper strategy choices. Of course, I were also glad to see clearly my next step in the future work.

## 5.2 Background

### *5.2.1 Listening strategies*

In cognitive psychology, the term 'strategy' is linked to the conceptual framework of human learning and memory and refers to mental steps or operations carried out to accomplish cognitive tasks (Clark and Lisa, 2009). Many researchers have tried to define the term language learning strategy in the linguistic world. Wenden and Rubin (1987) defined learning strategies as "any sets of operations, steps, plans, routines used by the learner to facilitate the obtaining, storage, retrieval and use of information." Later on, Richards and Platt (1992) added that language learning strategies were "intentional behavior and thoughts used by learners during learning so as to better help them understand, learn, or remember new information". As listening strategies belongs to the realm of language learning strategies, in the context of my research, I can deduce its definition as the mental processes/mechanisms carried out by F/SL learners to achieve reasonable comprehension when processing information contained in a large input of utterance. Furthermore, a couple of research have also shown that especially for F/SL learners, they have to work under the constraints of an overloaded working memory, and a lack of linguistic, sociolinguistic and content knowledge (Call, 1985; Farch and Kasper, 1986). O'Mally and Charmot (1985) categorized listening strategies into three classifications: Metacognitive strategies, Cognitive strategies and Social strategies. Firstly, Metacognitive strategies are strategies which require planning for learning, thinking about the learning process, monitoring of one's comprehension and evaluating learning outcomes after an activity is completed. For example, the learners who take notes to track their level of comprehension during listening practice, are adopting one of the metacognitive strategies. On the contrary, Cognitive strategies are more limited to specific learning tasks and they involve more direct manipulation of the learning material itself. A learner who successfully inferred the meaning of an unfamiliar word based on the contents understood is actually putting a cognitive strategy into operation. As to the Social strategies, it can be stated that they are related with social behaviors learners conduct when communicating with others, and examples include asking skilled ones for advises, to compare notes and etc. Evidences from various experiments revealed that F/SL learners, regardless of skilled or unskilled, were all applying some listening strategies, consciously or unconsciously (Goh, 2002). It has been claimed that the differences in strategy use among the learners lie in what they are using and the way of using them (Smidt and Hegelheimer, 2004). It has been found that effective language learners know how to use appropriate strategies in their learning while ineffective ones are less skilled in their strategy choice and application (Goh, 1998). Moreover, since what learners know about their learning can directly influence the process and even the outcome of it (Palmer and Goetz, 1988), it has been proved

many times the importance of improving learners' metacognitive awareness of their strategy choice and application through various experiments of related research (Goh, 1998, 2008; Holden, 2004; Bozorgian and Pillay, 2013).Goh (2008) stressed in her findings that learners need to be aware of how their listening comprehension is affected by their choice of listening strategies to develop flexibility in the use of listening strategies as well as find suitable ways for systematic practice, ultimately be able to obtain listening skills.

### *5.2.2 Listening Comprehension Tactics*

The concept of listening comprehension tactics (which is referred as tactics/listening tactics in this research) was brought up by Goh (1998). She defined tactics as individual mental techniques through which a general strategy is operationalized. Goh also identified that the tactics used for the same strategies vary from learner to learner, and skilled learners demonstrated better on strategy choices and the combination of appropriate tactics. For example, a learner successfully inferred the meaning of an unfamiliar word out of the contents he/she perceived earlier; on the other hand, another learner inferred the meaning of the same word by using his own world knowledge. The fact is that they are adopting the same cognitive strategy called inference but through different tactics. The reasons for this difference, Goh indicated, may exist in the learners' differences in listening ability or whether being aware of the ways of strategy use. In this research, I think that well-performed tactics are actually learning skills having inseparable relationships with the strategies which will be explained in later sections. For comprehension tactics are processions of understandable learning behaviors to operationalize listening strategies, it is possible to identify and organize tactics proved to be effective in academic listening, and then correspond these tactics to the according listening strategies defined by O'Mally and Charmot (1985).

### *5.2.3 Difficulties in Applying Listening Strategies in Academia:*

As what I discussed in the previous sections, although researchers in the field of linguistics have repeatedly claimed and proven the effectiveness of consciously adopting their own learning strategies in listening practice through various methodologies, by taking into account the reality most foreign students face, it is difficult for them to successfully utilize proper listening strategies effectively. Firstly, it is difficult to consciously put listening strategies into operation. Ordinarily, this problem is usually solved through teaching the learners effective listening strategies and then introducing the ways for operation. However, in real academic life in which foreign students often are pressed by hard schedules and mostly failed to attend such classes (if there are any), self-directed learning is commonly what they do when it comes to language learning. As a result, they tend to resort to their inefficient accustomed way of practicing without being aware of what strategies they are using and how these strategies affect their learning. Secondly, it is difficult to flexibly adopt effective listening strategies. The possibility has been revealed in some research that even though a number of positive strategies though as helpful in language learning have been identified, the results were not desirable at all when they were used by some other learners (Lessard-Clouston, 1997). Factors including personal traits,

motivation level and cognitive style can influence the strategy choice (Oxford and Nyikos, 1989). Because of their lacking of strategy knowledge and guidance from experts, it is considered difficult to come up with an effective combination of listening strategies which suits the learners' characteristics and learning goals. Thirdly, it is difficult to put social strategies into practice. It would be really enlightening if the ways for strategy choice and application of the effective learners can be communicated over groups or communities. As self-directed movement is the mainstream among foreign students, it is considered inconvenient for them to get involved actively in communication or cooperation with like-minded people to ask help, exchange ideas and acquire advices. This leads to another reality of the missing of learning opportunities and sharing of knowledge.

### *5.2.4 Limitations in Current CALLs & Research Challenges*

Back in the late 80's, and early 90's, with the fast development of information technologies and the prevailing use of computer, CALL was breaking ground in the new technology frontier and began to draw attention. Up to now, numerous CALL systems have been developed to meet different requirements. Some of them are working as an additional supplement to the actual teaching courses known as blended learning (Neumeier, 2005), which are not designed for self-directed learning and proved performing better in the combination of instructors' involvement (Li and Wang, 2012). Furthermore, for CALLs appropriated for self-directed learning, there are still some limitations. First of all, they did not pay attention to how to improve learners' metacognitive awareness of learning strategies. They provided the learners with sets of pre-designed supporting functions without explaining the reasons why those functions were introduced and how would they affect the learning. Secondly, the supporting functions provided to the learners were not necessarily suitable to everyone, since the learners were offered with the identical learning environment. Despite of the fact that there are research focusing on adaptations conducted throughout the years, most of them focused on the adaptation from the viewpoint of learning materials, not the learning functions (Yang, Hwang, Chiang and Yang, 2013; Wang and Mendori, 2013; Fisser and Strijker, 2014). In those research, learners were not in the position of choosing or adjusting system functions to meet their individual learning needs. Thirdly, they are not providing enough support to take social strategies into account, which causes the lack of communication among the learners themselves. There have been studies such as the one on enabling limited sharing and peer-reviews on learning outcomes (Ogata and Yano, 2004), the learning techniques of each learner and the strategy application are not the focuses to be represented in a universally recognizable way.

Having considered these limitations existing in current CALL systems, and in order to address the difficulties encountered by foreign students, I come up with three corresponding challenges, which if addressed, are assumed to be able to improve the current learning situation for self-directed listening practice. They are:

1. A learning environment should be provided where not only effective supporting functions are provided but also the strategic meaning of each function are provided in order to improve the awareness of strategy application.

2. The flexibility of adjusting the supporting functions should be provided to the learners, so they can build up their personal effective learning environment according to their own characteristics and learning needs.
3. A more effective communicative platform should be provided where not only the sharing of established knowledge can take place, but also the learning techniques and strategy applications of each learner can be perceived and communicated, while probably leading to the proper adjustments to their learning environment.

Aiming to effectively address these challenges, I intend to design and develop a self-directed and community-based learning environment with the main purposes of: making the learners aware of strategy application, helping them build up effective learning environments, and enabling them to communicate on not only leaning resources and knowledge but also on learning strategies and techniques. I expect the learners to learn and improve their learning skills through: the strengthened metacognitive awareness of their strategy application; the process of building up their effective learning environments which will be constantly adjusted by themselves from peer-reviews and system recommendation; and the awareness of the relationships between their learning activities and the according listening strategies.

## 5.3 Approach

### *5.3.1 Strategy Object Mashups Approach*

Figure 22 describes the main concept of the proposed approach. Firstly, strategy & tactic models are constructed by putting together listening strategies which have been proved positive for cultivating academic listening skills, and the related tactics most commonly adopted by effective F/SL learners. They are, in another word, learning techniques and methods supposed to be taught to the learners to strengthen their listening ability. Secondly, based on the established strategy & tactic models, I design and develops the functional units—referred as strategy objects in this research. The learners are expected to choose their interested strategy objects to compose their personal distinctive learning environment that I refer as strategy object mashups in this research. Finally, the strategy object mashups used by each individual learner, together with the ideas or opinions of making such combinations, can be communicated on the social strategy platform, I hope that the good ways of learning would be passed on to the less effective learners. In the meantime, a feedback agent is to be implemented to recommend the learners with more appropriate strategy objects or the ones which will advance their learning skills, in order to help the learners construct a more appropriate learning environment, and on the other hand, make them aware more advanced learning skills.

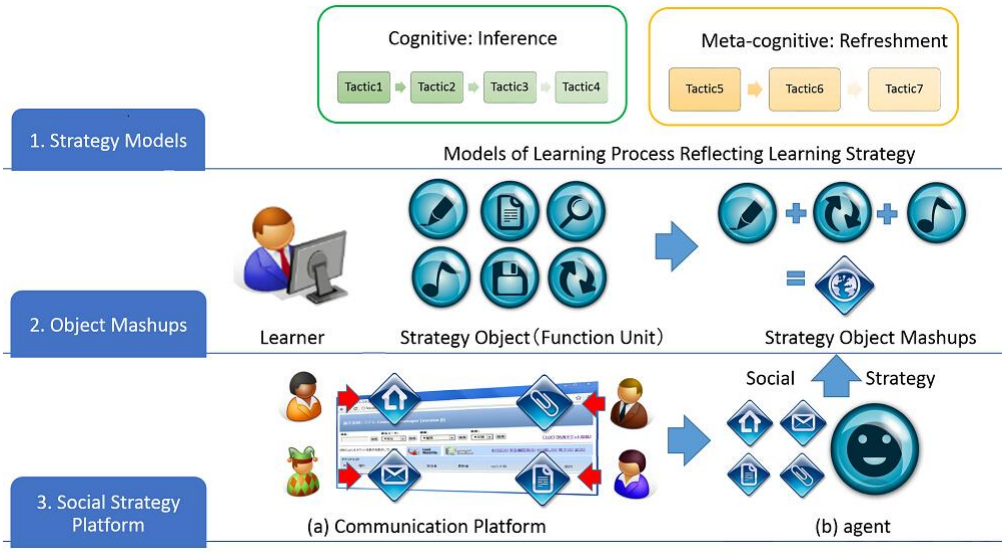


Figure 22. The Concept of Strategy Object Mashups Approach.

### *5.3.2 Multi-layer Map Model*

Considering the three challenges described before, the relationships among strategies, tactics and the learning environment need to be cleared in order to ensure every strategy object be traced to its according tactics and strategies. For this reason, I have designed the system model. A multi-layer model is a core of this learning environment and intended to perform as a GUI for S/FL learners for self-directed and community-based listening practice. Figure 23 shows the model which possesses of four layers. The object layer is where the system presents all the strategy objects for the learners to choose. Also, the detailed description of each object will also be provided to the learners to help them make reasonable choices. The learners choose their wanted objects and the system assembles the selected ones into strategy object mashups on the upper layer where basically, the learners conduct their listening practice while making references to the mashups used by the others if necessary. The tactic layer is where to display the tactics being adopted based on the learners' object mashups, by putting together the tactics traced from the selected objects. And accordingly, the listening strategies operationalized by the tactics can be found on the strategy layer. The upper two layers are meant to attach semantic meanings to object mashups used by each learner, with the purpose of improving their metacognitive awareness of what listening strategies and tactics are being used and how they affect their learning. For example, in Figure 24, one of the learners picked the objects of "display comments of other people, "display background knowledge" and "input keywords", the chosen objects working together as object mashups would support his learning activity. By tracing the tactics related to the chosen objects, the new tactic "inference from related background knowledge and comments of others and input keywords" would be generated and so would the corresponding strategies which were inference and cooperation in this example. Basically, with this system, the learners are expected to be able to: (A). Create their personal mashups; (B). Refer to others' object mashups to make adjustment to their own; (C). Adjust their personal mashups by the recommendation from feedback agent. Specifically speaking, by using the proposed system, the learners would be able to assemble their personal object mashups by putting together proper objects, to refer to others' object mashups for

possible adjustment of their own, and to take into account of the system's recommendation of new objects that could be more effective. In this repeated procedure of building and adjusting the object mashups, I expect the learners to be able to gradually construct the most effective learning environment, while picking up the most effective strategies and tactics during the process, and eventually build up their listening skills.

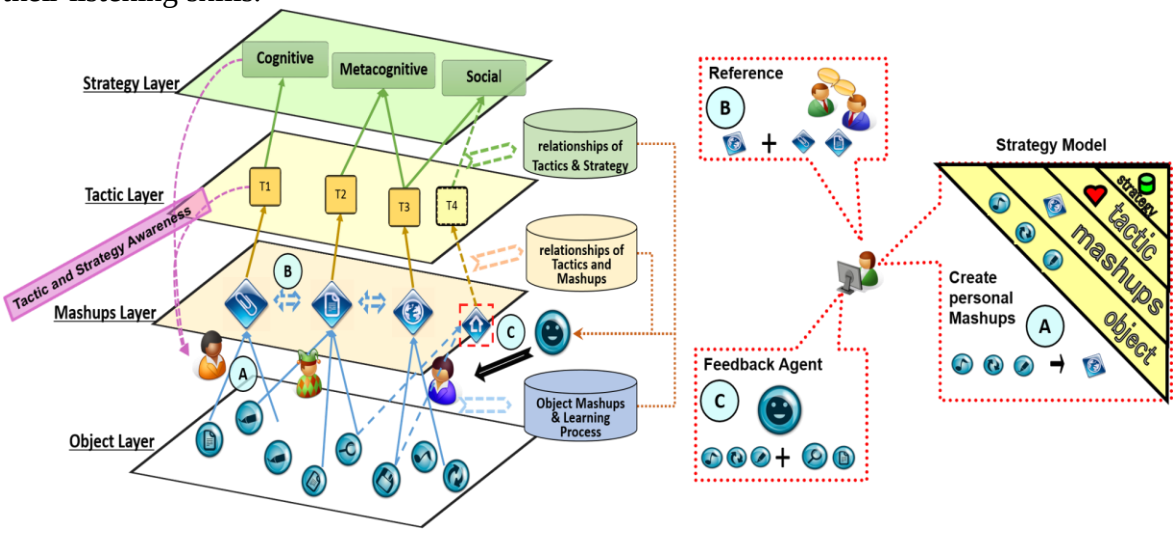


Figure 23. Multi-layer Model.

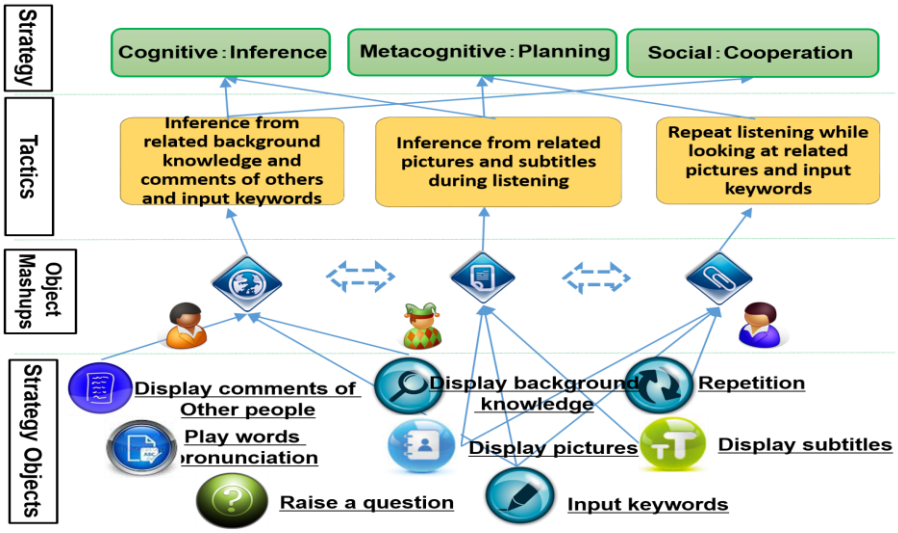


Figure 24. A Concrete Example of Multi-layer Model.

### *5.3.3 The Relationship among Strategy, Tactics and Objects (STO)*

In order to connect the strategy objects with the according tactics and strategies, I introduced a simple relationship to do the job. The relationships between the listening strategies and the tactics are referred as the strategy & tactic models as shown in Figure 25. And then the strategy objects will be developed based on various established strategy & tactic models. In order to visualize each tactic into minimum-sized functional units yet capable of being operated either alone or cooperatively, I take into account the actions learners usually take (See, Write and Listen) while doing listening practice, and then combine them into the strategy & tactic models. Because I intend to attach tactics and strategy to the object mashups composited by the learners,

I relate the items of strategy, tactic, and strategy object and object mashups in an manner as shown in Figure 25. The strategy models are expected not only to be able to represent the learning processes of different learners who uses diverse tactics for the execution of the same listening strategies, but also to be presented as the model of the intellectual activities with the applicable description for designing purpose. The following example better illustrates this mechanism by introducing several strategy models I have established along with the according tactics and strategy objects.

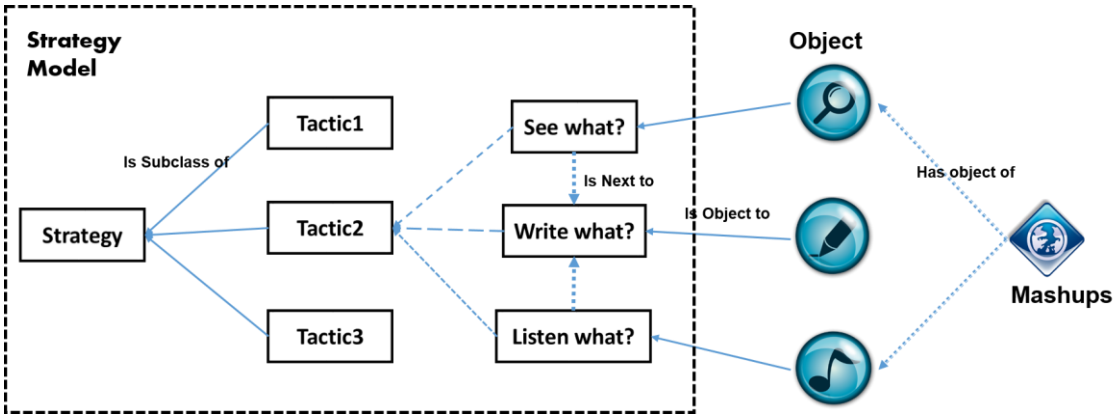


Figure 25. The Relationship among Strategy Model, Strategy Object and Mashups.

Figure 26 shows partially the mechanism of how I systematize the listening strategies into strategy & tactic models and how the strategy objects are being derived. All the listening strategies are subclasses of the three major categories whose relationships have been determined by O'Mally (1989). The tactics are the ones organized from various related research that have been proved to have the positive effect on academic listening. In this figure, there is a typical cognitive strategy called 'take note'. Ordinarily, to operationalize this strategy, I suppose the learners can summarize the important keywords from the transcript of a learning material beforehand or, they might want to dictate the whole transcript while checking the subtitles to monitor their accuracy. Hence, I identified these two tactics, which, by taking account of the learning actions the learners commonly take, are divided into learning procedures. For the former tactic, the first action of the learners would be seeing the transcript followed by writing important keywords from it, leading to existence of the objects 'show transcript' and 'write down keywords'. As to the latter tactic, with the same process, I firstly conclude that the learners need to listen to the learning material and then dictate all the content along the way, checking the subtitles constantly to correct their errors and collect knowledge. As a result, the objects needed would be listening to a video (we plan to use videos as the learning materials), writing transcript and seeing the subtitles. In this way, I expect, the strategy mashups composited by the learners can bear semantic meaning of tactics and strategies by being traced back the objects consisted of.

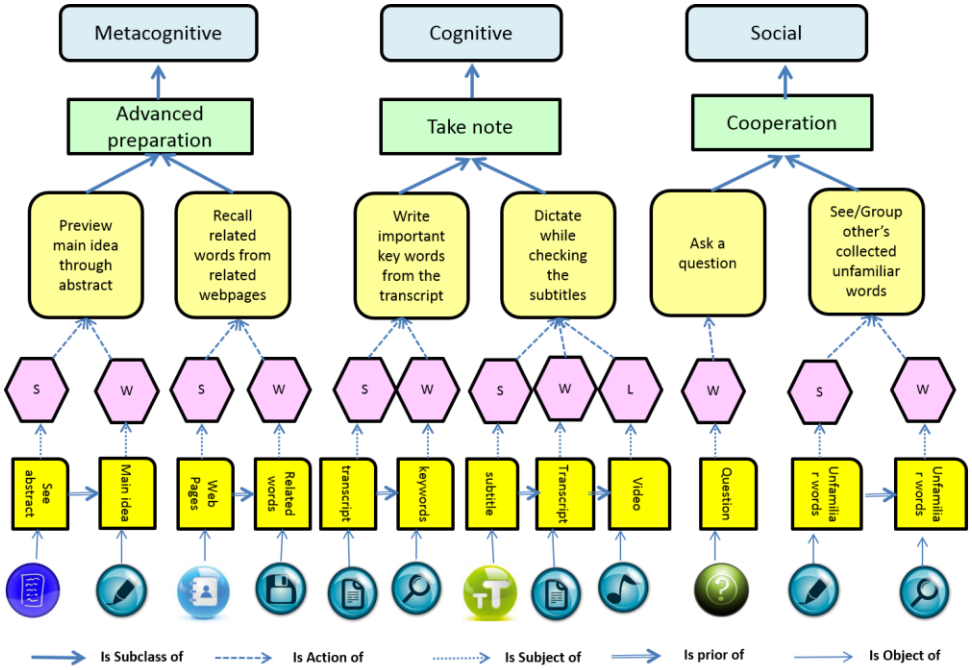


Figure 26. An Example of the Mechanism.

## 5.4 System Review

Recently, I have established 10 strategy models. Based on these strategy models, I have managed to develop the pilot system using Microsoft .NET MVC. The system can be operated in common browsers such as Microsoft Internet Explorer and Google Chrome consisting of 16 strategy objects and a mashups environment where the chosen strategy objects are assembled and operated as a whole. As to the feedback agent and the social strategy platform, I are planning to tackle them in the future, based on the results of the evaluation on the current pilot system.

Firstly, I grouped the strategy objects according to the learning actions (what to see, what to write and how/what to listen) thought to be taken by the learners as shown in Figure 27. For example, strategy object O1 is an object for "See Abstract" meaning to display the abstract of the current listening material if chosen by the learners. By this arrangement, the learners are assumed to be able to quickly decide on their choices on strategy objects as long as they have determined on what to see, what/how to listen and what to write. In the meantime, I divided the listening activity into three phases—Pre-listening, On-listening and Post-listening, by considering that the academic listening in colleges usually takes the form of taking lectures, which is necessary for the learners to develop a sense of phases. Below the strategy objects, there are three boxes representing each listening phase where the learners drag and drop the chosen objects into. Moreover, when hovering the mouse around the object, a piece of message explaining what exact the object does will appear to help the learners decide on their choices. As long as the learners have determined on their choices of strategy objects for the three phases respectively, the next step would be the start of practicing staring from Pre-listening phase. Of course the learners can always come back to change the combination of objects to meet their needs and learning goals until satisfied with the assembled learning environment.

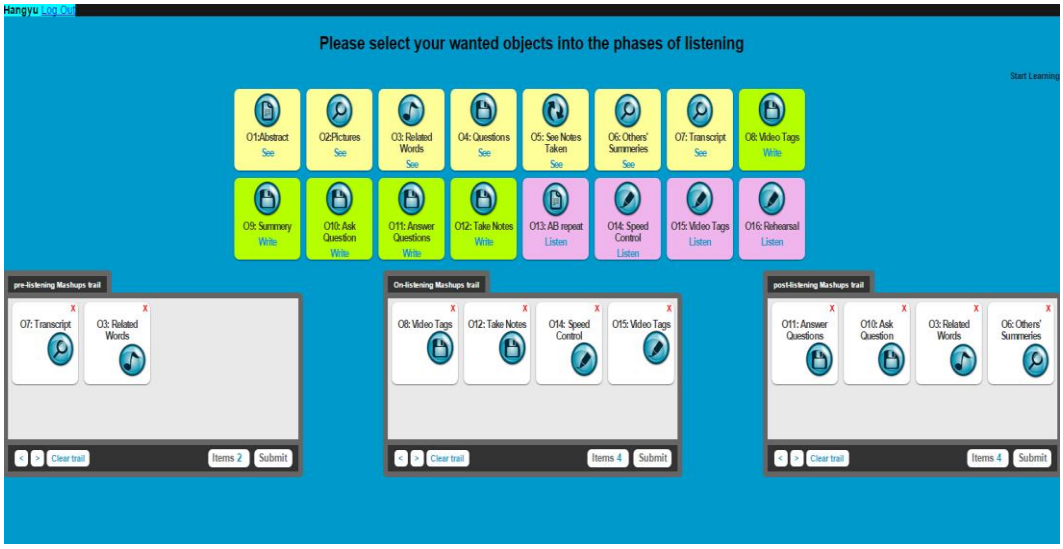


Figure 27. The GUI for Selecting Objects for each phase.

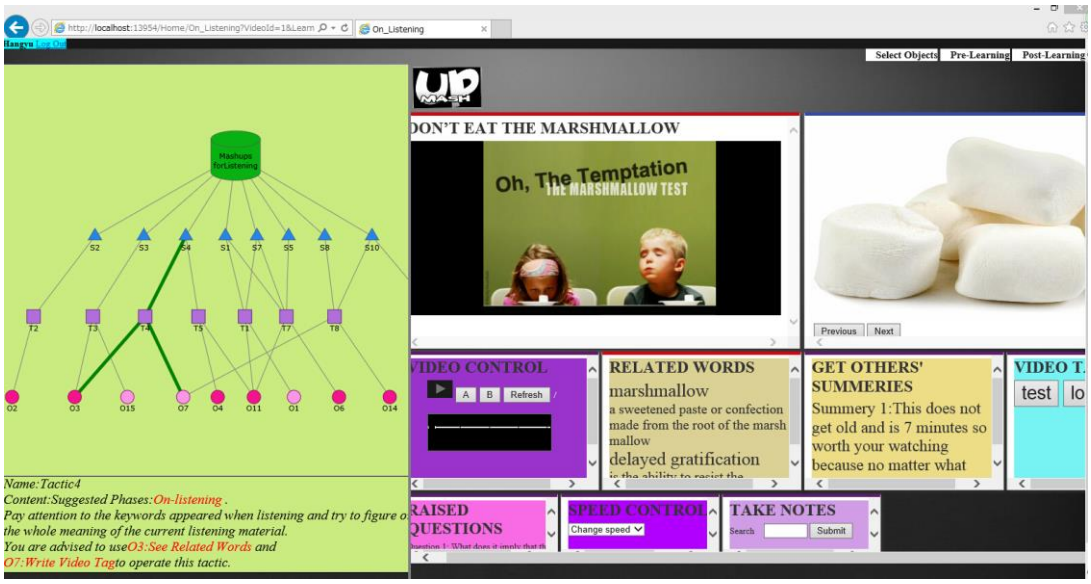


Figure 28. The GUI for the Phase of On-listening.

Figure 28 shows the learning environment of the On-listening Phase. This page is divided into two blocks. The right one is where the learners conduct their actual listening practice, which is consisted of movable tiles that respectively are the visualizations of the selected strategy objects. The sizes of each tile can be changed by being dragged and dropped into places of various sizes. On the left side, it depicts the information about tactics and strategies being adopted by the current learners and the relationships with the objects they have chosen. I call this graph STO which is automatically generated based on the objects chosen to construct the learning environment. The lowest layer of the graph represents the chosen objects (dark red circles), and the objects suggested to be chosen (light red circles) to effectively use certain tactics. The upper layer of squares is the tactics in connection with the objects, informing the learners what they should consciously be aware of while using the chosen objects, and in the meantime, what are other options of object they should consider for a possible better learning experience. The layer of triangles is the listening strategies in connection with the tactics right below. It informs the learners of what listening strategies they are actually adopting, and also, on the contrary, what

other options of tactics are under the same listening strategies. By clicking the shapes of circles, squares and triangles, the descriptive information will appear on the left-down corner. The STO is believed to play an important role in cultivating the learners' listening skills during their listening practice by informing the learners of the according tactics and strategies as well as the advises for object selections. For instance, as shown in Figure 7, the object O3 (See Related Words) is chosen by the current learner, showing related vocabularies in a tile on the right side. As shown in the graph, this object directly relates to Tactic T3 (Get familiar with the pronunciations and sounds of the related words of the current listening material) and T4 (Pay attention to the keywords appeared when listening and try to figure out the whole meaning of the current listening material) which directly relates to S3 (Functional planning: Planning for and rehearsing linguistic components necessary to carry out an upcoming language task) and S4 (Self-evaluation: Checking the outcomes of one's own language learning against a standard after it has been completed). By checking these connections, the first step the learner probably takes is to add object O15 (Listen Video Tag) and O7 (See Transcript) to effectively adopt T3 and T4. And secondly, through the checking of the listening strategies, the learner notices that there is another tactic T5 for operationalizing S4 which, totally up to the learner himself/herself though, might lead to another attempt of configuring the current object arrangement for the possibility of constructing a better learning environment. The reasons for this GUI representation are, first of all, to make the learners aware of their strategy and tactic application, making them aware of what the meanings are for choosing such combinations of objects, and secondly, to help the learners build up more efficient mashups learning environment which suits their needs the most.

## 5.5 Preliminary Case Studies

As the first two of my research challenges are about informing learners with the listening strategies and tactics and, at the same time, enable them to construct their own personal learning environment, I felt it was necessary to evaluate the mashups environment in the current pilot system for two reasons: one is to see the effectiveness of the STO in the role of building up suitable learning environments; the other one is to see whether the pilot system has potential in cultivating listening skills after a longer period of application. As a result, I conducted both short-term and mid-term case studies. Findings from qualitative and quantitative data, respectively from these two case studies, were compared, contrasted and conclusions and assumptions were drawn, so did the requirements for my future work relating to this study. Furthermore, I suppose that the results would also shed some light on the mechanisms of the designs of the feedback agent and social strategy platform to be implemented in the future.

### *5.5.1 Short-term Case Study*

One of the unique features of the pilot system is making the learners aware of their applications of the listening strategies and tactics, as well as the suggestions of other strategies, tactics and objects which might lead to a better learning experience. The STO, as an important part of the system, plays just the role of these aspects.

Therefore, I find it necessary to evaluate the effectiveness the STO has in the pilot system, especially in the process of building up the effective personal learning environment. Moreover, I decided to address this issue objectively by conducting a short-term case study to see whether the STO promotes the number of objects used and the times of making changes to the mashups in the system, both of which are considered important in the process of shaping up the personal learning environment.

20 Japanese graduate and undergraduate students from the department of Information Science and Engineering, whose first language is not English, attended this case study and the procedures are as the following. Firstly, the participants were instructed how the system works. After that, I divided them into four groups and then asked them to finish tasks using the system with or without the STO. The arrangement is shown in Table 5. This arrangement was made by taking into account the counterbalancing, and in addition, pre-test and post-test for listening abilities were made before/after each phase. The test materials were the ones I selected from an IELTS training book and the video contents were Ted talks. In order to diminish the influence from the first task in phase one, I took an interval of 3 days instead of having both phases conducted back to back. Finally, I collected qualitative data through questionnaires with questions related to the experiences they had with the pilot system, the comparative thoughts between with and without the STO, and their suggestions and expectations.

Table 5.The experiment arrangement (short-term)

| | **Phase one** | | **Interval** | | **Phase two** | |
|---|---|---|---|---|---|---|
| Pre-test 1 | Task 1 With STO | Post-test1 | 3 days | Pre-test2 | Task2 Without STO | Post-test2 |
| Pre-test 1 | Task 2 With STO | Post-test1 | 3days | Pre-test2 | Task1 Without STO | Post-test2 |
| Pre-test 1 | Task 1 Without STO | Post-test1 | 3 days | Pre-test2 | Task2 Without STO | Post-test2 |
| Pre-test 1 | Task 2 Without STO | Post-test1 | 3days | Pre-test2 | Task1 Without STO | Post-test2 |

### *Evaluation Factors*

I established several evaluation factors trying to find out the effectiveness, positive or negative, that the STO had on the process of building up one's learning environment by the quantitative data collected from the case study

- From the changes of number of strategy objects chosen by each participant between phase one and phase two, I wanted to see if the STO affected the number of objects chosen by the participants.
- From the times for making changes to the mashups between the two phases, I wanted to see the effects the STO had on the participants when feeling necessary to make changes to their object collections.
- From the results of the pre-tests and post-tests, although it might be hard to say whether the STO was the reasons for the possible changes between the two tests due to the limited time of usage, I expected to find out traces of evidence suggesting so combined with the qualitative data.

### *Data Analysis and Discussion*

Table 6. The experiment data with T-test (**P-value = 0.01)

| | **Without STO** | **With STO** | **T Stat** | **T Critical two-tail** | **P(T<=t) Two tail** |
|---|---|---|---|---|---|
| Number of Objects | 12.25 | 14.35 | 3.3446847 | 2.09302 | **0.0034 |
| Times for changing Mashups | 2.15 | 4.75 | 6.72497971 | 2.09302 | **0.0000 |
| | **Pre-test** | **Post-test** | **T Stat** | **T Critical two-tail** | **P(T<=t) Two tail** |
| Percentage of Correctness in Listening tests of Phase 1 | 17.5% | 28.5% | -4.221 | 2.09302 | **0.00046 |
| Percentage of Correctness in Listening tests of Phrase 2 | 19% | 32.5% | -4.761 | 2.09302 | **0.00014 |

(** P-value < 0.01)

Details are shown in Table 6. I used a T-test to determine whether the means of the two groups were statistically different from each other and to assess whether the difference was meaningful or not. I can see from this table that *t Critical two-tail* < |T stat.| and $p < 0.01$ from every group of data indicated that differences within each group were statistically significant.

Based on the results of the quantitative data analysis, I can see that the STO does have a positive effect on the promotion of the number of the object used and the times for making changes to the mashups Furthermore, I designed questions in the questionnaire to subjectively seek the evidences for such results, as shown in Table 7. In Table 8, From Q1 to Q4, the questions were particularly designed to investigate the participants' thought on the STO. 7 or 6 Likert scales were prepared for them to choose, as well as their reasons for making such choices. I received positive responses in general. Specifically speaking, Q1 and Q3 were asked to evaluate to what extent the STO influenced the participants when making changes to the mashups. 15 participants thought their mashup environments more helpful with the STO, meaning that they had followed the suggestions the STO provided when changes to be made. In addition, 15 participants answered that the STO encouraged them more when making the changes, which explains the outnumbered situation in changing times using the STO revealed from the quantitative data. Q2 and Q4 were designed to investigate the effects the STO had on the participants' learning skills. 16 participants thought that they had learned more ways of practicing listening with the help of the STO, and also 16 believed that they had learnt new effective tactics and strategies. Because the more objects the learners use in the system, the more tactics and strategy knowledge they will be exposed to, I suppose that these answers indirectly explains why more objects were being used with the STO as shown in Table 6. At the same time, the participants provided us with the reasons why they made such choices, although most of them were encouraging, there were several minus yet constructive remarks. Most participants expressed that the STO was helpful in the process of building the mashups, they felt that the information/suggestions received from the STO "taught me the purposes of using some objects or the combination of objects", "gave me advises on choosing some useful objects", "helped me understand more of

the video", "improved the learning efficiency", "informed me other effective ways of learning, making me try more objects", "supplemented what was lacking in my learning environment" and etc. On the contrary, there were participants thinking: "it costs time when reading the STO", "It may be useful once become familiar, it was quite troublesome in the beginning", "It interrupted me when trying to concentrate on listening", "it was difficult to understand" and etc. From these comments, I concluded that the STO was undoubtedly necessary but further thoughts and considerations should be given to the design, contents and presentation in the future. Q5 and Q6 were mainly for their attitudes towards the objects. Nearly all of the participants were contented more or less with the objects they had applied and willing to try more in the future. Meanwhile, I received many suggestions on the designs and functions of certain objects, as well as the expectations for some new objects in days to come.

In addition, I conducted pre and post listening tests for each phase respectively, trying to measure the changes of listening abilities for every participant before and after using the system. In spite of the STO, data from Table 6 indicates that there were slightly improvements in the average scores between pre-tests and post-tests in both phases. However, I am fully aware of the fact that it is hard to give the system credits for these changes since the participants only used it twice and the scores could be easily affected by many other factors. Furthermore, to compare the changes of scores by introducing the involvement of the STO, I counted the number of the participants based on their scores changes between the two tests—whether went up, down or remain unchanged as shown in Table 8. It shows that there were slightly more participants who made a progress on the scores when the STO was being involved, which quite contrasted with my expectation. I assumed that the STO might had a positive effect on the listening abilities of the participants but, as showed in the case study, there was no evidence indicating this assumption. Of course, I can again ascribe this results to the limited time of the participants' using the system. If given more time, there might be a different result confirming my hypnosis. However, at least I was encouraged by these results and determined to evaluate further the effect on listening ability in my future studies.

Table 7. Results of the questionnaire (short-term)

| | **1 Strongly With STO** | **2 With STO** | **3 Mildly with STO** | **4 Similar** | **5 Mildly Without STO** | **6 Without STO** | **7 Strongly Without STO** |
|---|---|---|---|---|---|---|---|
| **Q1: Which Mashup environment you built into the system are more helpful?** | 0 | 5 | 10 | 3 | 1 | 0 | 1 |
| **Q2: From which system you think you have learned more in the ways of practicing listening?** | 1 | 6 | 9 | 4 | 0 | 0 | 0 |
| **Q3: When you wanted to make changes to the mashup environment, which one encouraged you more?** | 0 | 8 | 7 | 2 | 3 | 0 | 0 |
| | **1 Strongly yes** | **2 Yes** | **3 Mildly Yes** | **4 Mildly No** | **5 No** | **6 Strongly No** | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Q4: By using the one with STO, have you learnt new and effective tactics and strategies that you did not know before?** | 0 | 10 | 6 | 3 | 1 | 0 |
| **Q5: Do you find the objects you applied useful for the listening practice?** | 0 | 13 | 6 | 1 | 0 | 0 |
| **Q6: Are you willing to try more objects in the pilot in the future?** | 2 | 7 | 8 | 2 | 1 | 0 |

Table 8. The number of participants with scores up, down and no change of with & without STO

| | Scores Up | Scores Down | Scores No Change |
|---|---|---|---|
| With the STO | 14 | 1 | 5 |
| Without the STO | 15 | 1 | 4 |

### *5.5.2 Mid-term Case Study*

The results from the short-term case study indicated that the STO would promote both the numbers of objects used and the times of making changes to the mashups. Meanwhile, the qualitative results suggested that the STO was helpful in the construction of a more effective learning environment and introducing more effective ways of learning. However, since the time for the participants to use the pilot system was rather limited, there are still two questions need to be answered: is the pilot system assistant in cultivating listening skills; and can the learners listening ability be improved by using the pilot. Given the fact that it is almost impossible to cultivate learning skills or abilities overnight, the chances that learners' listening skills/abilities can be improved after one-time use of the system are even more remote. For this reason, I conducted a mid-term case study allowing the participants to use the system for at least one hour a day for eight consecutive days. In this case study, I invited 6 international students studying at my graduate school whose native languages are not English but using English to conduct their research. Although their English abilities were diverse, they had all experienced difficulties in understanding the lectures effectively and were keen to find ways to improve their academic listening skills. In order to make the experience closer to the real-time academic lecture, I carefully chose 8 Ted Talks videos as listening tasks covering different topics of various fields. The participants were asked to use the system to finish one task per day for at least one hour until all the eight tasks were completed.

There were several steps in the mid-term case study. Firstly, I took an investigation on the participants to get a hold of their listening strategies application status though 18 questions, before using the system. These questions were developed based on the SILL questionnaire proposed by Oxford (1990) in order to apprehend what listening strategies and to what extent were carried out unconsciously by the participants. Five Likert scale (Never or almost never true of me, Generally not true of me, Somewhat true of me, Generally true of me, Always or almost true of me) were given to each question such as "I try to picture the setting of the conversation to understand what the speakers are talking about", with the purpose of measuring the average degree of awareness for each strategy classification (the metacognitive, cognitive and social) for every participant. Secondly, I operated a pre-test for listening ability for every participant. This procedure was to test their actual listening abilities as an indicator of

possible changes after using the system. Since I targeted academic listening in my study, I partially selected some listening tests from a book of simulation test collection for IELTS academic test-takers. Thirdly, I spent around 10 minutes explaining to the participants how to operate the system, what were listening strategies and tactics, how to comprehend the graph generated on the left side of the page—all they should know in order to finish each listening task smoothly. Fourthly, the participants used the system to carry out the eight listening tasks one by one. As language learning required an enduring process of accumulation which required daily attendance, they were asked to finish only one task for at least one hour per day. The fifth step was the counterpart of step one. The participants were presented with the same questions as previously to confirm the changes of the degree of awareness towards listening strategies. The next step was to test the listening ability again using the similar level of listening tests from the IELTS simulation test book in order to check whether the participants listening abilities changes after using the system. The final step was to ask all the participants to take a questionnaire for qualitative data collection and, a short interview afterwards mainly about their opinions or reasons of making such choices.

***Evaluation Factors***

In order to evaluate the effectiveness of the pilot system with longer period of application—whether the participants' awareness of listening strategies had strengthened, as well as their listening skills got improved, I established several evaluation factors, trying to find the indications which could address the first two challenges I had proposed from the quantitative data collected from the case study.

- From the changes of number of strategy objects chosen by each participant for every listening task, I hoped to find patterns or trend indicating the effects, resulted from the operation of the system, on listening skills of each individual.
- From the times for the changes of object selection made by each participant for every listening task, I believed that how many times the participant changed their mashups and the pattern/trends of doing it must have some meaningful indications.
- From the times of usages for every strategy objects for each participant, I hoped to see diverse preferences over a certain object for certain listening phase.
- From the results revealed from the investigation of awareness degree for the listening strategies, carried out before and after the listening tasks, I could deduce whether the metacognitive awareness of listening strategies have grown stronger or not, as well as the willingness of adopting certain listening strategies consciously later on.
- From the comparison between the percentage of correct answers revealed from the pre and post listening tests, I hoped the trace of improved listening ability (if there is any) resulted from the cultivation of listening skills could be found, which might justify my study from a result-oriented view.

***Data Analysis and Discussion***

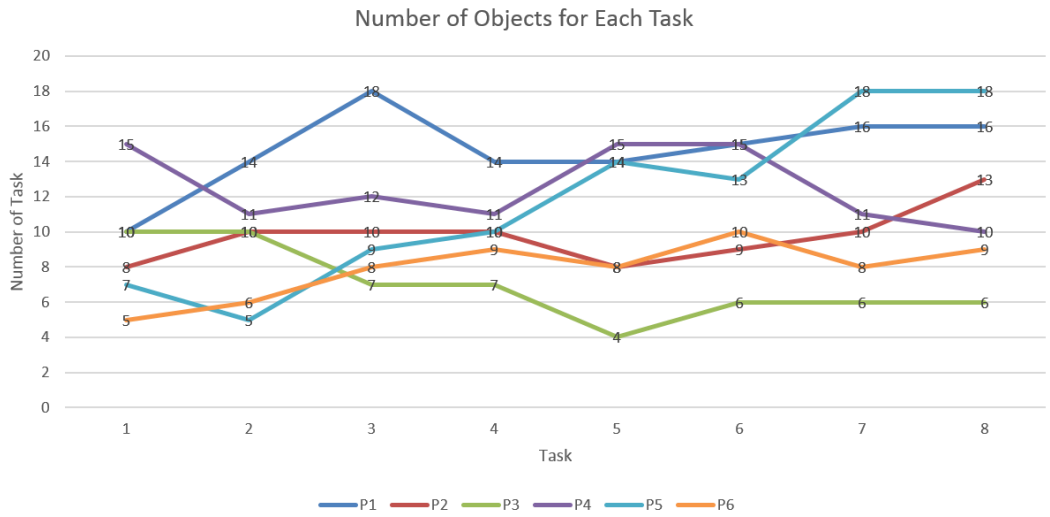


Figure 29. The Changes of the Number of Objects for Each Task

From Figure 29, I can see how the number of objects used by each participant for each task changes during the case study. At least four participants showed an increasing trend in the number of objects they chose over tasks. As every object was connected with the according tactics which were related to certain strategies, the more objects the participants used during the task, the wider range of tactics and strategies they had access to. I deduced that this could possibly enable the participants to learn more effective tactics and put them into operation consciously, as a result, making the participants with more strategy objects at their disposal stand a better chance of improving the learning skills. Four participants showing an increasing trend could indicate that their learning skills had got improved in the process of finishing the tasks one by one. I ascribed these results to the STO which informed the participants of the tactics and strategies they were using on the left, revealed in the short-term case study. By comparison, the interviews with the other two participants revealed that they had been willing to improve the object numbers, but they simply thought they were just temporarily overwhelmed and lost confidence in dealing with more objects at the same time. The two participants were sure that they would increase their objects number if there had been more tasks to come.

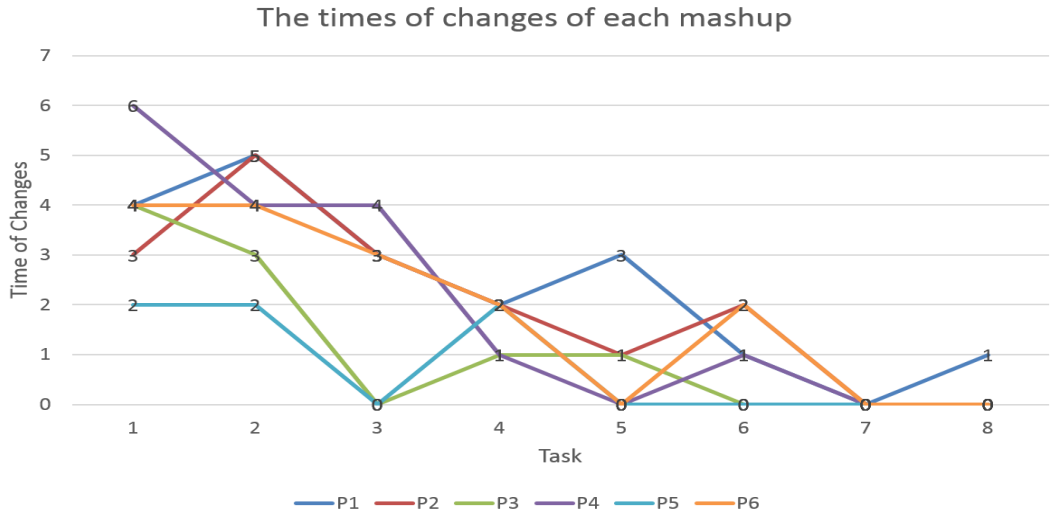


Figure 30. The Changes of the Number of Mashups for Each Task

Figure 30 showed the results for the times of changes made to every individual mashups for each task. The participants were encouraged to change the mashup environment they have created whenever they felt necessary, by deleting or adding the strategy objects they thought appropriate. The purposes of doing this was apparently for the building of a more effective learning environment. The results showed a decreasing trend for every participant. I assumed that in the beginning, the participants were not familiar with the functions of every object and changed the configurations of the objects frequently. Later on, as they were gradually becoming accustomed with each object and, with the reference to the STO and started to grow confidence in their first choices knowing what objects were suitable for conducting a more successful practice. Therefore, in the later stages, their needs for adding/deleting objects of the first choice diminished. These results at least conveyed two pieces of information: one is that the participants would take the initiatives to construct the effective learning environment, if granted with the privilege; and the other one is that at first they might appear unskilled due to the unfamiliarity, but later on they would catch up by providing proper support/guidance. After the case study, I asked the participants what prompted them to make the changes. All the participants answered that it was mainly because they were inspired mainly by the STO on the left, combined with their personal experiences over previously used objects and their willingness of trying out new objects. The same results also were revealed in the short-term case study.

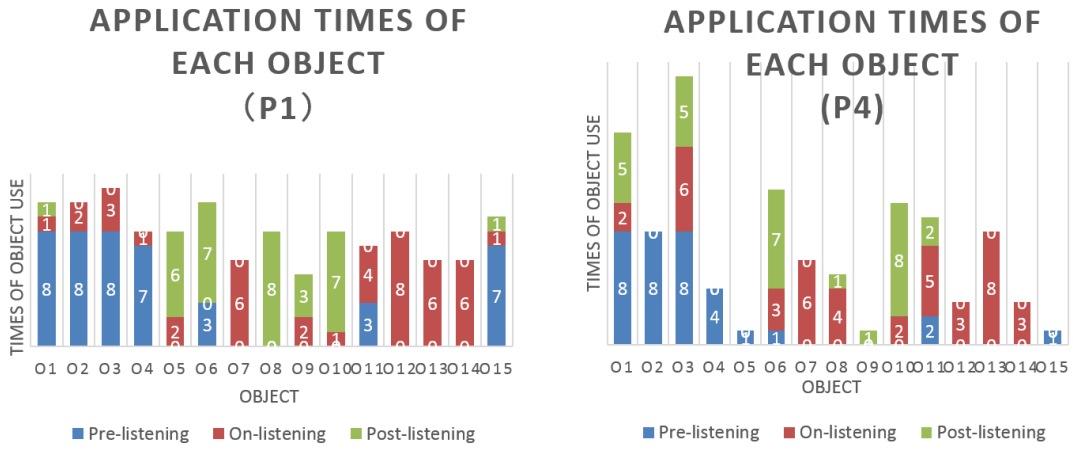


Figure 31. The Times of Object use for each learning phases (for participant 1 and 4)

We also recorded the times being used for every strategy objects in the pre-listening, on-listening and post-listening phases respectively, in the hope of discovering some patterns out of it for each participant. Figure 31 showed the examples of participant 1 and participant 4. The X axis is for all the objects and the Y axis is for the times being used for each object. From this graph, I can see that some strategy objects were frequently used for certain listening phases while some were either less than 3 times or none. There was a pattern of preferences for the object use for everyone, and the pattern varies from participant to participant. For example, as shown in Figure 31, for participant 1, object 1, 2, 3, 4 and 15 were apparently his favorite for pre-listening phase. By comparison, participant 4 only showed preference on object 1, 2 and 3 for his pre-listening phase. I believe these results indicate that the participants had their preferences over object choices to suit their learning needs,

which would justify the necessity for giving learners the right to build their own personal learning support system. In addition, providing the participants with the freedom to build their personal learning environment might increase individuality, but at the same time, probably shut them from accessing to more effective objects. Hence, in my future study, I will implement the recommendation feature to the system, helping the learners in the process of building up the effective learning environment.

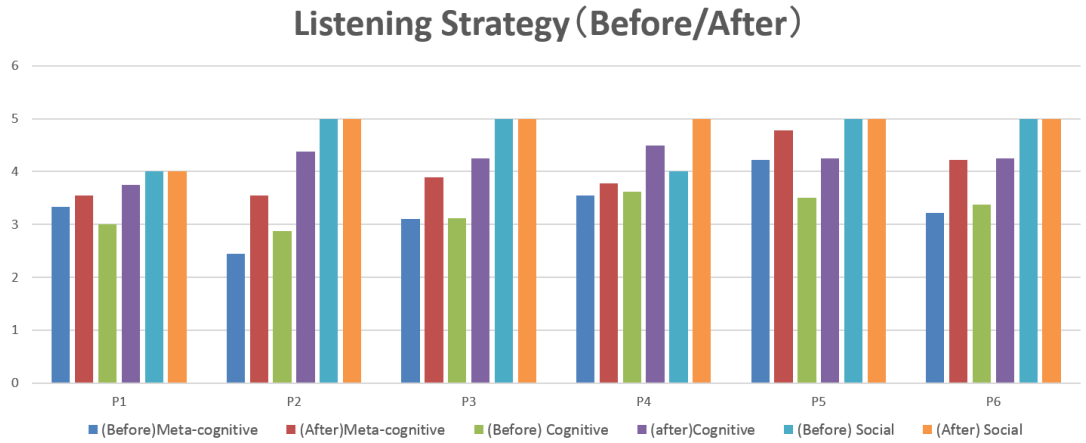


Figure 32. The Average Points of Awareness for Listening Strategies before/after Listening Tasks

As it is shown in Figure 32, I can see the changes for the awareness degree towards listening strategies after finishing all the listening tasks. The vertical axis is the average points attained by each participant for the three classifications of listening strategies, calculated based on the data collected from the questionnaires with 18 questions. As only one question was about the social strategy, I could only see one participant with the improvement of awareness degree in that aspect, while the others remained unchanged. For metacognitive and cognitive strategy, I could see that every participant showed varied improvements. It indicates that after using the system intended to educate/strengthen the knowledge of listening strategies, the participants became more willing to put the according listening strategies into practice consciously from now on in their academic life. In addition, I carried out a short interview regarding the answers attained in the questionnaire and found out that not only the participants had learnt a lot knowledge pertaining to listening strategies and tactics, which led to positive answers in the second round of investigation, but also expressed their willingness of carrying out certain strategies/tactics to improve their listening.

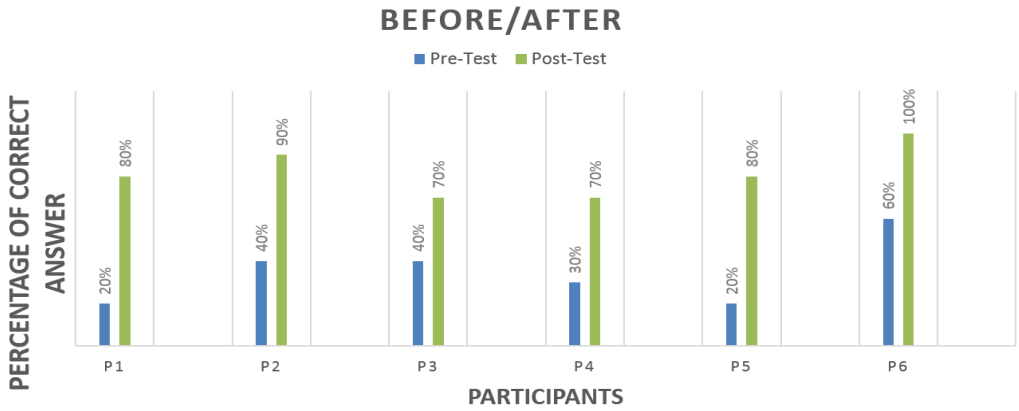


Figure 33. The Percentage of Correct Answers of before/after Listening tests

From the results of pre and post listening tests, I can see that all the participants showed different levels of improvements in the percentage of correct answers. Although I expected that this positive change was the result of sharpened listening skills after using the system, there were no direct connections to explain this difference. It might be caused by the less difficult questions in the latter test, or simply because anyone who practices that much could also progress, which had nothing to do with the system. At least it was more convincing than that of the short-term case study. In order to find much clearer clues leading to this outcome, I interviewed all the participants about any changes between the two tests to their own experiences. Two participants could not explain why the scores were higher than previously, but the other four claimed that they actually put the learnt strategies and tactics into practice for the latter test. One said: "at the Post-test, I check all the questions listed before starting to listen, while trying to picture the images possible to appear in the upcoming context. Because I knew that would help my understanding". Therefore, the system might have some positive effects on the sharpening of the participants listening skills.

Table 9. Questionnaire for Mid-term Case Study (Item/Number of Participants)

| | 1 Strongly yes | 2 Yes | 3 Mildly Yes | 4 Mildly No | 5 No | 6 Strongly No |
|---|---|---|---|---|---|---|
| Q1: Is the mashups you build in the system helpful for you? | 0 | 3 | 3 | 0 | 0 | 0 |
| Q2: Is the STO graph on the left helpful for you when building the mashups? | 0 | 5 | 1 | 0 | 0 | 0 |
| Q3: Has the system taught you better ways of practicing listening? | 1 | 1 | 2 | 2 | 0 | 0 |
| Q4: Have you learnt new and effective tactics and strategies that you did not know before? | 0 | 3 | 3 | 0 | 0 | 0 |
| Q5: Do you find the objects you used during listening practice helpful? | 0 | 4 | 2 | 0 | 0 | 0 |
| Q6: Are you willing to try more objects in the system in the future? | 2 | 3 | 1 | 0 | 0 | 0 |

In the end, all the participants were asked to fill in a questionnaire for the investigation of their subjective satisfactory. The questions and results are shown in Table 9. Generally speaking, almost all the responses were positive. Q1 and Q2 were to investigate the participants' attitudes towards the mashups they built for each task

and the STO graph which was supposed to help them build it. The answers were positive. As one of them put it: “the mashups I created were helping me understand more during the task, and the STO was surely helpful”. But there were also comments such as: “most of the objects were useful, but the functional improvements should be taken care of in the future”, “the STO was not quite informative” and “the tactics information was quite limited, soon I found myself running out of tactics for latter tasks”. According to these comments, I concluded that not only more considerations should be given to the functional aspects, but also more tactics should be included in STO in my future study, so as other options to present the STO for better understanding. Q3 was to make sure whether the participants had benefited by using the system—have their learning skills got improved (mastering new useful ways of learning). 4 participants were positive on different levels. They commented that more or less they felt that they had learnt new effective learning techniques for listening practice and were willing to stick to these techniques in the future. On the contrary, the other two participants did not think the same way, they claimed that they were still exploring and might be able to find good ways of learning if there had been more tasks. From these comments, I again felt the necessity of implementing a recommendation feature in the system, helping the learners find the good learning techniques at an early stage. Q4 was set to find out that, to every participant, whether the listening strategies and tactics encountered useful while using the system for the improvement of listening ability. The responses were positive, but three participants wished that if the explanations for some listening strategies could be more understandable. I realized that it was true that compared with tactics, listening strategies were indeed obscure. In the future, more explanatory information about listening strategies should be included. Q5 and Q6 were designed to investigate the satisfaction over the objects. Despite the fact that the responses were relatively promising, I also received a lot of suggestions for the improvement of certain objects, ranging from interface design to functional refinements. Even several new objects were suggested to be added in the future. However, all of them expressed a more or less desire to try more objects in their learning, which encouraged us to put more efforts to develop new and more useful objects in my future study.

### *New Tactics*

By analyzing each participant’s object options during the case study, I found that, at the early stage, some objects were chosen but seemed not making any sense. I assumed this phenomenon reasonable due to the unfamiliarity towards the system. However, at the later stage, although the numbers of “unreasonable choices” reduced, there were still some “strange” options over objects made by some participants which did not seem to fit in any learning tactics provided in the system. Table 10 listed some examples (one example per participant). I interviewed the participants for the reasons, surprisingly they had their own explanations. For example, Participant 1 selected O3 (See Related Words: see the related vocabularies which will appear in the learning material) and O16 (Rehearsal: Play the pronunciation of the word you input) for on-listening phase, a combination which were suggested be used only in pre-listening. He explained that he wanted to make sure the pronunciation changes of the related words between when being said as a single word and in a whole sentence. That actually served as a listening tactic for this participant, although not provided by the system, obviously suited his needs. I think that once the learners get used to the system with a

certain amount of knowledge for tactics and strategies, they can create their own tactics and the according combination of objects to put them into practice. I believe such wisdoms should be shared among the learners, since the system cannot possibly include all the tactics. For this reason, I will combine a social strategy platform into the system, enabling the learners to communicate and share their mashups and the reasons for doing so.

Table 10. Examples of "unreasonable" choices of objects

| | Unreasonable choices | Used phases | Suggested be used | Personal reasons (New Tactics) |
|---|---|---|---|---|
| P1 | O3, O16 | Post-listening | Pre-listening | To revise the important vocabularies in the end |
| P2 | O1 | Post-listening | Pre-listening | To monitor the general understanding by checking the abstract |
| P3 | O15 | Post-listening | On-listening | To use the tags as hints for writing a summary of the video |
| P4 | O6, O10 | On-listening | Pre-listening, Post-listening | To recognize other's opinion better and then ask more related questions during listening |
| P5 | O15 | On-listening | Pre-listening | Confirm the pronunciations of certain words during listening |
| P6 | O3, O16 | On-listening | Pre-listening | To make sure the pronunciation |

## 5.6 Conclusion

This research reviewed the related literatures mainly from the field of educational linguistics, emphasizing a very important concept for cultivating academic listening skills—listening strategies. Many research have shown that having a good command of listening strategies can improve listening skills effectively, which eventually leads to the improvement of listening ability. This requires the learners to be aware of the listening strategies they are using, and how those listening strategies affect their learning, and then realize what listening strategies are most effective for them, and finally be able to come up with the most effective combination of listening strategies and put them into practice. However, by considering the real situation, making that achievement is difficult. As a result, this research then reviewed the related CALL systems, trying to find answers to this problem. However, the current CALLs appropriate for self-directed learning are either ignoring the importance of listening strategies or learners' diversity by offering everyone the same set of support functions without explaining why those functions were introduced with proper listening strategies and tactics. Based on my investigation, I proposed three challenges aiming at making learners aware of the listening strategy and tactics use, offering them the freedom of constructing their own personal learning environment, and providing them with the platform for communication over listening strategies and tactics with others.

In order to address these challenges, I proposed a new concept of approach - strategy object mashups. This new approach is intended to provide self-directed language learners with the freedom of constructing effective learning environment by putting together wanted strategy objects, but also to be aware of the corresponding

tactics and strategies they are adopting and how are they affecting their learning. For the development of the pilot system, I proposed a multi-layer model based on an simple manner I had designed. Eventually, I develop a pilot system, consisting 16 strategy objects and the mashup environment where the chosen objects can be operated together. Along with the mashup environment, I introduced the STO—a graph consisting of links and notes of different shapes to inform the learners of the according listening strategies and tactics. By using the system, the learners are expected to improve their listening skills in the process of building up their personal learning environment. In order to evaluate the effectiveness of the pilot system in this aspect, I conducted both short-term and mid-term case studies. The short-term case study mainly evaluated the effectiveness of the STO, while the mid-term case study, on the other hand, was set to evaluate the effectiveness of the system in cultivating listening skills given the fact that it is almost impossible to build up learning skills overnight. Based on the results of both short-term and mid-term case studies, I can tentatively state that this pilot system has a positive effect on cultivating listening skills, and might possibly be effective in improving listening abilities. In the meantime, the results of the case studies also indicated that it is necessary to not only provide the learners with the flexibility for constructing their personal learning environment, but also the STO (or other similar forms) to make them aware of the strategy and tactic related and guide them in the early stage of learning. In addition, the results also indicated the necessity of implementing the feedback agent and the social strategy platform which I proposed to address the third challenge claimed.

# Chapter6
# Knowledge Constructing—Using Topic Maps Standards to Improve Note-Taking/Sharing in Video-on-Demand Based Self-directed Learning through Visualization

## 6.1 Introduction

With the rapid development in streaming video and information technologies, the advent of multimedia websites and video sharing sites have led to the unprecedented Internet delivery of video contents. Videos are very important learning resources which not only produce authentic learning experiences for students (Kearney and Campbell 2010; Kearney and Schuck, 2006) but also enable students to acquire a range of transferable skills (Allam, 2006). Needless to say, videos are more efficient and intuitive learning resources than that of the text-based. Because of these benefits, countless educational videos are being created and uploaded onto the Internet and the number is still growing exponentially. This opens up another great opportunity for self-directed learners in their pursuit of knowledge for either personal or professional reasons. Millions of users are searching, browsing and sharing online videos as a source of learning information daily. This type of learning activity is referred as VOD based learning, which is now playing an important role in distant learning resources (Deniz, 2004). Note-taking, as an effective way of recording information in traditional lectures, is also equally highly recommended in VOD based learning for various possible purposes of better comprehension, concentration and reflection etc. Although VOD does help us successfully avoid time pressure by allowing us to revise any part of video contents whenever we want, for note-taking there are still difficulties to resolve and rooms left for improvements. For example, the notes taken during VOD based learning should be well organized in a meaningful structure to facilitate later learning activities such as revising, and should also be generally managed over numerous videos. Furthermore, with the new technologies being developed and exploited, several challenges should be taken for more possibilities to improve the note-taking situation in VOD based learning. I will discuss these issues in the following section. In this research, I propose a VOD learning system which intends to help self-directed learners take note more effectively and efficiently in a virtual space. Moreover, this system also intends to provide an effective way enabling the learners to share their notes with others, and meanwhile, review others' notes as reference.

## 6.2 Issue Addressed

### *6.2.1* VOD Based Learning

It has been known that videos are important learning resources that enable learners to gain knowledge more effectively and intuitively than written materials because they are more informative and engaging. For example, a video about an historic event can

give the learners more information both verbally and visually, which can never be placed with written words. Furthermore, the videos offer the learners the authentic learning opportunities that are more attractive and motivating. More recently, Willmot et al. (2011) found out that there is strong evidence showing that video reporting can inspire and engage students through various aspects of the student-centered learning activities (increasing student motivation, enhancing learning experience, development of learner autonomy, etc.). The fast development in video streaming and information technologies are making all these benefits more universal and accessible. The number of educational video clips is exploding on the Internet. We can literally find videos of any subject on video sharing sites like YouTube uploaded by dedicated individuals, or get access to those high quality lecture videos made by universities and educational organizations around the world, enabling us to learn more effectively and intuitively without the restriction of time and space.

### *6.2.2* Related Research on Note-Taking System and the Challenges

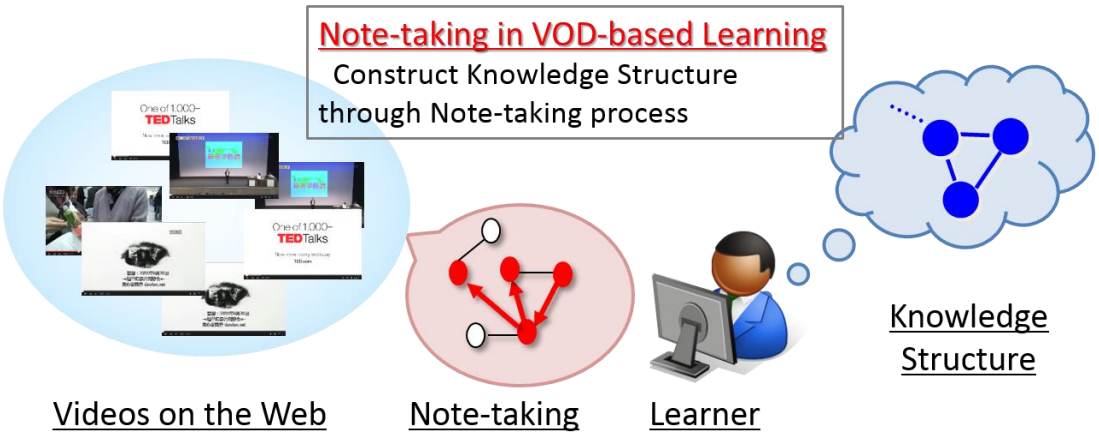


Figure 34. Note-taking in VOD based Learning.

When taking lectures in a classroom, we tend to take notes. The reasons for doing these varies from person to person, but the main advantages for note-taking (Henk, 1985; Barnett et al, 1981) can be summarized as the following:

1. Note-taking forces the learners to listen carefully and measures your understanding of the lecture.
2. The notes taken help the learners remember important points of the lecture.
3. Notes taken are excellent references for future work (reports, essays, projects, presentations, etc.).
4. Notes taken are easier to revise for knowledge attainment and reflection.

This list is even longer under different circumstances. Obviously, most of the benefits equally apply in VOD based learning. In the meantime, as note-taking is a complex activity that requires comprehension and selection of information and written production processes (Piolat, 2005) which is intellectually challenging and time consuming, the difficulties also remains the same in VOD based learning. In order to address these difficulties, there are many research on note-taking (tagging, annotation indexing) on E-documents. Although there are research mainly focusing on the type of E-documents (for example real-time lectures, text-based webpages etc.) other than videos, most of the issues and proposals discussed in these research can also be applied to the note-taking in VOD. Aware of the fact that it is necessary for

the learners to make up for missed lectures as well as to corroborate the accuracy of their notes, Rohit (2013) focused on utilizing speech recognition technology to provide learners all the verbal contents afterwards. Ota (2012) took the same approach but only to filter words possible to provide hints for note-taking instead of the whole verbal contents. Another recent research (Yu et al, 2012) adopted linked data technology (Berners, 2006) to firstly provide the users with machine-understandable keywords for annotation, but also connect current video resources with other knowledge data on the web. As for collaborative note-taking which is very important (Ellis and Phelps, 2000), some emphasized on making connections with the notes of others (Miyake, 2000), some focused on sharing text messages (Singh, Denoue and Das, 2004) or facilitated hand-drawing among lecture participants synchronically with real-time lectures (Kam et al, 2005; Bateman and Brusilovsky, 2007). By considering the fact that, unlike real-time lectures, we can always go back to certain parts of the video contents for revision without the restriction of time, some research (Nakanishi, Shimada, Kojima and Fukuhara, 2010; Hasegawa and Dai, 2015) took this unique advantage in VOD based learning by connecting scene-related comments/questions to the exact timeline to support synchronic communications among the learners.

Undoubtedly, the note-taking situation would be greatly improved if the techniques or ideas proposed in those research can be applied in VOD based learning. However, there are still several limitations. First of all, the notes are not taken in a way to better facilitate later learning activities. They are simply aligned linearly which is too simple to represent the knowledge constructing. Secondly, the notes should be overall managed other than only in one video. Because it is possible that sometimes notes in different videos should be related for the purposes of better understanding and illustration. Especially when every note connects with the according timelines of different videos, with the properly structured notes the learners can jump through video parts guided by their notes efficiently to reflect scene-related-knowledge. Thirdly, the notes taken are not effectively shared among the learners. Recent situation is more like Q&A in a blog site or sending instant messages to each other. A more sophisticated way to present collaborative notes should be presented for community-based knowledge attainment and reflection.

Concept map (Novak and Gowin, 1984) and knowledge map (O'Donnell, Dansereau and Hall, 2002) are diagrams that represent ideas as node-link assemblies which has been prevalently studied in many research. It has been shown that the concept/knowledge mapping in a digital learning environment was very effective in overall learning gains and knowledge retention (Lin, Wong and Shao, 2012). For this reason, we think it is necessary to introduce the concept of mapping to visualize the note-taking behaviors in VOD based learning. Having considered both the good proposals and limitations existing in current note-taking support systems, and the necessities of introducing mapping techniques into this research, to this end, this research has identified the following primary challenges.

- *The learners should be able to take notes in a non-linear way*. The current situation for note-taking on online videos are all linear, in the form of strings of words serving as tags or comments. Many research have suggested that all non-linear note-taking strategies benefit learning more than does the liner recording of information (Boyle and Weishaar, 2001). In this way, learners can improve the quality of the selection and the organization of the information that is recorded as knowledge structures. This means that notes taken should be visualized in terms of nodes and links. Goyal and Gilly (2013) has proved in their experiments that visualization of data links significantly improved participants' sense-making

ability whereas the notepad did not.

- *Every piece of notes should be synchronized to the playback time of the video.* Recent technology has already made it possible to take synchronized comments that are being overlaid directly over the video (nico nico douga of Japan). This is a privilege in VOD based learning we should take advantage of, to make learners aware of when and why they took the notes when they are revising. Furthermore, by synchronizing the notes of other people, the learners can re-experience the note-taking processes of the others and make that useful for themselves.
- *The notes taken should be able to connect to useful knowledge data from the web.* Piolat (2005) described note-taking as short condensations of a source material that are generated by writing them down while simultaneously listening, studying, or observing. However, sometimes we need to supplement something that is not in the source material to deepen/expand our comprehension. As a result, the notes taken in VOD based learning should be able to connect with other knowledge data from the web. It might be other parts of the current video, Pdf files from the other website or another videos shared by other people and etc.
- *The notes should be shared and reviewed among the learners.* Most of us have the experience of borrowing lecture notes from classmates to supplement what we missed during the class or for confirmation. It has been found that note-sharing can support collaborative externalization and reflection and should be implemented in VOD based learning (Miura, Kunifuji and Sakamoto, 2007).

This research adopts the visualization technology in the combination of Topic Maps standards to address these issues. The details will be discussed in the following sections.

## 6.3 Approach

### *6.3.1 Topic Maps*

Figure 35 illustrates the three basic concepts of Topic Maps and the rough ideas of how are they applied in our research. In this research, topics represent the notes taken by the learners while they are conducting VOD based learning. The notes are pieces of selected information describing the learners' comprehension status at the current situation. Association links represent various relationships among the notes. Occurrence links represent the time point of the video when the notes are being taken.

The reason for adapting the concept of Topic Maps is because it properly meets all of our requirements for the challenges we are going to take. Firstly, notes are condensed pieces of information created by the learners to conceptualize the knowledge they have learnt so far. Obviously, topics are quite conveniently fitting this position. Secondly, we have mentioned the necessity of enabling non-linear way of note-taking. The concept of association links enabling learners to make various connections among notes is perfectly serving this purpose. Thirdly, the recorded time points for every note of the video resources are the occurrence links that represents the information resources to better illustrate each note taken. The learners can jump directly to the video clip where and when they made the note for knowledge revision and reflection. To take advantage of the semantic features of Topic Maps, we plans to define several different shapes of nodes (triangle, square, ellipse and etc.) and lines (continuous, dashed with arrow, two arrows and etc.), to represent various types of topics and associations with semantic meanings according to the learners themselves.

For example, when watching history-related videos, the learners may define ellipse as people, square as historical site, and triangle as important event and etc. As to associations, we plan to pre-define several types which could meet most scenarios such as “is kind of”, “is subject of”, “is prior to” and etc. by checking this structure later on, the learners are expected to immediately recall the knowledge they have learnt, and furthermore, deepen their comprehensions. The occurrences will not appear in the whole structure, whose information reveals only when certain notes are selected by the learners for details. Finally, the merging feature in Topic Maps can be used for note-sharing among the learners for community-based learning. All the notes taken in one video will be merged into an understandable formation along the timeline based on a set of rules (notes similarity, connections and etc.) to inform the learners the notes taken by others who have watched the same video. A detailed discussion of how these three concepts are applied and the architecture of our research is held in the following sections.

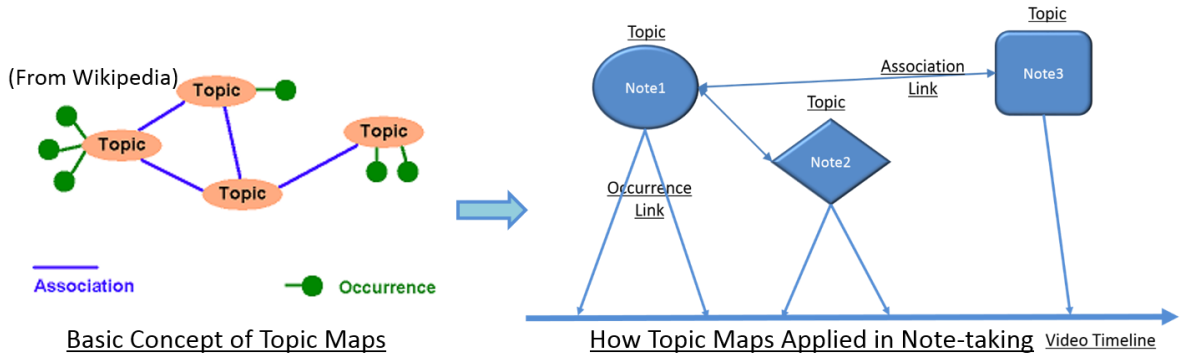


Figure 35. The Basic Concept of Topic Maps.

### *6.3.2 The Research Concept*

***Multi-layer Map Model—for Knowledge Constructing***

Because visualization of the notes taken is the main key point of this research, I proposed the Multi-layer Map Model based on the concept of Topic Maps described before, aiming to realize basic learning behaviors of note-taking in VOD based learning. The multi-layer Map Model is also the core of the proposed learning environment, which is intended to perform as a GUI for self-directed and community-based learning, Figure 36 shows the four layers of the model; the video layer is where the actual videos are located. The note layer is the place where the learners take their notes. They can define notes, build up connection between notes and include other information into the notes. Every note taken by them will be connected with the according points of the timelines in the video layer. The summation layer is where the learners summarize some of the notes they took in note layer if needed. The final layer is the collaborative note layer. This layer merges the personal notes with those of other people who had been watching the same videos, by displaying bubble charts based on their features and relations.

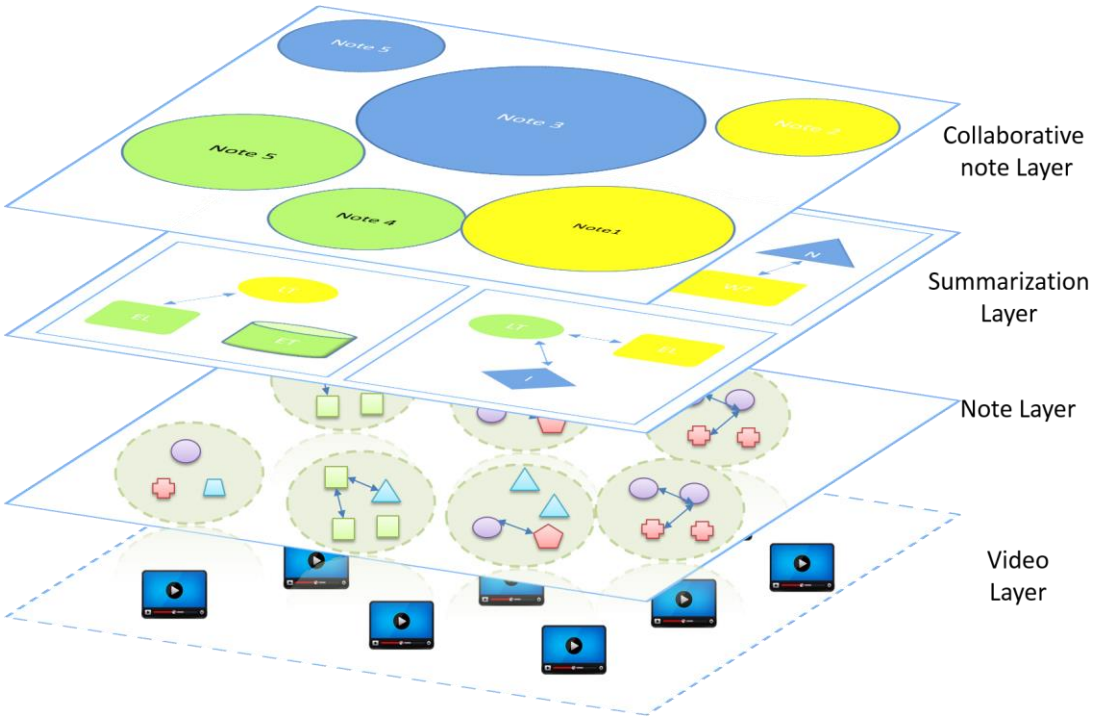


Figure 36. Multi-layer Map Model for VOD based Note-taking

***The Overall Concept***

Figure 37 describes the overall concept of our approach. Learners can create notes while they are watching videos. Each notes has three types of occurrences: strings of words, url, and time point. Strings of words are input by the learners for further explaining the notes they have created. Url is the address of other web resources added by them to better illustrate the current note. The time point is automated recorded at the very moment when the note is created and added by them as the other type of occurrence. Then, the learners can make various kinds associations among notes. For better management, the types of associations will be pre-defined. The learners can choose the types they think appropriate to relate the notes they have taken. Moreover, because the number of the notes keeps growing, so as the connections among notes, the appearance of the note structure would be really messy for management. As a result, the learners can once in a while summarize the notes they have taken by combining several notes into one bigger note to make the structure more clear and easy to understand. Not only can they relate the notes taken in one video, but also the notes they took in previous videos. In this way, the knowledge structure can be properly expanded along with the learning processes, and also it makes the revision and reflection more efficient by only using notes to jump through video parts over numerous video clips.

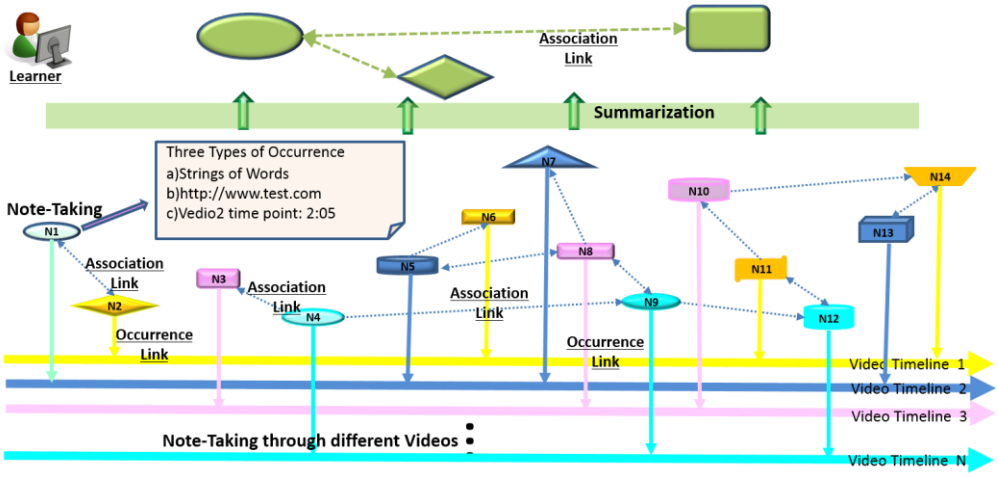


Figure 37. The Concept of Personal Note-taking.

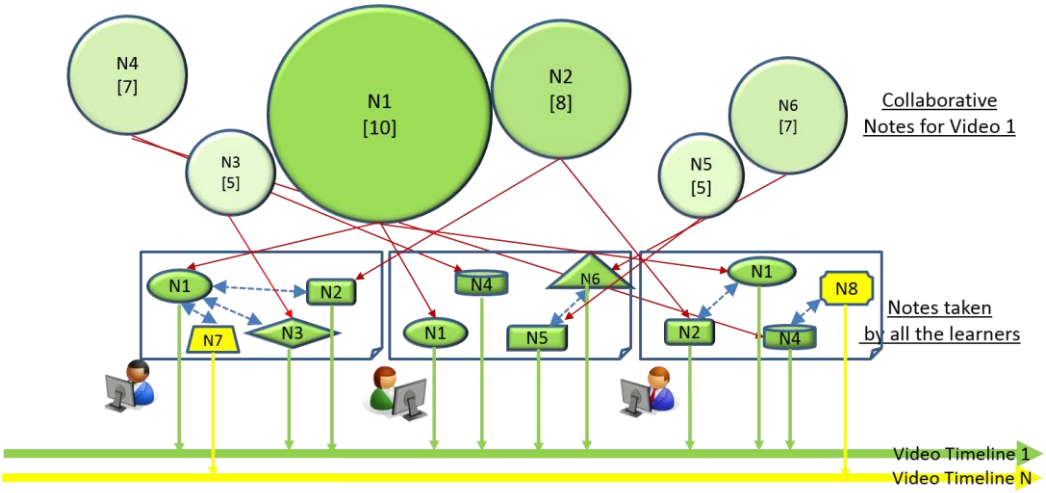


Figure 38. The Concept of Collaborative Note-sharing.

For the purpose of sharing notes taken by the learners who have watched the same video, I intend to merge same/similar notes into bubble form charts as shown in Figure 38. The color density of each bubble represents the number of the learners who have taken the same/similar notes. The system will calculate the similarity from the notes' contents and merge the similar notes created by different learners into one bubble. The denser the bubble is, the more learners have taken the same/similar notes. The relative position between bubbles represents the extent of how two notes relating to each other. Since learners are making all kinds of associations among notes, the number of association links between two notes will be calculated as distance between two bubbles. The size of each bubble represents the number of occurrences included in each note. The strings of words, urls and time points from different videos will all be treated as occurrences. The bigger the bubble is, the more occurrences contained in one note.

### *6.3.3* The System Architecture

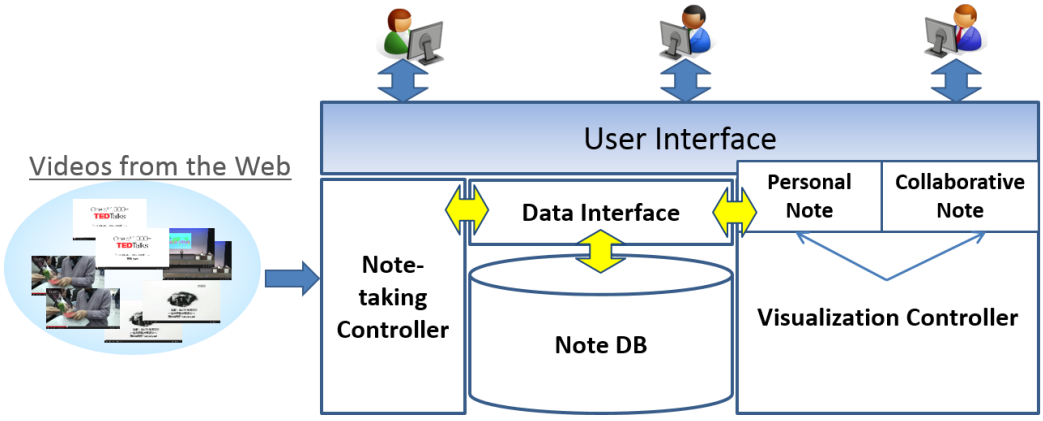

Figure 39. The System Architecture.

From system development point of view, the system bears many resemblances with our previous research (Li, Hasegawa and Kashihara, 2015), we decided to use the system architecture of the previous one only with several minor adjustments. Figure 5 describes the architecture of this system. The learners are interacting with the system through the user interface. The note-taking controller provides the learners with all the necessary functions for note-taking. For example, it provides different shapes of nodes for the learners to choose to represent their notes, various types of association links to draw among nodes and also the data of the current time point when new notes being created. All data will be stored in Note DB through data interface in term of XML Topic Maps (XTM) which is an xml syntax for expression and interchange of Topic Maps. The visualization controller visualizes the personal notes taken by each individuals for revision and also the collaborative notes taken by all the learners who have watched the current video for note-sharing.

Note-taking Controller visualizes the basic learning behaviors when taking non-linear notes. Firstly, it provides the learners with different shapes of the nodes to represent their notes. And then it enables the learners to draw different types of lines among nodes to make associations among notes. After each node and line are being added, the controller will automatically recorded the time point for learners to add as a type of occurrence. Meanwhile, it also offers the options of adding strings of words or Urls as other types of occurrence. All the information will be recorded to the Note DB in the format of XML according to the Topic Maps standard.

Visualization Controller has two function unit. One is for visualizing personal notes. It visualizes the notes taken for each individual in a non-linear way. The other one is for visualizing collaborative notes. It visualizes the notes taken by all the learners in a universally recognizable way. The learners can share their notes, review the notes of others for knowledge reflection and attainment.

## 6.4 The Concept GUI of the Proposed System:

In this section, I will introduce the image of the system GUI and how learners use it to take notes in their self-directed VOD based learning. Please be noted that the figures I made are to better explain how the support system would work.

As the learners are expected to take notes while watching the video, the system offers the learners a block of icons in different shapes right below the video block to help them represent each individual note as shown in Figure 40. When the learners decide to take notes, they can firstly choose one icon from the lower left corner to

present a particular concept based on their own reasoning (for example, ellipse represents people.). Meanwhile, the system will record the time point at the moment for the learners to add as one of the occurrence. And then, the learners will define the note by giving it a title, adding occurrences (strings of words, urls and time point) and the type of associations with the existing notes. When all of these are finished, the well-defined icon will appear on the right side of the screen. Also on the lower left corner, there is a block for all the types of association links for the learners to choose. The learners can choose a type of line and use it to directly link icons on the right side directly while the time point will also be recorded. The notes taken will be presented in a non-linear way, consisting only icons (topics) and lines (associations). The text message in the structure are only topic titles and association types, but further details (occurrences) of each topic and association will appear after being clicked. In this way, the learners can define each note and make associations while watching videos, and at the same time connect the related notes over a number of videos. We expect the learners could build up their knowledge structure during this process, which also would help them revise the learnt knowledge points more effectively.

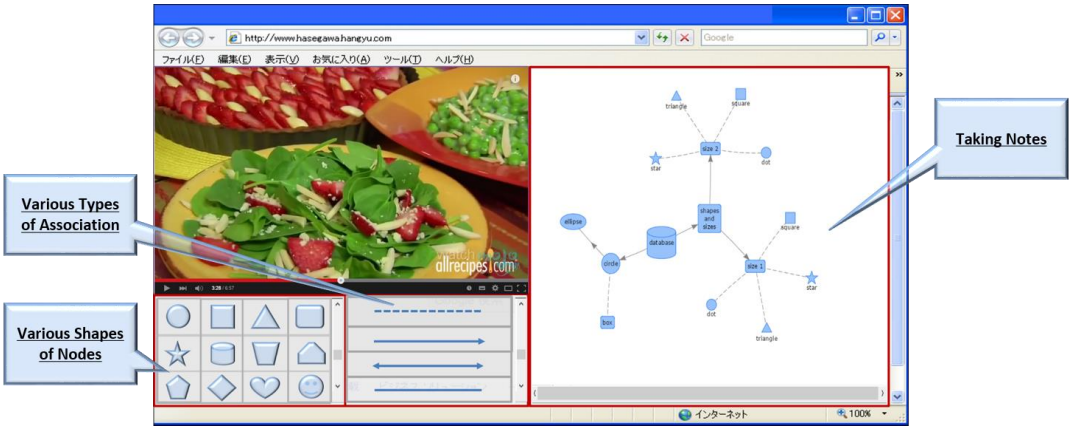


Figure 40. The GUI for learners to take note.

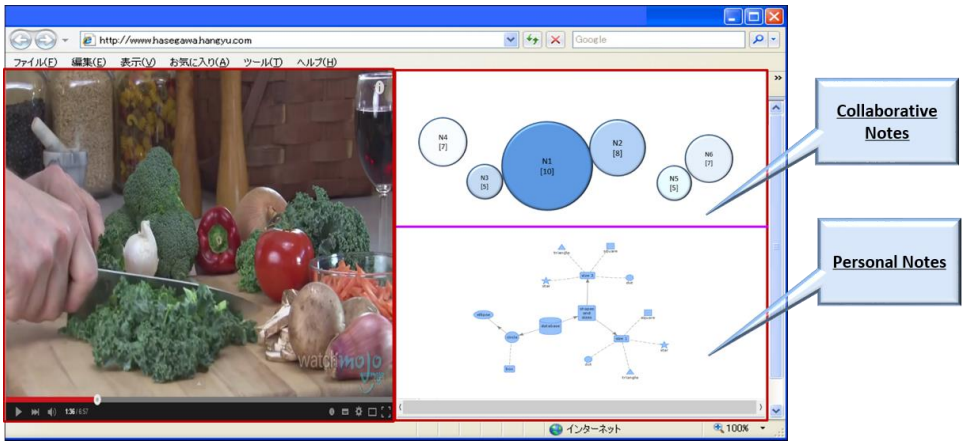


Figure 41. The GUI for learners to view personal and collaborative notes.

When the learners finished watching the video, they can review the notes taken by themselves and also the notes taken by the other people who have watched the same video. On the right side of the window, there are two blocks. One is for personal notes taken by the current learner. And the other one block is for showing the notes taken by other learners in terms of bubble form charts. As I have discussed before, the size of the bubble, the relative distance among bubbles and the color density of each

bubble are all informing the learners the note-taking situations of the current videos. All the notes will be synchronized along with the video's time line. In this way, the learners is able to re-experience the moment when they took the notes and the reasons for doing that. Moreover, by checking the collaborative notes, the learners can on one hand catch new knowledge point, and on the other hand have the opportunity to access some other useful learning resources.

## 6.5 Conclusions

This research proposed a Topic Maps based approach to support self-directed learners' note-taking behaviors on VOD based learning. We treated every pieces of notes as topics and the connections among notes as associations. Each note has its occurrences which not only point to the timeline of the current video, but also expand to learning information from other resources. By using the system, we expect the learners not only can note down important things while conducting VOD based learning, but also can construct a complete knowledge structure which indexes important information over numerous learning resources. By introducing the merging feature of Topic Maps standard, I expect the note-sharing among learners will become more smooth and convenient.

In the future, I firstly will continue the design and also try to finish the development of the pilot system using Microsoft ASP.NET MVC. And then based on the pilot system, an evaluation will be conducted using the video archive of lectures in our institutes, which contains all the courses in our department. We will evaluate the effectiveness of knowledge constructing and reflection by taking notes with the pilot system and then how the collaborative notes in the system would help the learners accumulate knowledge.

# Chapter7
# Conclusions

In the advent of Internet technologies, we inevitably are encountering the self-directed learning in the digital age. Even in this new context, the difficulties risen in self-directed learning also appear to be new and challenging. In order to address these difficulties, I proposed a Multi-layer Map-oriented Model based on the ISO standard—Topic Maps. And then, based on this model, we design/developed three corresponding learning support systems aiming to improve the learning situations of web-based self-directed learning in three major aspects—resource finding/organization, learning skill cultivation and knowledge constructing.

I spread these issues into three chapters—chapter 4, 5, and 6, as following:

- **Chapter 4—Resource Finding/Organization: a resource organization system for self-directed learning combined with the community-based learning.**
  In this chapter, based on the proposed Multi-layer Map Model, several difficulties in web-based self-directed learning have been addressed. The system ROS visualized the basic learning behaviours when it comes to searching and organization the learning resources from the web. The results of the case study indicate that the learners using ROS performed better on learning tasks than that of using traditional Internet Explorer. Furthermore, the results can also tentatively reveal that building connections among learning topics not only provides a better means of resource management but also is subconsciously helpful in the creation of knowledge structure.
- **Chapter 5—Learning Skill Cultivation—Cultivating Listening Skills for academic English based on Strategy Object Mashups Approach**
  Because learning skills varies to different learning subjects, here in this paper, I chose academic English listening skills as the research objective, expecting the methodology I proposed will also be able to apply other learning subjects. I proposed a new concept of approach, strategy object mashups approach. This new approach is intended to provide self-directed language learners with the freedom of constructing effective learning support systems by putting together wanted strategy objects, but also to be aware of the corresponding tactics and strategies they are adopting and how are they affecting their learning. I expect the learners to improve their learning skills while building up their support learning environment. The case studies indicated that this approach has a positive effect on cultivating listening skills, and might possibly be effective on improving listening abilities. I hope this approach can be extended to other fields of learning, because any learning subject should have its own unique learning strategies which, if properly itemized, can also be applied in the mashups approach.
- **Chapter 6—Knowledge Constructing—Using Topic Maps Standards to Improve Note-Taking/Sharing in Video-on-Demand Based Self-directed Learning through Visualization**
  This chapter mainly discussed how to improve note-taking in VOD based learning. Note-taking is a common form of knowledge constructing, conducted by the learners to conclude key points to memorize important knowledge. VOD based learning certainly offer us the access to a much wider world of video contents with learning value, but the note-taking is not as easy as when using

pencils and notebook. In this chapter, I proposed a Topic Maps based approach to support self-directed learners' note-taking on VOD based learning. I also designed a system. By using the system, we expect the learners not only can note down important things while conducting VOD based learning, but also can construct a complete knowledge structure which indexes important information over numerous learning resources. By introducing the merging feature of Topic Maps standard, I expect the note-sharing among learners will become more smooth and convenient.

Generally speaking, the most original contributions of this research are the proposal of the Multi-layer Map-oriented Model by introducing the concept of Topic Maps, and the practical attempts of such a model in the three major aspects of learning: Resource Finding & Organization, Learning Skill Cultivation and Knowledge Constructing. Expect for the aspect of knowledge constructing which I only designed the pilot system without development and evaluation, this research has shown that with appropriate adjustments, this model is supposed to have positive effects on Resource Finding & Organization and Learning Skill Cultivation. However, beyond that, I believe this model has a lot of potential. In addition to the most acknowledgeable advantage of Topic Maps being able to represent complicated structures, this model introduces layers which not only enables horizontal but also vertical managements to various diversified subjects. As web-based self-directed learning itself is a very complicated combination of learning resources, knowledge construction, technological functions and the undetected cognitive skills which also contain endless other elements, this model is properly assisting web-based self-directed learning through perceptive visualizations. Furthermore, in this research, I proposed another new concept of strategy object mashups, combined with MLM model, this could be used to enable self-directed learners to perceive cognitive skills as to improve skills of their own. This concept is not confined to foreign language learning but also to other subjects of learning as no matter what the subject is, there always will be strategies, with which, a system of strategy object mashups can be developed. However, this research did not thoroughly take fully advantages of this model, as I failed to introduce a real community-based learning environment into the pilot systems I developed. Hence, I cannot declare with confidence that it is also benefiting self-directed learners in a learning community no matter how much I believe so. Although building a convincing learning community can be really hard, I would like to give it a try in the future to add some statistical evidences in this aspect.

## 7.1 Future Work

For resource finding and organization, I will try to improve the current model's functionality by introducing another ISO standard (ISO/ICE 19788) which is to use metadata for better descriptions and retrieval of learning resources besides the webpage title both in self-directed and community-based learning, enable the learners not only to categorize the learning resources they found on the web, but also to locate their needed learning resources in the learning community.

For strategy object mashups, based on the comments I received from the participants, I will firstly re-design/develop some objects and the STO to provide the learners with a better user-friendly interface, and secondly I will introduce a feedback agent and a social strategy platform. The feedback agent is supposed to give the learners recommendations of objects or mashups based on their personal preferences

and learning situations. The social strategy platform is where the learners can compare the mashups of each other, as well as the according tactics and strategies. I expect that by adding these two new features to the system, I can not only provide the learners with the more effective learning environment, but also improve their learning skills more effectively.

For note-taking in VOD based learning, I firstly will continue the design and development of the pilot system using Microsoft ASP.NET MVC. After the development, an evaluation will be conducted in our institute using the video archive of lectures, which contains all the courses in our department. We will evaluate the effectiveness of knowledge constructing and reflection by taking notes with the pilot system and then how the collaborative notes in the system would help the learners accumulate knowledge.

In general, I will further reform the MLM model to make it more compatible with a wider range of learning scenarios such as indexing, information retrieval, knowledge sharing and etc. I believe that this model can also be applied in other fields of learning as long as the learning behaviours of the targeted learning type can be identified. This means we need to know what common learning behaviours of the learners while conducing this particular typed of learning. And then determine various elements involved in the learning and categorize the elements of the same feature and put them on the same layer. Furthermore, I want to further discuss the difference between my research and other learning support tools such as MOOC. For example, MOOC is an open on-line course, which means that it contains well prepared learning materials by experts. But that is one type of learning resources from the point of view of self-directed learning. Because the learners need to collect learning resources from the internet all by themselves. In addition, I will also combine all this features into one big pilot system with an interesting learning subject. And then I will try to build a learning community with a large number of participants and evaluate the system for a longer period of time. I expect this would enable me to see a more convincing positive effects that this MLM model has on Web-based self-directed learning combined with community-based learning.

# References


Allam, C., M., Vanbuel, M., Verstegen, S., Young C. (2006). Handbook on Digital Video and Audio in Education, Creating and using audio and video material for educational purposes, The Videoaktiv Project.

Barneet, J. E., DiVesta, F. J., & Rogozinski, J. T. (1981). What is learned in Note Taking? Journal of Educational Psychology, 23(2), 1981, pp.181-192.

Boyle, J. R., & Weishaar, M. (2001). The Effects of Strategic Note Taking on the Recall and Comprehension of Lecture Information for High School Students with Learning Disabilities. Learning Disabilities: Research & Practice, 16(3), 133-141.

Berner-Lee, T. (2006). Linked Data, http://www.w3.org/DesignIssues/LinkedData.html.

Bateman, S., Brooks, C. & Brusilovsky, P. (2007). Applying Collaborative Tagging to E-learning. WWW 2007. Banff, Canada.

Brusilovsky, P. (1996). Methods and Techniques of Adaptive Hypermedia. Journal of User Modeling and User- Adapted Interaction (6), 87-129.

Benson, M. J. (1994). Lecture listening in an ethnographic perspective. J.Flowerdew, (ed), Academic listening: Research perspectives, 181-198.

Buell, C. (2004), Cognitivism. Retrieved from http://web.cocc.edu/cbuell/theories/cognitivism.htm

Call, E. (1985). Auditory short-term memory, listening comprehension and the Input Hypothesis. TESQL Quarterly, Vol.19, 4, 765-781.

Clark C., Lisa, C. (2009). Cognitive Strategy. The Gale Group, Inc. http://www.education.com/reference/article/cognitive-strategies/

Carmel, D., Roitman, H., and Yom-Tov, Elad. (2010). Social bookmark weighting for search and recommendation. The international Journal on Very Large Data Bases, Vol.19 (6), 761-775, 2010.

Chmielewski, T. L. and Dansereau, D. F. (1998) Enhancing the Recall of Text: Knowledge Mapping Training Promotes Implicit Transfer. Journal of Educational Psychology, 90(3): 407-413.

Chen, Y. and Xia, H. (2009). Research on the auto-construction methods of concept map. Proceeding of international conference on intelligent human-machine systems and cybernetics.

Cook, J., Smith, M. (2004). Beyond Formal Learning: Informal Community E-Learning. Computer & Education 43, 35-47.

Coffey, J. W., Carnot, M. J., Feltovich, P. J., Feltovich, J., Hoffam, R. R., Canas, A. J., and Novak, J. D. (2003). A Summary of Literature Pertaining to the Use of Concept Mapping Techniques and Technologies for Education and Performance Support. Technical Report submitted to the US Navy Chief of Naval Education and Training. Pensacola, FL: Institute for Human and Machine Cognition.

Coffey, J. W., Canas, A. J., Reichherzer, T., Hill, G., Suri, N., Carff, R., Mitrovich, T., and Eberler, D. (2003). Knowledge Modeling and the Creation of E1-Tech: A Performance Support System for Electronic Technicians. Expert System with Applications, 25(4).

Dunkel, P. (1991). Listening in the Native and Second/Foreign Language: Toward and Integration of Research and Practice. TESOL Quarterly, Vol.25, 3, 431-457.
Dansereau, D. F. & Newbernm, D. (1997). Using knowledge maps to enhance teaching. In W. E. Campbell & K. A. Smith (Eds.), New Paradigms for college teaching, pp.125-147.

Dabbagh, N. and Kitsantas, A. (2004). Supporting Self-Regulation in Student-Centered Web-based learning Environments. International Journal on E-Learning, 3(1), 40-47.

Dragan G. and Marek, H. (2006). Ontology Mappings to Improve Learning Resource Search. British Journal of Educational Technology. Vol.37, No.3, 375-389.

Deniz, D. Z. & Mohamed, N.O. (2004). Pedagogically Enhanced Video on Demand Based Learning System. Proceedings of IEEE 5th Conference on IT Based Higher Education and Training (pp.415-420), Istanbul, Turkey.

Dicheva, D., Dichev, C., Sun, Y. & Nao, S. (2004). Authoring Topic Maps-based Digital Course Libraries. Proceedings of the Workshop on Applications of Semantic Web Technologies in e-Learning 2004.

Dicheva, D., Dichev, D. & Wang, A. (2005). Visualizing Topic Maps for e-Learning. Proceeding of Fifth IEEE International Conference on Advanced Learning Technologies.

Driscall, M. (2000). Psychology of Learning for Instruction. Needham Heights, MA, Allyn & Bacon.

Eades P. (1984). A Heuristic for Graph Drawing. Congressus Numerantium, Vol.42, pp.149-160.

Euler, L. (1768). Institutionum Calculi integralis.

Ellis, A. & Phelps, R. (2000). Staff Development for Online Delivery: A Collaborative, Team based Action learning Model. Australian Journal of Educational Technology. 16(1), 26-44.

Farch, C., Kasper, G. (1986). The role of comprehension in second language learning. Applied Linguistics 7, 257-274.

Fisser, P., Strijer, A. (2014). Using ICT for personalized and adaptive learning, the case of Linked Data. Proceedings of Society for Information Technology & Teacher Education International Conference 2014, pp. 1243-1247.

Farooq U., Ganoe, H. C., Xiao, L., Merkel, B. C., Rosson, B. M. and Carroll, M. J. (2007). Supporting Community-based Learning: Case Study of a Geographical Community Organization Designing its Website. Behavior & Information Technology, 26:1, 5-21.

Fischer, F., Bruhn, J., Grasel, C. and Mandl, H. (2002). Fostering collaborative knowledge construction with visualization tools. Learning and Instruction, 12, 213-232.

Fujimoto, R., Hasegawa, S., Miura, M., and Kunifuji, S.. (2006). Development of Community Based Learning System at a University", Information and Creativity Support Systems. Information and Creativity Support Systems (KICSS2006), 66-71.

Gaines, B. R., Shaw, M. L. G. (1995). WebMap: Concept Mapping on the Web. Proceeding of Second International WWW Conference.

Goh, C.C.M. (1998). How ESL learners with different listening abilities use comprehension strategies and tactics. Language Teaching Research 2, 2, pp.123-147.

Goh, C.C.M. (2000). A cognitive perspective on language learners' listening comprehension problems. System 28(1), 55-75.
Goh, C.C.M. (2002). Exploring listening comprehension tactics and the interaction patterns, System 30, 185-206.

Goh, C.C.M. (2008). Metacognitive Instruction for Second Language Listening Development: Theory. Practice and Research Implications. TECL Journal Vol.39 (2), 188-213.

Goyal, N., Leshed, G. & Fussel, R. S. (2013). Effects of Visualization and Note-Taking on Sense-Making and Analysis. Proceedings of CHI2013. Paris France.

Gredler, M. E., (2005). Learning and Instruction: Theory into Practice-5th Edition, Upper Saddle River, NJ, Pearson Education.

Hasegawa, S., Kashihara, A., and Toyoda, J.. (2003). A local Indexing for Learning Resources on WWW. John Wiley & Sons, Inc. 34(3), 1-9.

Holden, R. (2004). Facilitating Listening Comprehension: Acquiring Successful Strategies. Bulletin of Hokuriku University Vol.28, 257-266.

Hasegawa, S. and Kashihara, A. (2006). A Support for Adaptive Navigation Planning in Hyperspace. Transactions of the Japanese Society for Artificial Intelligence, 4(21), 406-416.

Hasegawa, S. and Li, H., (2012). A proposal for Sequentially Spring-Model Map for Visualization of Concept Space. Proceeding of JSAI-SIG-ALST-B202 (pp.55-58) (2012 in Japanese).

Hossein B. (2013). Enhancing foreign language learning through listening strategies delivered in L1: An Experiment Study. International Journal of Instruction, Vol.5, No.1.

Herl, H.E., O'Neil, H.F. and Chung, G.K.W.K. (1999). Reliability and Validity of A Computer-based Knowledge Mapping System to Measure Content Understanding. Computers in Human Behavior 15 (1999), 315-333.
Herman, I., Melancon, G. and Marshall, M. S. (2000). Graph visualization and navigation in information visualization: A survey. Visualization and Computer Graphics, IEEE Transactions on Volume 6, Issue 1, pp.24-43.

Hasegawa, S., Dai, J. (2015). A Ubiquitous Lecture Archive Learning Platform with Note-centered Approach. Proceeding of the 17th International Conference on Human-Computer Interaction (HCI), USA. (to appear)

Henk, W. A., & Stahl, N. A. (1985). A Meta-analysis of the Effect of Note-taking on Learning from Lecture. Paper presented at the 34th Annual Meeting of the National Reading Conference, 1985. ED 258-533.

ISO/IEC 13250 (2002). Topic Maps. Second Edition.

ISO/IEC 19788. (2002). Information technology-Learning education and training-Metadata for learning resources.

Jack, p., Sam, H. (2002). XML Topic Maps, Creating and Using Topic Maps for the Web. Addison-Wesley.

John C. N., Olusola, O. A. (2006). Learning With Concept and Knowledge Maps: A Meta-Analysis. Review of Educational Research. Fall 2006, Vol. 76, No.3, pp.413-448.

Jolliffe, A., Ritter, J. & Stevens, D. (2001), The Online Learning Handbook. Developing and Using Web-based Learning. London:Kogan Page Ltd.

Kashihara, A., and Hasegawa, S. A Model of Meta-Learning for Web-based Navigational Learning. International Journal of Advanced Technology for Learning, 2(4), 198-206.

Kashihara, A., Hasegawa, S., Toyoda, J. (2002) Adaptive Hypermedia and Adaptive Web-based Systems. Second International Conference. AH 2002, Malaga, Spain. May 29-31. Springer 2002.

Knowles, M.S. (1975). Self-directed learning. A guide for learners and teachers. Chicago:Follett Publishing Company.

Kearney, M. & Campbell, C. (2010). Digital Storytelling Generic Learning Design. From LAMS Foundation site: http://implementinglearningdesigns.lamsfoundation.org/page6/page17/page17.html.

Kearney, M. & Schuck, S. (2006). Spotlight on authentic learning: Student-developed digital video project. Australian Journal of Educational Technology, 22(2), 189-208.

Kam, M., Wang, J., Iles, A., Tse, E., Chiu, J., Glaser, D., Tarshish, O. & Canny, J. (2005). Livenotes: A System for Cooperative and Augmented Note-Taking in Lectures. Proceedings of CHI2005: Educational & Help Systems. Porland, Oregon, USA.

Lu, H., Feng, B. and Chen, X. (2010). Extended Topic Map: Knowledge Collaborative Building for Distributed Knowledge Resource. Network Operations and Management Symposium (NOMS), IEEE, pp.128-135.

Li, H., and Hasegawa, S. (2010). Multi-layer Map-oriented learning Environment for Self-directed/ community-based Learning. Workshop of the 18th International Conference on Computers in Education (pp.109-116). Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education.

Li, H., Hasegawa, S., and Kashihara, A. (2012). A Resource Organization System for Self-directed/ Community-based Learning. Proceeding of the 20th International Conference on Computers in Education (pp.1-4). Singapore: Asia-Pacific Society for Computers in Education.

Li, H., Hasegawa, S., and Kashihara, A. (2013). A Resource Organization System for Self-directed/Community-based Learning. Proceeding of the 21th International Conference on Computers in Education (pp.329-338). Bali, Indonesia: Asia-Pacific Society for Computers in Education.

Li, H., Hasegawa, S. (2014) Improving Academic Listening Skills of Second Language Learners by Building up Strategy Object Mashups, Proceeding of the 16th International Conference on Human-Computer Interaction (HCI), Greece, (12) 384-395.

Li, H., Hasegawa, S. System Design for Academic Listening of Second Language Based on Strategy Object Mashups Approach, Proceedings of the 22nd International Conference on Computers in Education (ICCE), Japan, pp.711-720.

Li, Y, Wang, L. (2012). College English Listening strategies Training Model in Computer-Assisted Language Learning Environment and the Corresponding Effect Analysis. US-China Foeign Language, Vol.10, No.11, 1752-1758.

Lin, C. P., Wong, L. H., and Shao, Y. J. (2012). Comparison of 1:1 and 1:m CSCL environment for collaborative concept mapping. Journal of Computer Assisted Learning, 28: 99-113.

Li, H., Hasegawa, S., and Kashihara, A. (2015). A Multi-layer Map-oriented Resource Organization System for Web-based Self-directed Learning Combined with

Community-based Learning. The Journal of Research and Practice in Technology Enhanced Learning (RPTEL) (in press).

Lessard-Clouston, M. (1997). Language Learning Strategies: An Overview for L2 Teachers. The Internet TESL Journal.

Lin, F. and Hsueh, C. (2005). Knowledge map creation and maintenance for virtual communities of practice. Information Processing and Management 42 (2006), 551-568.

Lin, C. Y., Wang, C. L. and Tserng, P. H. (2005). Enhancing knowledge exchange through web map-based knowledge management system in construction: Lessons learned in Taiwan. Knowledge Enabled Information System Application in Construction. Volume 15, Issue 6, pp. 693-705.

Liu, E., Chang, Y. (2008). The Learning Opportunities of Social Bookmarking Service: An Example of Funp. WSEAS TRANSACTION on SYSTEMS.

Lave, J. and Wenger, E. (1991), Situated Learning: Legitimate Peripheral Participation, Cambridge University Press, ISBN0-521-42374-0.

McCagg, E.C. and Dansereau, D. F. (1991). A convergent paradigm for examining knowledge mapping as a learning strategy. Journal of Educational Research, 84(6): 317-324.

Millen, R. D., Yang, M., Whittaker, S. and Feinberg, J. (2007). Social bookmarking and exploratory search. Proceedings of the 10th European Conference on Computer-Supported Cooperative Work, Limerick, Ireland, pp.21-40.

Mason, A. (1995). By dint of: student and lecture perceptions of lecture comprehension strategies in first term graduate study. J.Flowerdew, (ed), Academic Listening: Research Perspectives. 199-218.

Miyake, N., & Masukawa, H. (2000). Relation-Making to Sense-Making: Supporting College Students' Constructive Understanding with an Enriched Collaborative Note-Sharing System. Proceedings of Fourth International Conference of the Learning Sciences. (pp.41-47). Mahwah, NJ: Erlbaum.

Miura, M., Kunifuji, S. & Sakamoto, Y. (2007). AirTransNote: An Instant Note Sharing and Reproducing System to Support Students Learning. Proceedings of 7th IEEE International Conference on Advanced Learning Technologies. (pp.175-179). Niigata.

Mase, M., Yamada, S. & Nitta, K. (2008). Extracting Topic Maps for Web Pages by Web Link Structure and Content. Evolutionary Computation, 2008, IEEE World Congress on Computational Intelligence. pp.1232-1239.

Neumeier, P. (2005). A closer look at blended learning-parameters for designing a blended learning environment for language teaching and learning. ReCALL, 17, pp. 163-178.

Novak, J. D., Gowin, D. B. (1984). Learning how to learn. New York: Cambridge University Press.

Noll, G. M., Meinel, C. (2007). Web Search Personalization Via Social Bookmarking and Tagging. Proceedings of the 6th International Semantic Web Conference, 2nd Asian Semantic Web conference, Busan, Korea, pp.367-380.

Nakanishi, T., Shimada, S., Kojima, A., and Fukuhara, Y. (2010). Lecture Video and Scene-related Knowledge Sharing Common Platform Design and its Prototyping- A Practical Example of Learner-centric Open Video Content Service, Proceedings of the 18th Conference on Computers in Education (ICCE), pp.270-274.

O'Donnell, A. M., Dansereau, D. F., and Hall, R. H. (2002). Knowledge maps as scaffolds for cognitive processing. Educational Psychology Review, 14, 71-86.

Ota, K., Kashihara, A., and Hasegawa, S. (2005). A Navigation History Comparison Method for Navigational Learning with Web Contents. The Journal of Information and Systems in Education, 4(1), 14-23.

O'Mally, J., Chamot, A. (1989). Listening Comprehension Strategies in Second Language Acquisition. Applied Linguistics, 10(4), 418-437.

Oxford, R. (1990). Language learning strategies: What every teacher should know. Boston, MA: Heinle and Heinle.

Oxford, R., Nyikos, M. (1989). Variables Affecting Choice of Language learning Strategies by University Students. The Modern Language Journal. Vol.73 (3), 291-300.

Ogata, H., Yano, Y. (2004). Knowledge awareness for a computer-assisted language learning using handhelds. International Journal of Continuing Engineering Education and Life Long Learning, Vol.14, 435-449.

O'Donnell, A. M., Dansereau, D. F., and Hall, R. H. (2002). Knowledge maps as scaffolds for cognitive processing. Educational Psychology Review, 14, 71-86.

Ota, k., Hishizaki, H. & Sekiguchi, Y. (2012). Development of Note-Taking Support System with Speech Interface. Signal & Information Processing Association Annual Summit and Conference, 1-4.

Pepper, S. (2000). The TAO of Topic Maps. Retrieved January, 1, 2000, from http://www.topicmap.com/resources/-tao-topic-maps-finding-way-age-infoglut .

Puntambekar, S. and Stylianou, A. (2003). Improving Navigation and Learning in Hypertext Environments with Navigable Concept Maps. Human-Computer Interaction, 2003, Vol.18, pp. 395-428.

Pythagoras K. and Demetrios, S. (2005). Adaptive Learning Resources Sequencing in Educational Hypermedia System. Educational Technology & Society, 8(4), 128-147.

Piolat, A., Olive, T. & Kellogg, R. T. (2005). Cognitive Effort during Note Taking. Applied Cognitive Psychology. 291-312.

Roto, V., Popescu, A. Koivisto, A. and Vartiainen, E. (2006). Minimap: a web page visualization method for mobile phones. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. pp 35-44.

Richards, J. (1983). Listening comprehension: Approach, design, procedure. TESOL Quarterly, 17, 219-239.

Richards, J. and John P. (1992). Longman Dictionary of Language Teaching and Applied Linguistics. Essex:Longman.

Rohit R., Teresa, T., Yiren G., Keith, B, Heather, M., J. Paul R., Bradley, S. D., (2013). Using Speech Recognition for Real-Time Captioning and Lecture Transcription in the Classroom. IEEE Transactions on Learning Technologies. Vol.6, No.4.

Singh, G., Denoue, L., & Das, A. (2004). Collaborative Note Taking. Proceedings of the 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education.

Schnackenberg, H. K., Sullivan, H. J., Leader, L. F., Jones, E.E.K. (1998). Learner Preferences and Achievement under Different Amounts of Learner Practice. Educational Technology Research and Development, 42(2), 5-15.

Sharon, M., Rosemary, J. S. (1998). Navigation in hyperspace: An evaluation of the effects of navigational tools and subject matter expertise on browsing and information retrieval in hypertext. Interacting with Computers 10 (1998), 129-142.

Smidt, E., Hegelheimer, V. (2004) Effects of online academic lectures on ESL listening comprehension, incidental vocabulary, and strategy use. Computer Assisted Language Learning, 17, 517-556.

Siemens, G. (2004). Connectivism. Retrieved from http://www.itdl.org/journal/jan_05/article01.htm

Thuering, M., Hannemann, J. and Haake, J. M. (1995). Hypermedia and Cognition: Designing for comprehension. Communication of the ACM, 38(8), 57-66.
Wisse, P.E. (2006). Topic Maps Uprooted. Sprouts: Working Papers on Information Systems, 6(18).

Vandergrifft, L. (2004). Listening to learn or learning to listen. Annual Review of Applied Linguistics Vol.24, 3-25.

Wang, J., Mendori, T. (2013). An Evaluation of A Customizable Ontology-driven Language Learning Support System. 21st International Conference on Computers in Education, pp.11-19.

Wenden, A. (1987). How to be a successful learner: Insight and perspectives from L2 learners. In A. Wenden, & J. Rubin, (Eds.). Learner strategies in language learning. Prentice Hall: New Jersey.

Wikipedia: Blended Learning. http://en.wikipedia.org/wiki/Blended_learning.

Willmot, P., Bramhall, M. & Radley, K. (2011). Introducing audio-visual media for inspirational learning and positive engagement, Proceedings of SEFI International Conference on Engineering Education (pp.420-426). Lisbon, Portugal.

Yu, H., Pedrinaci, C., Dietze, S. & Domingue, J. (2012). Using Linked Data to Annotate and Search Educational Video Resources for Supporting Distance Learning. IEEE Transactions on Learning Technologies. Vol.5, No.2. 130-142.

Yang, T., Hwang, G., Chiang, T., Yang, S. (2013). A Multi-dimensional Personalization Approach to Developing Adaptive Learning Systems. Human-Computer Interaction and Knowledge Discovery in Complex, Unstructured, Big Data Lecture Notes in Computer Science. Volume 7947, 2013, pp.326-333.

# Publications

**International Journal**

1. Hangyu Li, Shinobu Hasegawa, and Akihiro Kashihara: A Multi-layer Map-oriented Resource Organization System for Web-based Self-directed Learning Combined with Community-based Learning, Research and Practice in Technology Enhanced Learning, 2015, 10:14(DOI: 10.1186/s41039-015-0012-2)
2. Hangyu Li, Hajime, Kira and Shinobu, Hasegawa: Cultivating Listening Skills for Academic English based on Strategy Mashups Approach, The Institute of Electronics, Information and Communication Engineers, 2015. (Accepted)

**International Conference**

1. Hangyu Li, Shinobu Hasegawa: Using Topic Maps Standards to Improve Note-Taking/Sharing in Video-on-Demand Based Self-directed Learning through Visualization, Proceedings of the 23rd International Conference on Computers in Education (ICCE), Hangzhou, China, 2015, pp.248-256
2. Hangyu Li, Shinobu Hasegawa: System Design for Academic Listening of Second Language Based on Strategy Object Mashups Approach, Proceedings of the 22nd International Conference on Computers in Education (ICCE), Nara, Japan, 2014, pp.711-720
3. Hangyu Li, Shinobu Hasegawa: Improving Academic Listening Skills of Second Language Learners By Building up Strategy Object Mashups, Proceeding of the 16th International Conference on Human-Computer Interaction (HCI), Greece, 2014, pp.384-395
4. Hangyu Li, Shinobu Hasegawa, and Akihiro Kashihara: A Resource Organization System for Self-directed & Community-based Learning with A Case Study, Proceeding of the 21th International Conference on Computers in Education (ICCE), Indonesia, 2013, pp.329-338
5. Hangyu Li, Shinobu Hasegawa, and Akihiro Kashihara: Resource Organization System for Self-directed/Community-based Learning, Proceeding of the 20th International Conference on Computers in Education (ICCE), Singapore, 2012, pp.1-4
6. Hangyu Li, Shinobu Hasegawa: Multi-layer Map-oriented Learning Environment for Self-directed/Community-based Learning, Workshop of the 18th International Conference on Computers in Education (ICCE), Malaysia, 2010, pp.109-116

**Domestic Conference/Symposium:**

1. 李航宇，長谷川忍，吉良元：ストラテジオブジェクトマッシュアップに基づく第二言語聴解学習支援システムの開発とそのケーススタディ，2015 年度人工知能学会全国大会（第 29 回）論文集，1E4-OS-11a-4, 2015.
2. 李航宇，長谷川忍，吉良元：ストラテジオブジェクトマッシュアップに基づく第二言語聴解学習支援システム，2015 年度 JSiSE 北信越博士研究発表会.
3. 李航宇，長谷川忍：ストラテジオブジェクトマッシュアップに基づく日本語聴解学習支援システムの設計，教育システム情報学会 39 回全国大会講演論文誌，19-20, 2014.
4. 李航宇，長谷川忍：アカデミックジャパニーズ聴解学習支援のための

Strategy Object Mashups アプローチ，人工知能学会先進的学習科学と工学研究会資料 SIG-ALST-B202， 横浜，pp.31-34, 2013.

**5.** 李航宇，長谷川忍：Strategy Object Mashups によるアカデミックジャパニーズの適応的学習支援，教育システム情報学会 38 回全国大会講演論文誌，145-146, 2013.

**6.** 長谷川忍， 李航宇: 概念空間の可視化における逐次的バネモデルマップの提案，人工知能学会先進的学習科学と工学研究会資料 SIG-ALST-B202, pp.55-58, 2012.

**7.** 長谷川忍，李航宇，柏原昭博：マルチレイヤマップによる Web-based Learning 支援環境の構築，人工知能学会先進的学習科学と工学研究会資料 SIG-ALST-B101-01-07, pp.33-38, 2011.

**8.** 長谷川忍，李航宇，大田光一，柏原昭博：コミュニティによるハイパー空間地図の作成を通じた Web-based Learning 支援環境の設計，2011 年度第 25 回人工知能学会全国大会論文集，3D1-OS16-2, 2011.

**9.** 李航宇，長谷川忍：Web-based Learning における学習支援ツールの設計，2010 年春 JSiSE 学生研究発表会論文集，金沢，pp.83-84, 2010.

**Awards:**

1. Best Student Paper Nomination, International Conference on Computer in Education, 2013.
2. Best Technology Design Paper Nomination, International Conference on Computer in Education, 2015.

# Appendix A

Detailed information of the STO (listening strategies, Tactics and strategy objects used in the pilot system and their relationships)

Table 1. All the objects used in the evaluation

| | |
|---|---|
| O1 | See Abstract: check the abstract of the current learning material |
| O2 | See Pictures: Check the pictures related with the current learning material |
| O3 | See Related Words: see the related vocabularies which will appear in the learning material. |
| O4 | See Questions: check the questions has been asked by other people who have listened the current learning material. |
| O5 | See Notes Taken: see the notes the users have taken |
| O6 | See Others' Summary: See the summaries taken by other learners who listened to the current martials |
| O7 | See Transcript: Add Tags to places where you want to focus on later during your listening. |
| O8 | Write Video Tags: Add Tags to places where you want to focus on later during your listening. |
| O9 | Write Summary: Summarize the content of the current listening material |
| O10 | Ask Questions: Write down the questions you have for the current learning material. |
| O11 | Answer Questions: Answer questions posted by other learners who have listened to the current learning material. |
| O12 | Take Notes: Write down the words you think important, for example: words you do not know, words related and etc. |
| O13 | AB Repeat: Repeat the A, B selected part while listening. |
| O14 | Speed Control: Control the play speed of the current learning material. |
| O15 | Listen Video Tag: Jump to the parts you have marked before. |
| O16 | Rehearsal: Play the pronunciation of the word you input. |

Table 2. All the Tactics used in the evaluation

| | |
|---|---|
| T0 | See the Transcript of the current learning material and write down the words needed to pay attention to |
| T1 | See the abstract of the current learning material and deduce the contents and keywords which might appear during listening. |
| T2 | Use the image provided to visualize the information appearing during listening. |
| T3 | Get familiar with the pronunciations and sounds of the related words of the current listening material |
| T4 | Pay attention to the keywords appeared when listening and try to figure out the whole meaning of the current listening material |
| T5 | Check the questions having been raised by other learners and deduce content related with the listening material |
| T6 | Summarize the contents and learnt knowledge of the listening material, while referring to the notes taken before |
| T7 | See the summaries taken by others and try to deduce contents related with the listening material |
| T8 | Mark the parts you want to listen again for a clearer understanding or for note down something important |

| | |
|---|---|
| T9 | Ask questions or answer questions being raised by other learners |
| T10 | Repeat/slow the parts you think difficult to understand during your listening |
| T11 | Check the transcript while listening for a better understanding, and make the places you might want to listen again. |
| T12 | See the transcript after listening to check how much you have understood |

Table 3. All the Strategies used in the evaluation

| | |
|---|---|
| S1 | Advance Organizers: Previewing the main ideas and concepts of the material to be learned. |
| S2 | Using mental or actual pictures or visuals to represent information. |
| S3 | Functional planning: Planning for and rehearsing linguistic components necessary to carry out an upcoming language task. |
| S4 | Self-evaluation: Checking the outcomes of one's own language learning against a standard after it has been completed. |
| S5 | Cooperation: Working together with one or more peers to solve a problem, pool information, check a learning tasks, model a language activity, or get feedback on oral or written performance. |
| S6 | Summarizing: Making a mental, oral, or written summary of new information gained through listening or reading. |
| S7 | Note Taking: Writing down keywords and concepts during listening activity. |
| S8 | Self-monitoring: Checking one's comprehension during listening. |
| S9 | Question for clarification: Asking peers or teachers questions for additional explanations, rephrasing, examples. |
| S10 | Repetition: Repeating a chunk of language (a word or phrase) in the course of performing a language task. |

Table 4. Relationship between Objects and Tactics

| | T0 | T1. | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 | T11 | T12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O1 | | ◆ | | | | | | | | | | | |
| O2 | | | ◆ | | | | | | | | | | |
| O3 | | | | ◆ | ◆ | | | | | | | | |
| O4 | | | | | | ◆ | | | | | | | |
| O5 | | | | | | | ◆ | | | | | | |
| O6 | | | | | | | | ◆ | | | | | |
| Q7 | ◆ | | | | | | | | | | | ◆ | ◆ |
| O8 | | | | | ◆ | | | | ◆ | | | ◆ | |
| O9 | | | | | | | ◆ | | | | | | |
| O10 | | | | | | | | | | ◆ | | | |
| O11 | | | | | | | | | | ◆ | | | |
| O12 | ◆ | ◆ | | | | ◆ | | ◆ | | | | | |
| O13 | | | | | | | | | | | ◆ | | |
| O1 | | | | | | | | | | | ◆ | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | | | | | | | | | | | | | |
| O15 | | | | | | | | | ◆ | | | ◆ | |
| O16 | | | | ◆ | | | | | | | | | |

Table 4. Relationship between Tactics and Strategies

| | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 |
|---|---|---|---|---|---|---|---|---|---|---|
| T0 | ◆ | | ◆ | | | | ◆ | | | |
| T1 | ◆ | | | | | | ◆ | | | |
| T2 | | ◆ | | | | | | | | |
| T3 | | | ◆ | | | | | | | |
| T4 | | | | ◆ | | | | | | |
| T5 | ◆ | | | | ◆ | | ◆ | | | |
| T6 | | | | | | ◆ | | | | |
| T7 | ◆ | | | | ◆ | | ◆ | | | |
| T8 | | | | | | | | ◆ | | ◆ |
| T9 | | | | | | | | | ◆ | |
| T10 | | | | | | | | | | ◆ |
| T11 | | | | ◆ | | | | | | |
| T12 | | | | | | | | ◆ | | |

# Appendix B

Questionnaire for measuring the awareness of listening strategies

Please circle only one number for each statement.

1. **Never or almost never true of me**
2. **Generally not true of me**
3. **Somewhat true of me**
4. **Generally true of me**
5. **Always or almost true of me**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. I try to picture the setting of the conversation to understand what the speakers are talking about. | | | | | |
| 2. I use the words I understand to help me guess the meaning of the words I don't understand. | | | | | |
| 3. I use the main idea of the text to help me guess the meaning of the words that I don't know. | | | | | |
| 4. As I listen, I compare what I understand with what I already know about the topic. | | | | | |
| 5. Before I start to listen, I have a plan in my head for how I am going to listen. | | | | | |
| 6. I pay attention to language elements e.g. pronunciation, intonation, etc. | | | | | |
| 7. I preview information related to what I am going to listen if I know what it is going to be about. | | | | | |
| 8. As I listen, I have a goal in my head. | | | | | |
| 9. After listening, I think back how I listened, and about what I might do differently next time. | | | | | |
| 10. I clearly identify the purpose of the language activities before listening. | | | | | |
| 11. I listen for keywords to get the main idea. | | | | | |
| 12. I capture the main idea and drop the details that are not important. | | | | | |
| 13. I listen for details better comprehension and for questions. | | | | | |
| 14. I note down only the key words instead of noting down every word. | | | | | |
| 15. I visualize the information being said while listening. | | | | | |
| 16. I ask for a repetition when I do not understand or cannot clearly hear the speaker. | | | | | |
| 17. I ask the speaker to slow down when he/she speak too fast. | | | | | |
| 18. I ask questions for clarification when I do not understand. | | | | | |