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A Value-added Applicable Way to Integrate Digital Archive E-Book and Technology Education

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ABSTRACT

This study aims to investigate the add-value application of Digital Archive Resources integrated into Science and Technology for senior graders in elementary schools. The participants of this study are 158 fifth graders who are selected from five different classes in an elementary school in Kaohsiung City. Two research tools were applied for assessing students’ technology education learning achievement and information literacy. Major findings are: It is believed that participants are with confidence about their own information literacy. And, the result revealed that the application of digital archive resources in the Big 6 Technology learning activity could promote students’ performance in the Technology education. So, the value-added application of Digital Archive Resources integrated into Science and Technology has using value to education.

Keywords: Digital Archive, Technology Education, Big 6 Skill

INTRODUCTION

As digitizing technology becomes increasingly widespread, information technology, computer and communications technology and the development of the Internet had influenced our society in an ever deeper way. In the past, information technology had brought about local changes to our daily life. With the rapid development of the Internet, the information technology had such a comprehensive impact on our ways of social communication, knowledge transference, presentation and management. Even more, the impact is also on our perceptions of and approaches to research and education.

Today, the influence of digitizing is world-wide and is increasing in importance at all time. Information technology had gradually altered our activities in our daily life, work, learning and entertainment, thereby promoting a digital era in which culture and education are changing in every aspect.

Technology education is the subject area concerning about technological literacy and preparing technologically literate persons. Technologically literate persons incorporate various characteristics from engineers, artists, designers, crafts-persons, technicians, mechanics, and sociologists that are interwoven and act synergistically. These characteristics involve systems-oriented thinking, the creative process, the aspect of producing, and the consideration of impacts and consequences. Technologically literate persons understand and appreciate the importance of fundamental technological developments.

Digital archive resources provide the potential of cooperating with technology learning. There is a need to demonstrate an efficient way to integrate digital archive e-book into technology education as the domain of context.

This study was to identify a way to apply digital archive for supporting education. Meanwhile, with the use of Big 6 teaching strategy, a learning activity based upon selected digital archive e-book was designed. This value-added learning activity was applied for field implementation and students’ achievements were examined for verifying the efficiency of collaborating digital archive resource and technology education.

LITERATURE REVIEW

Digital Archive

Using information technology for improving organizational communication and knowledge management became an essential skill for industrial and economic development.

The information economy or "knowledge economy" theory has won many adherents, and a wave of e-commerce has swept the world. Culture is the product of accumulated human wisdom and knowledge passed down from generation to generation (knowledge here is not limited to scientific domain). From this perspective, information technology's influence is not limited to intangible social culture; it also has a profound and across-the-board influence on industrial and economic development. The Taiwan e-Learning and Digital Archives Program [TELDAP] (TELDAP, 2008) was officially launched on 1 January, 2008. The project is aimed to creatively promote national digital archives and e-learning applications and facilitate the development of Taiwan's culture, society, industry and economy. TELDAP describes the infrastructure for digital archives and e-learning includes the establishment of electronic databases, user habits, information technology literacy, Internet accessibility,

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government regulations and policy, advanced academic research environment, capabilities of industrial applications, services and marketing, etc.

In addition, Chang, Wang, and Chen (2009) explained that projects for e-government, e-commerce, broadband fixed network, e-learning and e-health have been set in motion. [TELDAP] (TELDAP, 2008) also describes in Taiwan e-Learning and Digital Archives Program: Overview that Taiwan has been known to be one of the key countries in terms of its information technology production and services. The government also advocates the vision of the Green Silicon Island and knowledge economy. The digitization of national archives and education will contribute significantly to the accumulation, dissemination and application of knowledge, and will thus play an essential role in the development of the knowledge economy. However, Taiwan should accelerate its work on e-learning and digital archives (TELDAP, 2008).

Chang (2009) explained the digital archives means use of digital technology and integration of technologies, products or services to digitize and integrate the images, characters, images, voice, creative culture, leisure travel, life products. By the process of digital form, digital collectables can be more correct interpretation of digital collections for the long-term storage, maintenance and retrieval access (accessibility) of using value-added. Some of the digital collections of native and some changes due to collection into digital object. The main purpose of digital archives is to ensure the availability of digital data, persistence and intelligence integration.

Table 1 presented the educational resources in the showcase of TELDAP collections (TELDAP, 2008).

<table>
<thead>
<tr>
<th>Educational Resource</th>
<th>Main Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Museum of Natural Science: The Digital Museum</td>
<td>It produced a flash game in its “Digital Museum for Children.” Through interactive activities, a child can explore the Botanic Island, Animal Island, Geologic Island, Fungous Island and Human Island to gain knowledge of the plants, animals, fossils, fungus and archeology, respectively.</td>
</tr>
<tr>
<td>for Children</td>
<td></td>
</tr>
<tr>
<td>Much-awaited opening of “Temple of Heaven and Earth” is</td>
<td>Taiwan’s temple culture: “how to pray in these temples?”, “how to cast divination blocks, draw bamboo sticks, or have evil spirits exorcised?” “the symbolism behind each god and offering?”</td>
</tr>
<tr>
<td>here!</td>
<td></td>
</tr>
<tr>
<td>Institute of History and Philology (IHP), Academia Sinica:</td>
<td>IHP, Academia Sinica, has historical archives and collections, including archaeological data, language data, ethnological data, rare books, documents of Ming and Qing Dynasties, and stone and bronze rubbings. IHP has produced 10 animation videos so that viewers can get a glimpse of these treasures.</td>
</tr>
<tr>
<td>10 Animation Videos</td>
<td></td>
</tr>
<tr>
<td>Ceramics Procedures Guideline</td>
<td>Apart from the ancient ceramics collected in museums, kiln sites from all over Taiwan are continuously creating ceramics with local features. While there is a need for ancient ceramic to be preserved via digital archives, the need is greater for ceramics with local features to be digitized to enable the world to comprehend the subtleties of the traditional techniques as well as the rich creativity of Taiwanese people.</td>
</tr>
<tr>
<td>String-Bound Book Digitization Procedures Guideline</td>
<td>Ancient Chinese and Western books utilized string as binding material. In China, book pages, along with same-size front and back covers, were sewed together using strings. This method made it easier to browse a book and harder for a book to fall apart. The string-sewing method became common from the middle period of Ming Dynasty on.</td>
</tr>
<tr>
<td>Painting and Calligraphy Procedures Guideline</td>
<td>“Calligraphy” is the art of writing. The Chinese have a unique way of using ink and lines on paper to express the beauty of Chinese characters’ different forms and styles as well as the calligrapher’s sentiment.</td>
</tr>
<tr>
<td>3D Exhibition of TEES</td>
<td>Four stories that composed with Tatala Boat are hosted in this platform.</td>
</tr>
</tbody>
</table>
Technology Education

Technology education can involve the generation of knowledge and processes to develop many systems that solve problems and extend human capabilities.

Wright, Lauda, Israel, and Association (1993) define technology, as that a body of knowledge and actions, used by people, to apply resources in designing, producing, and using products, structures and systems to extend the human potential for controlling and modifying the natural and human-made environment.

Technological literacy is vital to individual, community, and national economic prosperity. ITEA (2007) explained the ability to use technology involves the successful operation of the key systems of the time. Understanding technology involves more than facts and information, but also the ability to synthesize the information into new insights. ITEA further explained that technologically literate persons are capable problem solvers who consider technological issues from different points of view and in relationship to a variety of contexts. Technologically literate persons understand technology involves systems, which are groups of interrelated components designed to collectively achieve a desired goal or goals.

- Technologically literate persons can identify appropriate solutions, and assess and forecast the results of implementing the chosen solution. Technologically literate persons understand the major technological concepts behind the current issues. They also are skilled in the safe use of the technological processes that are lifelong prerequisites for their careers, health, and enjoyment.
- The characteristics of technologically literate persons involve systems-oriented thinking, the creative process, the aspect of producing, and the consideration of impacts and consequences. Technologically literate persons have the ability to use decision-making tools in their lives and work.

No single component or device can be considered without understanding its relationships to all other components, devices, and processes in the system. Therefore, technologically literate people use a strong systems-oriented approach to thinking about and solving technological problems.

The Universals of Technology

Technology involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. As such, technology has a process, knowledge, and context base that is definable and universal. The processes are those actions that people undertake to create, invent, design, transform, produce, control, maintain, and use products or systems. The processes include the human activities of designing and developing technological systems; determining and controlling the behavior of technological systems; utilizing technological systems; and assessing the impacts and consequences of technological systems (ITEA, 2007).

Technological knowledge includes the nature and evolution of technology; linkages based on impacts, consequences, resources, and other fields; and technological concepts and principles. This includes much of the knowledge of how the technological processes are developed, applied, and used. The context of technology involves the many practical reasons why it is developed, applied, and studied. People want to develop and use systems that are developed can easily be categorized as informational systems, physical systems, and biological systems. The processes, knowledge, and context are all equally critical to the existence and advance of technology. All technological activities are for a reason, or done within a context (ITEA, 2007).

![Figure 1: The Universals of Technology](image)

Big6 skill

Hsieh (2009) explained the Big 6 teaching skills is a model to solve the problem, the education in the
Table 2: Steps and reminders of the Big 6

<table>
<thead>
<tr>
<th>Phases</th>
<th>Steps</th>
<th>Reminders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Definitions</td>
<td>Define the problem</td>
<td>What do I need to answer the question?</td>
</tr>
<tr>
<td></td>
<td>Identify the information</td>
<td>What information do I need?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How much information do I need?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How should I do?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What do I need to solve the difficulties?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do I need to narrow my topic?</td>
</tr>
<tr>
<td>Information Seeking Strategies</td>
<td>Determine all possible sources</td>
<td>What resources that I may use?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What is the most suitable reference?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What kind of index information that I should use?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do I need to use the web pages, journals, television, video or other resources?</td>
</tr>
<tr>
<td>Location and Access</td>
<td>Locate sources</td>
<td>Where can I find the resources?</td>
</tr>
<tr>
<td></td>
<td>Find information within sources</td>
<td>Who can help me find the required information?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use keywords or topic to search for the electronic information?</td>
</tr>
<tr>
<td>Use of Information</td>
<td>Engage</td>
<td>Which information is appropriate?</td>
</tr>
<tr>
<td></td>
<td>Extract relevant information</td>
<td>How do I record the graphic information?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Does the introduction appropriate?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How to effectively present my information?</td>
</tr>
<tr>
<td>Synthesis</td>
<td>Organize information from multiple sources</td>
<td>How do I organize the complex information?</td>
</tr>
<tr>
<td></td>
<td>Present information</td>
<td>Can I remove information which cannot answer my questions?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How to present my findings?</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Judge the result (effectiveness)</td>
<td>Do I complete the job requirements?</td>
</tr>
<tr>
<td></td>
<td>Judge the process (efficiency)</td>
<td>Do I check this work careful?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is this my best work?</td>
</tr>
</tbody>
</table>

Note. From (C. S. Chang & Weng, 2005; Eisenberg, 2003)

The application of the Big 6

Hsieh (2009) provided some strategies for the application of the Big 6:
1. Use the theme to design, and teaching period hours at least two weeks or more.
2. Use multiple teaching media and multiple methods of assessment.
3. Use computer and information technology is the important ability to learn in the Big 6.
4. Guide students to quest and answer by themselves in the course of each step, and make sure that students understanding the importance of six steps.
5. Big 6 teach students learn how to learn. The process is nonlinear, circular or web-type process.
6. Big 6 combined the learning of knowledge contents, technology-based learning process and the training of critical thinking and innovative ideas.
7. It is the most important to define problems. Students can use the mind map, diagram or organizational chart network approach help themselves to present the problems.
8. Teachers need to teach students how to search the information, and pay attention to whether students over-reliance on network resources.
9. Students have a basic experience to use of network resources, but they also need to learn how to find and use information appropriately.

Therefore, the use of Big 6 for teaching, researchers need to realize the object and subject of teaching, to use information retrieval, sorting and diverse collection of ways to correct the problem, and finally to assess problem-solving integrity, in order to obtain a series of complete knowledge construction process.

METHODOLOGY

Design and Procedure

In this study, researchers selected the Kaohsiung Museum of History Digital archive resources of memories of the city into the technology educations learning activity. With the Big 6 teaching strategy, the learning activity was developed. The experimental learning activity was conducted at 2 hours per week and continued for 8 weeks.

Measures

Two research tools were applied for assess students’ technology education learning achievement and information literacy. Achievement of technology
education assessment tool was designed according to the learning activity. Information literacy assessment tool was adopted “Elementary Information Literacy Self-assessment” created by (Hsieh, 2009). On the other hand, researchers collected evidence about students’ learning profiles and relevant literacy to conduct triangulation analysis.

Participants

The subjects were 158 fifth grade students from five classes at an elementary school in Kaohsiung. Participants were introduced the operating of the certain e-book and verified their ability of operating the e-book before research activity.

FINDINGS

Conceptual Framework

A proposed way to integrating digital archive e-book into technology education was designed according to the theory of technology education and Big 6 strategy.

- Selecting digital archive resources according to the context requirements of technology education.
- Design Big 6 activity to apply digital archive resources in learning technology education.

A Conceptual framework of collaborating Digital Archive E-book and Technology Education was illustrated in Figure 2. For fulfill the need of learning the content technology education, selected digital archive resource was blended into learning process through Big 6 strategy.

**Table 3: t-test result of information literacy**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>score</td>
<td>3.30</td>
<td>.46</td>
<td>21.72</td>
<td>157</td>
<td>.000</td>
</tr>
<tr>
<td>average</td>
<td>2.5</td>
<td>.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.*** p < .001

Achievement of Technology Education Learning Activity

A pretest and posttest method was used for identify the learning achievement. In Table 4, a paired T-test was applied to verify the score difference between pre-test and post-test. The significant level was reached. According to the two-tailed test, pretest score was significantly higher than the post score (t = 11.70, p < .001). This result reveal that the applying of digital archive resources in the Big 6 Technology learning activity could promote students’ performance in the Technology education.
A Value-added Applicable Way to Integrate Digital Archive E-Book and Technology Education

Table 4: Pair t-test of pre-test and post-test of technology learning achievement

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pretest</td>
<td>3.52</td>
<td>1.61</td>
<td>11.70</td>
<td>128</td>
<td>.000</td>
</tr>
<tr>
<td>post-test</td>
<td>5.64</td>
<td>1.55</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *** p < .001

DISCUSSIONS AND CONCLUSION

The balance between supporting and consuming is always a problem to the industry. In this knowledge world, information needs to be gathered for use. Creating a value-added situation would be a worthy work. The fruitful digital archive resources from the project of TELDAP provide lots well deigned materials to educators. In technology education, the foundation of technology learning is context. The digital archive resources could play a role in technology learning via on-purpose selecting and Big 6 learning strategy.

The digital archive resources jointed together by the TELDAP project were created critically at professional quality. That information is strictly reliable and with high correction. From cognition point of view, the resource provides not only fact knowledge, procedural knowledge, and conceptual knowledge, but also meta-knowledge if applied the Big 6 strategy to guide learners.

A win-win digital archive resource application in technology education was demonstrated in this study.

To the learner, both content of technology education and information literacy of digital archive were gained by learners. Both education goal and real-world knowledge of digital archive resource were provided to the learners.

The re-useable characteristic of digital information could be introduced into education system via the path designed in this study. It is hoped that through cooperating digital archive resource and educational application, the Win-Win situation could be established. The instructional style would be transferred from textbook oriented to multi-resource oriented.

The theory model of technology learning provides a significant hint on applying digital archive resources as context of technology. The context is a foundation portion of learning technology.

Based upon the statistical finding of learning achievement, it is concluded that learning activity with digital archive e-book could provide positive learning result. The Big 6 learning strategy provided well organized steps for the instructor maintaining learning direction of students and opportunities cooperated with digital archive resource.

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Supporting students’ brainstorming using an augmented social network service and exploring their intention to use it

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² Department of Network Multimedia Design, Hsing Kuo University of Management, No. 600, Sec. 3, Taijiang Boulevard, Tainan, 709, Taiwan

ABSTRACT

Social network services are regarded as a suitable tool for learning, since they provide virtual spaces where students can gather to discuss, interact, and share ideas, and thus can be used as platforms to undertake brainstorming without space or time limitations. Brainstorming is an important method in the teaching process, giving teachers a way of helping students generate creative ideas to overcome the barriers to learning that they encounter. However, there is little research on brainstorming over social network services. In this study, we developed an augmented social network service (ASNS) to support students when undertaking brainstorming, and investigated the factors related to their intention to use this system. A research model based on individual perceptions and social influence is constructed to explore the students’ intention to use the ASNS. The results indicate that (1) perceived usefulness and subjective norm have a positive and significant influence on the students’ intention to use the system; (2) perceived ease of use, perceived interaction, group norm, and social identity do not have a significant influence on the students’ intention to use the system. The results imply that the ASNS is as a feasible tool to support brainstorming, although it still faces some challenges.

Keywords: computer-mediated communication, interactive learning environments, multimedia/hypermedia systems

INTRODUCTION

Social network services provide individuals with a way to map their social relations. A social network consists of actors and ties (Garton, Haythornwaite, & Wellman, 1997; Pfeil & Zaphiris, 2009), with the actors including people, organizations, and nations, and the ties indicating the relationships among these ties. The relationships involve three characteristics: content, direction and strength (Garton et al., 1997). The content means that the relation between the actors, which depends on the exchange of information or resources, such as work-related information or emotional support (Pfeil & Zaphiris, 2009). The direction signifies that the relation between the actors, which often involves a direction, although this is not necessary (Pfeil & Zaphiris, 2009). The strength represents the strength of the ties between the actors, such as the frequency of contact, and the importance or the amount of the exchanged information (Garton et al., 1997; Pfeil & Zaphiris, 2009). The actors and ties can thus be used to characterize social relations as a social network.

Researchers have used social network services for numerous applications and investigations. For example, many studies used instant messaging services, such as MSN, in educational contexts, and their results showed that such tools can help the students’ discussion (Kinzie, Whitaker, & Hofer, 2005), promote online participation (Hrastinski, 2006), and enhance learning achievement (Hwang, Huang, & Wu, 2011). In addition, some educators have used blogs in educational applications (Hou, Chang, & Sung, 2009), and explored their effects in this context (Huang, Huang, & Fu, 2011). Blogs have also been explored with regard to the feasibility of their use in mobile learning (Huang, Jeng, & Huang, 2009), which has led to the investigation of microblogs (Ebner, Lienhardt, Rohs, & Meyer, 2010). Recently, Facebook has become the most popular social network service, and while some research has shown that it can encourage students to readily embrace learning (Hew, 2011; Mazman & Usuel, 2010), other work has found that students’ intention to use the Facebook in this context has been shown to be significantly influenced by social factors (Cheung, Chiu, & Lee, 2010).

A number of studies have shown that social network services are a promising way to support the students’ learning, because they can provide a virtual space that enables students to discuss and share ideas to overcome learning barriers (Raacke & Bonds-Raacke, 2008; Wang, Woo, Quck, Yang, & Liu, in press). That is to say, social network services can be used as a tool to support brainstorming, which refers to a method by which a group attempts to find a solution to a specific problem by gathering all the ideas spontaneously generated by its members (Hitchings & Cox, 1992; Osborn, 1963). During brainstorming, participants are encouraged to express as many ideas as possible so as to build upon those of other members. Accordingly, both the quantity and quality of ideas generated by group brainstorming can be expected to outperform those of ideas generated by individuals (Osborn, 1963). More importantly, brainstorming can boost students’ diverged and induced thinking (Jang, 2009). Diverged thinking can help create a novel idea, whereas induced thinking can cultivate students’ capability from problems to synthesize, induce, and select an idea. Brainstorming is
widely used in a variety of contexts, such as teaching and learning (Ardaiz-Villanueva, Nicuesa-Chacón, Brene-Artazcoz, Lizarraga, & Ba quedano, 2011), because it provides teachers with a way of helping students to develop creative ideas to overcome any barriers to learning that they encounter.

Although there has been much research on social network services, little effort has been devoted to applying them to support students’ brainstorming, although several studies have used other technologies for this purpose (Michinov & Primois, 2005; Pissarra & Jesuino, 2010). Based on the survey of social network services in the previous paragraph, it can be observed that the learning trends are gradually evolving into the greater use of social network services (Huang, Huang, Liu, Tsai, in press). Social network services enable students to share and exchange ideas to collaboratively solve problems of learning (Raacke & Bonds-Raacke, 2008; Wang et al., in press). More importantly, such services lead students to more readily embrace e-learning in formal education, since they spend a lot of time online in their leisure hours (Baran, 2010; Mazman & Usluel, 2010). However, there have so far been no studies that support student experiences with brainstorming in a social network service context, and this is the gap in the literature that this study aims to address.

In this study, we developed an augmented social network service (ASNS) to support the students’ brainstorming. Osborn (1963) proposed four rules with regard to brainstorming: (1) focus on quantity, (2) withhold criticism, (3) welcome unusual ideas, and (4) combine and improve ideas. The first rule is to encourage participants to generate as many ideas as possible, since this increases the chance of producing an effective solution. The second rule is to ask participants to reserve their criticism of ideas, even if they seem far-fetched, radical, or silly. The third rule is to stimulate participants to think out of the box, forgo assumptions, and look at the problem from new perspectives in order to produce better ideas. The fourth rule is to inspire participants to combine several good ideas to make a better one. To assist students in practicing these rules, a blog, MSN, and Facebook were used to implement the ASNS to support their brainstorming. The ASNS can help students in expressing their ideas and exchanging opinions in order to generate many more ideas. In addition, students can use the ASNS to send their ideas to other social network services, so as to obtain some more novel ideas that can further stimulate them. Finally, the ASNS can help students to immediately discuss how to combine several ideas into one better one. To examine whether students actually intend to use the ASNS to perform brainstorming, a research model based on individual perceptions (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989) and social influence (Bagozzi & Dholakia, 2002; Dholakia, Bagozzi, & Pae ro, 2004) was constructed in order to explore what factors influence this. Finally, a series of analyses were carried out to examine the model, and a number of conclusions were made based on the results of these.

### AUGMENTED SOCIAL NETWORK SERVICE

#### The development of the ASNS

In this study, the ASNS was developed to help students perform brainstorming, based on the integration of a blog, MSN, and Facebook. Blogs are a personal authoring platform that enables students to share their thoughts and collect the comments of others (Huang et al., 2011; Huang et al., 2009). MSN is an instant messaging tool that enables students to immediately discuss their opinions with others (Hwang et al., 2011), while Facebook allows them to share their ideas to obtain more feedback (Mazman & Usluel, 2010). The features of blogs, MSN, and Facebook are summarized in Table 1, with all three integrated into the ASNS via an open-source blog platform (Drupal, 2011), an MSN toolkit (MSNPSharp, 2011), and a Facebook plug-in (Service links, 2011).

<table>
<thead>
<tr>
<th>Social network service</th>
<th>Authoring support</th>
<th>Immediate discussion</th>
<th>Number of users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blogs</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>MSN</td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Facebook</td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

#### Demonstration of the ASNS

In this subsection, we present the procedure for using the ASNS to perform brainstorming. This procedure is shown in Figure 1, and has four steps: (1) instruction in brainstorming, (2) production of a lot of ideas, (3) acquisition of unusual ideas, and (4) combination of several ideas. At the start of the procedure, teachers instruct students in the rules of brainstorming. After this, the students utilize the ASNS to follow these rules to undertake brainstorming. Specifically, the students first use the blog to produce many ideas, and thus have a "focus on quantity". They then use Facebook to acquire some novel ideas, following the practice of "welcome unusual ideas". Finally, the students use MSN to discuss how to pool several ideas to make a better idea, based on the principle of "combine and improve ideas".
In this study, the process of brainstorming begins with giving the students an assignment they need to accomplish using brainstorming. At the start of the process, the teacher introduces the principles of brainstorming and the rules proposed by Osborn (1963) to the students. Specifically, the students are told to use a blog to express as many of their ideas as possible, which the other students can then read and comment on, as shown in Fig. 2. At this time, the students are asked to refrain from any criticism of the ideas, and only propose constructive opinions in order to generate more ideas.

Once the students have generated many ideas, they can share them with their friends by clicking on the “share to Facebook” button, as shown in Fig. 2. Friends of the student can see the post on their own Facebook walls, as shown in Figure 3, and can add any comments about it that they want, thus leading to better ideas.
Figure 3: A student's message is sent to their friends' Facebook walls.

When the students have generated some good ideas, they can immediately discuss how to combine these into a better one. Specifically, the students can use the blog to comment on another student’s post, giving their opinions about combining ideas. During this period of discussion, when a certain student, such as John, wants to immediately discuss an idea with another student, such as Mary, he can check the “sent to MSN” box to send his comment to her MSN, as shown in Figure 4. Mary’s MSN will then receive a message from the blog, which includes both the ID and title of the message associated with John’s comment, as shown in Figure 5. Accordingly, Mary can use MSN to respond to John’s comment, and the response will be sent to both the blog and John’s MSN. This process can then continue, with John and Mary discussing how to combine their ideas. In short, by integrating MSN, the students can immediately exchange opinions, but they must send the ID of the article associated with their response whenever they use this system, so as to ensure the interaction is smoothly linked, as shown in Figure 5.

Figure 4: The blog interface for making a comment.
RESEARCH DESIGN

Learning and Testing Module

The ASNS was developed to support the students’ brainstorming, and thus this study was structured around the following two research questions:

1. Do students intend to use the ASNS when brainstorming?
2. What factors influence the students’ intention to use the ASNS?

Research model and hypotheses

Based on these two questions, a research model based on individual perceptions and social influence was constructed to explore the students’ intention to use the ASNS. Davis et al. (Davis, 1989; Davis et al., 1989) and Dholakia et al. (Bagozzi & Dholakia, 2002; Dholakia et al., 2004) have presented a series of studies examining the intention to use a technology. In earlier work, Davis et al. found that when individuals perceive a technology as being easy to use and useful, they will embrace it. Later, Dholakia et al. revealed that when individuals perceive that others are using a technology or encouraging them to do so, they also intend to use it. Accordingly, the individuals’ intention to use a technology is influenced not only by their own perceptions, but also the actions and opinions of those around them, so that individual perceptions and social influence are considered as possible factors that affect the students’ intention to use the ASNS. Figure 6 shows the research model, which contains six hypotheses, described in more detail below.

![Figure 6: The research model.](image)

Individual perceptions are an individual’s feelings about a technology when they use it, and these are
widely used in the literature to explain the intention to use a technology (Davis, 1989; Davis et al., 1989; Liu, Chen, Sun, Wible, & Kuo, 2010; Swan, 2001). Davis et al. (Davis, 1989; Davis et al., 1989) proposed perceived ease of use and perceived usefulness to explain the intention to use a technology. Perceived ease of use refers to whether a person believes that using a technology will require much effort, while perceived usefulness refers to whether a person believes that using a technology will enhance his/her performance (Davis, 1989). Subsequently, other researchers found that the intention to use a technology is also influenced by perceived interaction, especially for Internet technology (Liu et al., 2010; Swan, 2001). Perceived interaction refers to a person's belief about whether using a technology will help them to interact with others. Accordingly, perceived ease of use, perceived usefulness, and perceived interaction are used in this work to explore the students' intention to use the ASNS.

In this study, we integrated a blog, MSN, and Facebook into the ASNS. Previous studies revealed that these technologies are widely used among students to share information (Hou et al., 2009; Huang et al., 2011), discuss opinions (Hwang et al., 2011; Kinzie et al., 2005), and promote social interaction (Cheung et al., 2010; Hew, 2011; Mazman & Usuel, 2010). Accordingly, based on the above studies, we expect that perceived ease of use, perceived usefulness, and perceived interaction, have a positive and significant influence on the intention of students to use the ASNS. Therefore, the following three hypotheses are proposed:

**H1.** Perceived ease of use has a positive and significant influence on intention to use the ASNS.
**H2.** Perceived usefulness has a positive and significant influence on intention to use the ASNS.
**H3.** Perceived interaction has a positive and significant influence on intention to use the ASNS.

Social influence signifies that the individuals’ thoughts, feelings, attitudes, or behaviors are influenced by social interaction, and is widely used to explain the intention to use a technology (Bagozzi & Dholakia, 2002; Cheung & Lee, 2010; Dholakia et al., 2004; Shen, Cheung, Lee, & Chen, 2011). Kelman (1958) proposed the three processes of social influence: compliance, internalization, and identification. Compliance occurs when individuals accept social influence because they want to get support or approval from others (Kelman, 1958; Shen et al., 2011). Internalization occurs when individuals accept social influence because both their goals and the values are similar to those of others (Kelman, 1958; Shen et al., 2011). Finally, identification occurs when individuals accept social influence because they hope to establish and maintain a positive relationship with others (Kelman, 1958; Shen et al., 2011).

Bagozzi and Lee (2002) proposed a model of social influence based on Kelman (1958). In their model, subjective norm is used to reflect the process of compliance, and refers to “the expectations from most people who are important to me think I should or should not perform the act” (Venkatesh & Davis, 2000). Group norm is used to reflect the process of internalization, and refers to “a shared agreement among participants about their shared goals and expectations” (Shen et al., 2011).

Social identity is used to reflect the process of identification, and refers to “a part of individuals’ self-concept that derives from members’ knowledge in a social group together with the value and emotional significance attached to that membership” (Tajfel, 1978). Social identity involves three components: cognitive social identity, affective social identity, and evaluative social identity (Ellemers, Kortekaas, Ouwkerk, 1999). Cognitive social identity refers to a cognitive awareness of one’s membership in a social group, and is based on the process of self-categorization (Bagozzi & Dholakia, 2002; Ellemers et al., 1999). Affective social identity refers to a sense of emotional involvement with the group, and is a form of affective commitment (Bagozzi & Dholakia, 2002; Ellemers et al., 1999). Evaluative social identity refers to the positive and negative values attached to group membership, and thus is an evaluation of self-worth based on belonging to a particular group (Bagozzi & Dholakia, 2002; Cheung & Lee, 2010; Ellemers et al., 1999). In this study, the teacher plays an important role in asking the students to use the ASNS to perform brainstorming to complete an assignment, and thus the students use the system in a group in order to achieve a common goal. This means that the subjective and group norms have a positive and significant influence on the intention of the students to use the ASNS. Furthermore, in the brainstorming process, social identity gradually arises through interaction with other members in the ASNS. Accordingly, based on the above studies, we expect that subjective norm, group norm, and social identity have a positive and significant influence on the intention of students to use the ASNS, and thus the following hypotheses are proposed:

**H4.** Subjective norm has a positive and significant influence on intention to use the ASNS.
**H5.** Group norm has a positive and significant influence on intention to use the ASNS.
**H6.** Social identity has a positive and significant influence on intention to use the ASNS.

**Participants**

A structured questionnaire was developed based on a review of prior studies (Cheung & Lee, 2010; Davis, 1989; Davis et al., 1989; Liu et al., 2010; Shen et al., 2011), as well as feedback from two experts. The questionnaire included the following seven constructs: perceived ease of use, perceived usefulness, perceived interaction, subjective norm, group norm, social identity, and intention. The questionnaire was distributed to the participants, who were told to complete it by indicating their level of agreement with a number of statements using a seven-point Likert scale, as shown in Appendix A.

**Procedure**

At the beginning of the procedure, the teacher gave the participants a lesson on the design of multimedia materials, and then asked them to accomplish an assignment in two weeks. The assignment was to design of multimedia materials to teach traffic safety. During the class period, the teacher asked the participants to use the ASNS for brainstorming to achieve the assignment. When the
assignment was completed, the participants were asked to complete the questionnaire, and based on the results of this the proposed research model was examined.

RESULTS AND DISCUSSION

The measurement was examined by item loadings, convergent validity, the reliability of measures and discriminant validity. An item is considered to be reliable if its loading is greater than 0.70 (Chin, 1998). The convergent validity was assessed by examining the average variance extracted (AVE), which must exceed the standard minimum level of 0.5 (Hair, Black, Babin, Anderson, & Tatham, 2006). The reliability of the measures was assessed by examining the composite reliability and Cronbach’s alpha, and the values of these must be greater than the standard minimum level of 0.7 (Hair et al., 2006). The discriminant validity is evaluated by the square root of AVE and latent variable correlations (Fornell & Larcker, 1981), in which the square root of AVE of each construct should exceed the correlation shared between one construct and other constructs in the model. Tables 2 3 and 4 show the results for the item loadings, convergent validity, reliability of measures, and discriminant validity. The results reveal that all the criteria exceeded the threshold suggested in the previous research, and thus a satisfactory measurement model was successfully obtained.

Table 2: The item loadings of the measurement model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Loading</th>
<th>Standard deviation</th>
<th>Standard error</th>
<th>T-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived ease of use</td>
<td>(1)</td>
<td>0.961</td>
<td>0.014</td>
<td>0.014</td>
<td>65.246</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.974</td>
<td>0.005</td>
<td>0.005</td>
<td>187.756</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>(1)</td>
<td>0.978</td>
<td>0.005</td>
<td>0.005</td>
<td>95.558</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.978</td>
<td>0.005</td>
<td>0.005</td>
<td>183.335</td>
</tr>
<tr>
<td>Perceived interaction</td>
<td>(1)</td>
<td>0.929</td>
<td>0.027</td>
<td>0.027</td>
<td>33.929</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.949</td>
<td>0.009</td>
<td>0.009</td>
<td>95.558</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>(1)</td>
<td>0.975</td>
<td>0.007</td>
<td>0.007</td>
<td>126.670</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.973</td>
<td>0.008</td>
<td>0.008</td>
<td>114.423</td>
</tr>
<tr>
<td>Group norm</td>
<td>(1)</td>
<td>0.983</td>
<td>0.006</td>
<td>0.006</td>
<td>154.695</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.985</td>
<td>0.004</td>
<td>0.004</td>
<td>197.775</td>
</tr>
<tr>
<td>Social identity</td>
<td>(1)</td>
<td>0.879</td>
<td>0.027</td>
<td>0.027</td>
<td>32.377</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.861</td>
<td>0.029</td>
<td>0.029</td>
<td>28.869</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>0.858</td>
<td>0.034</td>
<td>0.034</td>
<td>25.003</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
<td>0.792</td>
<td>0.064</td>
<td>0.064</td>
<td>12.306</td>
</tr>
<tr>
<td></td>
<td>(5)</td>
<td>0.813</td>
<td>0.059</td>
<td>0.059</td>
<td>13.575</td>
</tr>
<tr>
<td></td>
<td>(6)</td>
<td>0.824</td>
<td>0.054</td>
<td>0.054</td>
<td>15.070</td>
</tr>
<tr>
<td>Intention</td>
<td>(1)</td>
<td>0.964</td>
<td>0.011</td>
<td>0.011</td>
<td>80.402</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>0.968</td>
<td>0.008</td>
<td>0.008</td>
<td>120.701</td>
</tr>
</tbody>
</table>

Table 3: Both the convergent validity and the reliability of measure of the measurement model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Convergent validity</th>
<th>Reliability of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AVE</td>
<td>Composite reliability</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>0.935</td>
<td>0.966</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>0.956</td>
<td>0.977</td>
</tr>
<tr>
<td>Perceived interaction</td>
<td>0.882</td>
<td>0.937</td>
</tr>
<tr>
<td>Subjective norm</td>
<td>0.948</td>
<td>0.973</td>
</tr>
<tr>
<td>Group norm</td>
<td>0.967</td>
<td>0.983</td>
</tr>
<tr>
<td>Social identity</td>
<td>0.702</td>
<td>0.933</td>
</tr>
<tr>
<td>Intention</td>
<td>0.933</td>
<td>0.965</td>
</tr>
</tbody>
</table>

Table 4: The discriminant validity of the measurement model

<table>
<thead>
<tr>
<th>Latent variable correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>Perceived ease of use</td>
</tr>
<tr>
<td>Perceived usefulness</td>
</tr>
<tr>
<td>Perceived interaction</td>
</tr>
<tr>
<td>Subjective norm</td>
</tr>
<tr>
<td>Group norm</td>
</tr>
</tbody>
</table>
Supporting students’ brainstorming using an augmented social network service and exploring their intention to use it

<table>
<thead>
<tr>
<th>Social identity</th>
<th>0.588</th>
<th>0.637</th>
<th>0.723</th>
<th>0.597</th>
<th>0.550</th>
<th>0.837</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention</td>
<td>0.731</td>
<td>0.846</td>
<td>0.779</td>
<td>0.799</td>
<td>0.648</td>
<td>0.679</td>
</tr>
</tbody>
</table>

Structural model

The structural model is tested by assessing the $R^2$ value and path coefficients (Chin & Newsted, 1999). The $R^2$ value is used to evaluate the ability of the model to explain the variance in the dependent variables. The path coefficients are used to assess the statistical significance of the hypothesized paths (Hair et al., 2006). Figure 7 shows the results for the structural model, which explains 78.7% of the variability in intention. Six path coefficients are given in Figure 7. The path coefficient between perceived ease of use and intention is 0.037, $p > 0.05$, which indicates that H1 is rejected. The path coefficient between perceived usefulness and intention is 0.379, $p < 0.05$, which indicates that H2 is supported. The path coefficient between perceived interaction and intention is 0.134, $p > 0.05$, which indicates that H3 is rejected. The path coefficient between subjective norm and intention is 0.272, $p < 0.05$, which indicates that H4 is supported. The path coefficient between group norm and intention is 0.040, $p > 0.05$, which indicates that H5 is rejected. The path coefficient between social identity and intention is 0.135, $p > 0.05$, which indicates that H6 is rejected. The results show that there only two hypotheses are supported, H2 and H4. Consequently, while the students intended to use the ASNS to perform brainstorming, their intention was only influenced by perceived usefulness and subjective norm.

![Figure 7: The results of the structural model.](image)

Note: Marked coefficients * are significant at $p<0.05$ ($T>1.96$)
Marked coefficients N.S. are non-significant at $p>0.05$ ($T<1.96$)

Structural model

H1 was rejected, and thus perceived ease of use did not have a significant influence on the intention of students to use the ASNS. One possible reason for this may be that the students did not think that the ASNS was easy to use, as the way it used MSN was slightly different to the normal practice. Specifically, the students had to send the ID of a blog post and their response when they used MSN to respond to a message, and the students needed some time to get used to this process. A previous study indicated that the integration of technologies is often not easy, as users will at first be unfamiliar with how to use the new system, although this problem will be reduced over time (Akbaba-Altun, 2006). In this study, the novel use of MSN caused some confusion and inconvenience for the students, and thus reduced the perceived ease of use of the ASNS, leading to the rejection of H1.

However, H2 is supported, and thus perceived usefulness had a positive and significant influence on the intention of students to use the ASNS. This implies that the students thought the system was useful to support their brainstorming, which reflects the results of some earlier studies of social network services. For example, Hou et al. (2009) and Huang et al. (2011) indicated that blogs are useful for cooperatively constructing knowledge, while Hwang et al. (2011) revealed that MSN can facilitate immediate interaction among students. Both Hew (2011) and Mazman and Usluel (2010) showed that Facebook is useful in promoting the social interaction among students. In this study, the ASNS was developed to enable students to use a blogs to share ideas and comments, MSN to discuss their opinions, and Facebook to obtain more feedback. The use of these three systems may thus have caused the students to perceive the usefulness of the ASNS, leading to the support found for H2.

H3 was rejected, and thus perceived interaction did not have a significant influence on the intention of students to use ASNS. One reason for this is that students did not perceive any significant interaction occurring among them, and this can be seen in the ASNS log. Figure 8 shows these logs, and the proportion of comments made by each student. It can be seen that only
a few students made most of the comments, with 20% responsible for 70% of them, and thus most students remained passive when using the system. One reason for this may be that the real identities of the students were exposed when using the ASNS, and an earlier study has shown that this can lead to conflicts among peers that may inhibit participation (Preibusch, Hoser, Gürses, & Berendt, 2007). Another study also showed that users prefer to be anonymous when participating in an online community, because they do not have to worry about making a commitment when making comment (Preece, Nonnecke, & Andrews, 2004). Nunamakar et al. (1991) also have mentioned that anonymity may encourage members to challenge others for possible faults and achieve a more objective evaluation. More importantly, anonymity may provide less skilled members with a low threatening or comfortable environment, where they are more willing to participate in the discussion. In this study, the real identities of the students were not hidden, and this may have made them unwilling to interact with each other, leading to a low level of interaction, and thus the rejection of H3.

![Figure 8: The logs of the ASNS.](image)

In contrast, H4 was supported, and this subjective norm had a positive and significant influence on the intention of students to use the ASNS. This implies that students complied with the expectation of the teacher to use the ASNS, as expected based on the study of social influence. In the model of social influence (Bagozzi & Lee, 2002), subjective norm implies that “the expectations from most people who are important to me think I should or should not perform the act” (Venkatesh & Davis, 2000). In this study, the teacher was the most important person for the students, they followed the teacher’s request to use the ASNS to perform brainstorming. Accordingly, the students’ intention to use the ASNS was influenced by the teacher, supporting H4.

Finally, H5 and H6 were both rejected, and thus group norm and social identity did not have a significant influence on the intention of students to use the ASNS. One possible reason for this is that there was not much interaction among the students, as noted above. In the model of social influence (Bagozzi & Lee, 2002), group norm implies “a shared agreement among participants about their shared goals and expectations” (Shen et al., 2011); social identity implies that “a part of individuals’ self-concept that derives from members’ knowledge in a social group together with the value and emotional significance attached to that membership” (Tajfel, 1978). In this study, the shared goal among students was to perform brainstorming to design multimedia material to teach traffic safety. However, most students were unwilling to participate in brainstorming, and this may have been because the lack of anonymity in ASNS made them more cautious about commenting on the ideas of their peers (Preece et al., 2004). Accordingly, the sense of a shared goal and belonging to a social group were hard to form, leading to the lack of support for H5 and H6.

**CONCLUSION**

Social network services have considerable potential for use in various educational applications. In this paper, we developed the ASNS to assist students in performing brainstorming. To explore the students’ intention to use the ASNS, individual perceptions and social influence were applied to construct the research model, and then partial least squares approach was used to verify it. The results showed that the students’ intention to use the ASNS was influenced significantly by perceived usefulness and subjective norm.

Four practical implications drawn from this study may have some value for teachers, instructional software designers, and researchers. First, the results revealed that students perceived that the ASNS was useful for performing brainstorming. This implies that teachers may use such tools to support the students’ brainstorming in order to assist them to cooperatively construct knowledge. Second, our results showed that the teacher was able to play an influential role in promoting the use of the instructional software (i.e., the ASNS). This implies that teachers should try their best to encourage students to use such software in order to successfully achieve the intended outcomes. Third, the majority of students in this study were unwilling to use the ASNS to participate in brainstorming, since their real identities were revealed when using the system. This implies that teachers should give students the option to remain anonymous and to choose a pseudonym when...
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using such tools, but teachers also should take more care over the situation of free riding, which is hardly detected as usual. Fourth, the way MSN was used in this study was unfamiliar to the students, and thus it was perceived as inconvenient and confusing. This implies that instructional software designers or researchers should not introduce novel ways of interacting with existing technologies, and, if they need to do so, should always make these ways as user-friendly as possible, or else they are likely to be neglected.

The limitations of this study include the type of the measurements used and the relatively small sample size. Specifically, all of the measurements in this study were limited to the students’ self-reported perceptions, and future work in this area should introducing additional measures to examine the students’ intention to use the ASNS. Furthermore, a larger sample size should be used to strengthen the current findings about the use of the ASNS
Appendix A. The questionnaire

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Scale (seven-point)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived ease of use</td>
<td>(1) I think that this system is easy to use.</td>
<td>disagree-agree</td>
<td>Davis, 1989;</td>
</tr>
<tr>
<td></td>
<td>(2) I think that the functions of this system are clear.</td>
<td>disagree-agree</td>
<td>Davis et al., 1989</td>
</tr>
<tr>
<td>Perceived usefulness</td>
<td>(1) I think that using this system can promote the efficacy of collaborative assignment.</td>
<td>disagree-agree</td>
<td>Davis, 1989;</td>
</tr>
<tr>
<td></td>
<td>(2) I think that using this system can promote the quality of collaborative assignment.</td>
<td>disagree-agree</td>
<td>Davis et al., 1989</td>
</tr>
<tr>
<td>Perceived interaction</td>
<td>(1) I can use this system to provide others with comments.</td>
<td>disagree-agree</td>
<td>Liu et al., 2010</td>
</tr>
<tr>
<td></td>
<td>(2) I can use this system to obtain comments from others.</td>
<td>disagree-agree</td>
<td></td>
</tr>
<tr>
<td>Subjective norm</td>
<td>(1) Most people who are important to me think that I should use this system.</td>
<td>disagree-agree</td>
<td>Cheung &amp; Lee, 2010;</td>
</tr>
<tr>
<td></td>
<td>(2) Most people who are important to me approve of me using this system.</td>
<td>disagree-agree</td>
<td>Dholakia et al., 2004; Shen et al., 2011; Cheung &amp; Lee, 2010;</td>
</tr>
<tr>
<td>Group norm</td>
<td>Using this system for brainstorming is viewed as a goal.</td>
<td>weak-strong</td>
<td>Dholakia et al., 2004; Shen et al., 2011; Cheung &amp; Lee, 2010;</td>
</tr>
<tr>
<td></td>
<td>(GN1) Please indicate that the degree to which you agree with the goal.</td>
<td>weak-strong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(GN2) Please indicate that the degree to which for your group members agree with the goal.</td>
<td>weak-strong</td>
<td></td>
</tr>
<tr>
<td>Social identity</td>
<td>When I use this system for brainstorming.</td>
<td></td>
<td>Cheung &amp; Lee, 2010;</td>
</tr>
<tr>
<td></td>
<td>(SI1) I think that I and my members have the same image.</td>
<td>disagree-agree</td>
<td>Dholakia et al., 2004; Shen et al., 2011;</td>
</tr>
<tr>
<td></td>
<td>(SI2) I think that I and my members have the same style.</td>
<td>disagree-agree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(SI3) Please indicate that the strength of your attachment to the group.</td>
<td>weak-strong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(SI4) Please indicate that the strength of your feeling of belonging to the group.</td>
<td>weak-strong</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(SI5) I think that I am a valuable member.</td>
<td>disagree-agree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(SI6) I think that I am a significant member.</td>
<td>disagree-agree</td>
<td></td>
</tr>
<tr>
<td>Intention</td>
<td>(BI1) I hope that other courses also use this system to perform brainstorming.</td>
<td>disagree-agree</td>
<td>Davis, 1989;</td>
</tr>
<tr>
<td></td>
<td>(BI2) When I have another assignment, I will use this system to perform brainstorming.</td>
<td>disagree-agree</td>
<td>Davis et al., 1989</td>
</tr>
</tbody>
</table>
REFERENCES


Supporting students’ brainstorming using an augmented social network service and exploring their intention to use it

AUTHORS

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Social networks-based adaptive pairing strategy for cooperative learning

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ABSTRACT

It is generally believed that the very first e-book can be dated back to the study of Hart in 1971. That was more than 40 years ago. At that time, e-book is not as popular as expected, but the popularity has been grown explosively over the past ten years. More and more people enjoy the brand new experience an e-book brings to them, but the traditional e-book is plenty of room for improvement. One of the reasons is that the book has to be read page by page; thus, it is not easy to grasp the overall structure of such a book. As such, we propose a novel system based on the term frequency-inverse document frequency (TF-IDF) to automatically create the keyword concept map for each section of the book. Moreover, in addition to showing the context where each keyword in the concept map is located, with each keyword in the concept map is associated a hyperlink, to make it easy for a reader to move to the context associated with the keyword. Equipped with the keyword concept map and the hyperlink associated with each keyword, it can be expected that the learning achievement of the reader can be raised. Our experimental results show that the proposed e-book system with the keyword concept map can provide a better learning result than a tradition e-book does in terms of both the scores received after learning and practicing and the results of satisfaction questionnaire on learning, practicing, and system satisfaction.

Keywords: E-book, Concept map, TF-IDF

INTRODUCTION

The e-book (Woody, Daniel, & Baker, 2010) typically can be regarded as a product of book after digitization which means that e-book is composed of any kinds of digitized content. A precisely definition (PC magazine encyclopedia) is that a book can be read by the interactive digital devices, such as These devices might be desktop computer, cell phone, tablet. The basic concept of interactive for e-book means that is not only the digital contents for the audience, but also a smart device. From the way to display the images and audios, interactive multimedia, to smart aids, these works usually are impossible missions for paper-book. That is why with the advance of e-book, a digitized book now is become to a variety of multimedia products (Siegenthaler, Wurtz, & Groner, 2010). However, the reading styles and strategies for traditional e-book usually need to read page by page which will make the reader can not easy to grasp the overall structure of such a book. Since the number of words is not too many we can easy to understand the meaning of contents when we start with read the e-book from the first half; but most people may not be able to handle the contents of other half if contents of this book is too many (Squire, 1987). It is because our brain cannot remember everything we see and change the focus to the last part, the reader usually can not easy to comprehend the relationships of different concepts (or contents) of e-book. If the reader can not realize all the relationships of concepts, it will let him/her get some concepts like the fragments after read an e-book. Most of them will probably understand some ideas from this book, but they cannot get a big picture of this book and they also will not able to integrate these concepts. But the good news is that the contents display of e-book is not like the traditional paper-book cannot be changed, it can be added much more interactive functions to solving the problems that we cannot easy to realize all the relationships of concepts for a book.

Because the most important characteristic of e-book is it can provide the interactive using to the reader and book, it can be used to improve the learning performance of reader if concepts from different contents cannot easy be integrated to a simple concept. This paper will present a novel system by using the keyword concept map to provide an integrated viewpoint of book to make the reader can understand its overall structure. The basic idea of proposed system is try to let us can easy to understand the most things of the book very quickly by using the keywords of contents of the book when we read this book at the first time. However, the find out the keywords is difficult work if the reader is the first time to read this book. That is why the proposed system employed the term frequency-inverse document frequency (TF-IDF) (Aizawa, 2003) to calculate the frequency of word in different sections. Based on these information, the proposed then can be dynamic adjust define the frequency threshold of words to determine which words will be extracted. The proposed system then will automatically create the keyword concept map for each section of the book with

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the frequency of words. With this kind of e-book system at hand, the behavior that click different keyword can help the readers move the particular page they want, thus, reader then can easy to understand overall structure of such a book. The main contribution of the paper is that the proposed system will automatically create keyword concept to enhance the learning performance of reader.

RELATED WORK

Concept maps

Since how to enhance the learning performance is a critical problem, several tools and systems have been presented in recent years. Among them, mindtools is a computer application which can be used to show learners are in which kind of situations for learning and thinking to support them organize the knowledge they have and integrate these knowledge with other knowledge (Jonassen, 2000; Jonassen, Carr, & Yueh, 1998; Jonassen & Carr, 2000). The approaches of mindtools for education typically can be divided into five categories, which are: (1) database mindtools, (2) graph mindtools, (3) concept mapping, (4) search Internet mindtools, and (5) visualization mindtools (Averill & River Yale Public Schools, 2005). The concept mapping of them is one of well-known approaches because it an effectively knowledge visualization tool to support learner to identify and understand the structure of knowledge while it can also be widely applied to several fields (Cañas et al., 2005). From the 1980s presented by (Novak & Gowin, 1984) until now, the applications of concept map have undergone several changes and now it is become to one of useful tools for education (Erdogan, 2009). The roles of concept map for education can be the a to organize and construct the knowledge (Erdogan, 2009; G.-J. Hwang, Shi, & Chu, 2011; Yang, Hwang, Hung, & Tseng, 2013) · computer assisted instruction (Price, 2008), directed learning tool (Chu, Hwang, & Liang, 2014; Panjaburee, Hwang, Triampo, & Shih, 2010), or a tool to induce the learner study interest and initiative (G.-J. Hwang, Yang, & Wang, 2013).

Not only the traditional way by using the pen and paper to construct the concept map, but also the modern way by using the computer technologies to develop the digital concept map, much more studies shown that the concept map can be used to enhance the learning performance for the learner (Asan, 2007; G.-J. Hwang, Wu, & Ke, 2011; Yang et al., 2013). For example, Asan (2007) attempted applied the concept map to the course of natural science for the 5th grade and the results also shown that the learning performance of learner can be improved significantly when they used the concept map. Another example is that Yang et al. (2013) tried to apply the concept to cell phone by scanning the QR code of paper-book to get the concept to support student to learning (Yang et al., 2013). The final results of the study (Yang et al., 2013) also shown that this idea really can improve the student to reduce the number of content they cannot fully understand on the course. Due to one of characteristics of concept map is that it can be used to show the knowledge in our mind via the image display, compare to one the only simplest text, visualizing concepts is a better way to easy understand the content. That is why most of the logos and trademarks contain the text and images at the same time (Asan, 2007; Cicognani, 2000). Moreover, the concept map can also help us to understand the concepts and relationships from different subjects, catch up the key points quickly, and then understand the most of things of e-book (White & Gunstone, 1992).

From the perspective on the advance of information technologies to see the changes of teaching and learning ways as well as changes the learning tool, the concept map on paper become to the digital concept map is one of representative example. The advantages of digital concept map are the main reason why the several recent studies used the digital concept map to design the relevant experimentations to replace the way to drilled via paperwork. In the study of "The effects of a concept map-based information display in an electronic portfolio system on information processing and retention in a fifth-grade science class covering the Earth's atmosphere.”, Kim and Olaciregui (2008) given a discussion about the difference for performance of information processing and retention by using the concept map between traditional folder-based information display and concept map-based information display. Wu, Hwang, Milrad, Ke, and Huang (2012) also presented a novel learning strategy which integrated the digital concept map and real-time assessment and feedback to improve the learning performance of students when they are use concept map on paper but the teacher cannot quick evaluate concept maps of students to further providing the applicable feedback to students. Chu et al. (2014) in the study of "A cooperative computerized concept-mapping approach to improving students’ learning performance in web-based information-seeking activities" presented another solution to digitize the concept map to further improving the learning performance of student for web-based information-seeking activities.

Based on these perspectives, this study try to add the keyword to each section by the proposed system to support learner can easy to preview, learn, and review and then enhance the learning performance to reduce the number of unknown or unclearly concept of course.

Electronic book

In the previous stage of e-book development, the most well-known understanding is that display the contents of paper-book by digital formats (Roesnita & Zainab, 2013) while it need to be displayed on computer or e-book reader (Subba Rao, 2003). Most of studies were focused on challenges and opportunities (Cox, 2004), discussion on the electronic textbook and paper textbook (Christianson & Aucoin, 2005; Shespeerd, Grace, & Koch, 2008; Slater, 2009), and discussion on the paper-book will be disappeared or not (Höppner, Horstmann, Rahmsdorf, van der Veld, & Ernst, 2009) at that time. Even though the e-book has several useful distinguishing features (e.g., flexibility, usability, and creativity) to attracted a large number of advocates, however, it still has some studies pointed out that the students would like to learn by textbook (i.e., paper-book) not the e-book (Woody et al., 2010). Another
study (Gregory, 2008) also argued that although student will use the e-book, but they are much like to use the traditional textbook to learn the knowledge.

But the advocates of e-book and paper-book now are beginning to see these arguments will be endless if we discuss them by using different perspectives. No one can be beat the other one is become to a common consensus and consequently the research focuses have been shifted from the argues of e-book and paper-book to how to applied the e-book to which field, especially in education and learning. The changes can be easy found in recent studies. The study of Korat and Shamir (2008) presented an idea by using the e-book to support the preschoolers to emergent literacy as well as Yang et al. (2013) attempted use the smart phone to scan the QR code to get the auxiliary materials and concept map to make the user use the smart phone to be the e-book reader to read the relevant information.

In fact, Coyle (2008) has been mentioned that the key point to increase the value of e-book is how to develop the innovative technologies to make the e-book has a variety of learning methods not just only digitizing the text books. This kind of viewpoints has become to a promising research trend gradually in recent studies. Li, Chen, and Yang (2013) presented a visual cue map to solve the reading problem on e-book and the experimental results also shown their solution can be used to solve the problems of e-book on reading, reviewing, and navigational performance. Li, Fan, Huang, and Chen (2014) also presented an integrated solution to combine reading guidance module and annotation map on e-book to discussion the impacts of that kind of systems for college students. Moreover, the research focus of Lim and Hew (2014) is on the feeling of students when they use NG-eBook which has the ability to make the annotation and information sharing. In addition to the innovation, some of studies attempted make the discussion on humanity for e-book, such as the study of “Investigating E-book Reading Patterns: A Human Factors Perspective.” was focused on the different cognition styles (e.g., browsing patterns, navigation facilities, and annotation patterns) to observe the learning behavior of human (J.-P. Hwang & Huang, 2014).

With the advance of e-book (e.g., increase the value of e-book by innovation or using different analyses for cognition of human to make it more suitable for humanity), one of critical issues is how to improve the learning performance, therefore, the focus of this paper is that attempted presented a novel key concept map method to make the learner easy and simply to understand the content of e-book within a reasonable time or reduce the learning curve.

**Data Mining, Machine Learning and Information Retrieval**

The document analysis technologies typically play a key role in finding the important information for the textbook, material, examination paper and even the learning behavior of students on an e-Learning system. The well-known technologies for e-book are data mining (Fayyad, Piatetsky-Shapiro, & Smyth, 1996), machine learning (Dillenbourg, 1999), and information extraction and information retrieval (Baeza-Yates & Ribeiro-Neto, 1999). More precisely, the data mining and machine learning technologies can be used to find the hidden information from the textbook and learning behavior to provide the teacher additional information can easy to understand how to help the students improve the learning performance as well as can help the students know which part of contents need to review again to fully understand all the concepts of textbook. The information extraction technologies for e-book are usually used to be the data preprocess, such extract the most important contents of textbook and learning behavior of students. Generally speaking, the information extraction plays the role to reduce and filter the number of contents for information retrieval tool to avoid the redundant loading on the system. Since the main work of information retrieval for e-book is that understand the relationship between the contents on different sections or parts, vector space model (VSM) (Baeza-Yates & Ribeiro-Neto, 1999) would be one of important technologies for computing the similarity between contents or concepts. In addition to VSM, the other document similarity method can also be combined with other data mining techniques to give a complete analysis for text-book and e-book.

**THE PROPOSED SYSTEM**

**The Basic Idea**

As mentioned in previous, the basic idea of this study is attempt design an intelligent system to build the keyword concept map for e-book. The contents of the e-book will be loaded to our proposed system. By using the preprocessing methods (e.g., remove the irrelevant terms) and TF-IDF, the proposed system can compute the similarities of contents of each section. These information will useful to recognize the structure of the e-book. The proposed system then can used these similarities and relationships to know which section will relevant to another section. Of course, it can also find out the most important keyword from these sections by using the TF-IDF. With these information (relationship and important keyword) at hand, the proposed system then can construct the keyword concept map like as a knowledge integration map (http://en.wikipedia.org/wiki/Knowledge_integration_map). The reader on our proposed system then can easy to understand which parts are relevant. Thus, the reader will much easy to plan their reading strategy or learning path.

As shown in the Figure 1, we develop an Android APP to be the e-book reader which will load the contents of the e-book. Based on relationship and important keyword, the proposed system will able to construct the keyword concept map to improve the learning performance of reader for traditional e-book. After the proposed system (Android APP) find out the keyword from the contents of e-book, it will analyze the keyword frequency for each section and find out applicable keywords by the given threshold from teacher or expert. In other words, the high frequency or low frequency keywords must filter out. For example, if we set the range of frequency threshold is 30 to 50, the proposed system will select the keyword on this section
which at the least need to be appeared more than 30 times and not to be exceed more than 50 times. The proposed system will use frequency of these keywords to construct the keyword concept map. To make the user can easy to understand this concept map, each node of the concept map will add the keywords to explain the meaning or important concept of this node (e.g., paragraph or section). Moreover, readers can jump to the section they want to go after they click the keyword near the node.

A Simple Example

A simple example is used to explain how to use the proposed system. In this example, the contents of e-book of operating system will be used to document analysis which contains the preprocessing (i.e., information extraction) and similarity computing (i.e., information retrieval). If we set the frequency threshold between 15 to 25 times, the propose system will construct the concept map by this setting. As shown in fig. 2, the keywords are CPU, LRU, FIFO, Memory and Disk, the relationships between keywords and section provide the information to their relevance. For example, if the keywords CPU is appeared in chapter 1.1 twenty times, this information will be displayed on this connection edge (i.e., relationship). The descriptions will also be displayed near the keyword to explain where the keyword appeared in this section. It can be easy to found that the FIFO has been appeared in chapter 1.2, after click this node, the reader then can move the page of chapter 1.2. As a result, the reader can easy and quickly to find out the contents they need on the e-book and keyword concept map.
EXPERIMENT RESULTS

Participants and Experimental Procedure

The subjects are 61 students from one class of sixth grade students and then we divide them into two groups. All of these students have not been learning these materials before. One group as the students use the e-book with keyword concept map (G1) and the other group as the students use the e-book without the concept map (G2). The G1 group contains 31 students as the experimental group while G2 group contains 30 students as the control group. More precisely, the design of experimental was referred to the book of Campbell, Stanley, and Gage (1963), the students are divided into control group and experimental group, and then use the pre-test, post-test, and test after review to understand the learning performance of students. As shown in fig. 3, it can easy to recognize that seven steps will be used for the experiment in this paper which are: (1) pre-test, (2) introduction to experiment and operator procedures, e.g., questions from students and answers for these questions, (3) use the proposed system to construct the keyword concept map for e-book, (4) all the students, G1 and G2, learning by their e-books, (5) post-test, (6) review after fourteen days, and (7) the survey and test after review.

As shown in fig. 3, at the first steps, the students will divided into G1 group as the experimental group and G2 group as the control group, where the students in G1 group will use the e-book with the keyword concept map and the students in G2 group will use the e-book without the keyword concept map. Also, these two groups will conduct test at the same time. At the second step, teacher will guide all the students in this experimental how to operate the e-book they will be used to learning and answer the questions from the students. At the third step, the proposed system will analyze the contents of each section and counts the frequency (i.e., the number of times that each word in this section). The teacher will use this information to dynamic adjust the scope of frequency for sampling and use the keywords provided by the proposed system to selected applicable word to be the keyword. Finally, the proposed system will use these keywords to construct the keyword concept map of each section for e-book. At the fourth step, the students of G1 group will use the e-book with keyword concept map to learn the knowledge while the students of G2 group will use another kind of e-books (i.e., traditional e-book) to learn the knowledge. The time for learning is limited to 60 minutes. At the fifth step, the students of these two groups will be tested to evaluate their learning performance. At the sixth step, the students of these two groups have to review procedure via the e-book for twenty minutes after fourteen days. At the final step, all the students of these two groups need to be tested after the review procedure, and then we can evaluate the learning performance of them. In addition, all students need to complete a satisfaction questionnaire.

**Figure 3: The design of experimental.**

The tools

Four tools are used in this paper that are: questions for pre-test, questions for G1 and G2 after use the e-book to learn the knowledge, the questions after using the e-book to review, and a satisfaction questionnaire which based on Likert 5 point to design. The exams of pre-test, test after review, and pro-test have twenty-five questions, respectively and the perfect score is one hundred. Moreover, these question is developed by the expert in this field and e-book.

The satisfaction questionnaire

The satisfaction questionnaire for concept map of material is attempt to know can the keyword concept map able to support the students handle the content structure when they see the new materials at the first time and also yield twice the result with half the effort.
for review the materials. That is why we design a satisfaction questionnaire for concept map of material to observe the learning situation of students. This questionnaire contains fourteen items and these items can be divided into two groups: one is availability and the other one is usability which from item 1 to item 11, and item 12 to item 14, respectively. The Likert 5 point is also used to evaluate the result of this questionnaire from 1 (very disagree) to 5 (very disagree). Among them, the items of availability are used to observe the students to understand it is useful for their learning while the items of usability are used to know can the students easy to operate the proposed system.

Table 1: Questionnaire

<table>
<thead>
<tr>
<th>Rating Items</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Normal</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>By using this system, I can have a better understanding of computer science.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>The system can help me to find my learning problems.</td>
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<tr>
<td>The system can help me to understand knowledge of computer science I learn.</td>
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<tr>
<td>Through this system, I can think more extensible subjects of computer science.</td>
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<tr>
<td>Functions provided by the system are favorable for my learning.</td>
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<tr>
<td>Through feedbacks of the system, I can understand more knowledge about computer science.</td>
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<tr>
<td>Through feedbacks of the system, I can systematize my learning to knowledge about computer science.</td>
<td></td>
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</tr>
<tr>
<td>Through feedbacks of the system, I can focus on my learning.</td>
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</tr>
<tr>
<td>Feedbacks provided by the system can help me to revise the wrong idea.</td>
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<tr>
<td>Through feedbacks of the system, I can have a better understanding of concepts I didn’t understand completely before.</td>
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<tr>
<td>Information provided by the system can help me to have a better learning performance.</td>
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<tr>
<td>I can easily receive information through this system on mobile devices.</td>
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<tr>
<td>The interface of system can be operated easily.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can quickly learn to operate this system.</td>
<td></td>
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</tbody>
</table>

Results of Learning Performance

Tables 1 and 2 show the pre-test and post-test results of the experimental control and experimental groups. In the average score of pre-test we can understand the prior knowledge of control group G2 is better than experimental group G1. But the post-test results after the experimental shown a different situation that is the average score of experimental group G1 is better than control group G2. More precisely, the average score of experimental groups G1 is 81.68 which is better than the average score of control group G2 72.93 with p-value 0.027. These results shown that by using the keyword concept map will able to improve the learning performance significantly. In the other side, after fourteen days of the post-test, the students of these two groups will use their e-book to review and complete the test after the review, respectively. The results also shown that the students (G1) used the keyword concept map for the review can get better average score than the student of G2 group who do not use the keyword concept map, i.e., the averages of G1 is 83.13 and G2 is 75.33 with p-value 0.014. It means that if the e-book provide keyword concept map to support the student to review can significant to enhance the learning performance of students. In summary, the students can get better performance for learning and review when the traditional e-book adopts the keyword concept map.

Table 2: Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreTest</td>
<td>1</td>
<td>66.84</td>
<td>12.461</td>
<td>2.238</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>69.80</td>
<td>6.980</td>
<td>1.274</td>
</tr>
<tr>
<td>ProTest</td>
<td>1</td>
<td>81.68</td>
<td>10.849</td>
<td>1.948</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>72.93</td>
<td>7.114</td>
<td>1.299</td>
</tr>
<tr>
<td>ReviewTest</td>
<td>1</td>
<td>83.13</td>
<td>10.874</td>
<td>1.953</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>75.33</td>
<td>7.284</td>
<td>1.330</td>
</tr>
</tbody>
</table>
experimental subject create the keyword concept map to improve the learning performance. This study proposed a way by using keyword concept map to improve the learning performance of traditional e-book. The experimental subject is the students of sixth grade students by using the paper and pen to know the performance of proposed system for learn and review. These result response the Coyle (2008) that the vital value of e-book is depends on how to find out the applications that we have not to pay close attention for them. That is why the relevant issues of e-book still attracted the attention of researcher form different disciplines. It also because that when the traditional paper-book or traditional e-book matured, the innovation idea for e-book still can improve the e-book and become a popular research domain. For these reasons, this study tried to provide a novel system to create the keyword concept map to strengthen the traditional e-book to further making it can easy to understand. The results of learning performance with no doubt shown that not only the learning but also the review can be significant improved by using the proposed system to learn. The findings indicated that the students by using the e-book with keyword concept map as the experimental group can get better average score of test than the students used the traditional e-book without keyword concept which as the control group. Moreover, the results of satisfaction questionnaire also show that the experimental group is better than control group for the availability. An interesting result is that results of usability for these two different groups are very similar. According our observation, it means that because the e-book today is matured, thus, even though the traditional e-book the user experience will not be terrible. It means that only take into account the interface of e-book or using behavior would not get the significant result for user feeling. But if we only

Table 3: Independent Samples Test

<table>
<thead>
<tr>
<th>Table 3: Independent Samples Test</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>PreTest</td>
<td>16.932</td>
<td>.000</td>
</tr>
<tr>
<td>PostTest</td>
<td>5.145</td>
<td>.027</td>
</tr>
<tr>
<td>Review/Test t</td>
<td>6.430</td>
<td>.014</td>
</tr>
</tbody>
</table>

Results of the Satisfaction Questionnaire

Table 3 shows the results of the satisfaction questionnaire after the experimental that the user experience of all students for the proposed system is positive. First for the availability, it can easy to understand that this study integrated the keyword concept map to traditional e-book can enhance the availability of e-book while can make the user feel the proposed system can improve the learning performance much more than traditional e-book. Thus, the experimental group can get the average score 4.0155 which is better than the average score of control group 4.005 which is 3.568.

In the other side for the usability, we recognized that the average score of experimental group G1 4.19 is similar to the average of control group 4.005. It means that the e-book is very mature today, the interface and using of e-book today are much better than early e-books. The e-book nowadays is much friendly than before. As a result, the difference on usability for the experimental and control groups is not significantly. In summary, the goal of the keyword concept map is used to support the student for traditional e-book on availability. The results also matched the assumption of this study.

Table 4: Results

<table>
<thead>
<tr>
<th>Group</th>
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<tr>
<td></td>
<td>Standard Dev.</td>
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<tr>
<td></td>
<td>Variance</td>
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<td></td>
<td>Variance</td>
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CONCLUSIONS

This study proposed a way by using keyword concept map to improve the learning performance of traditional e-book. The experimental subject is the students of sixth grade students by using the paper and pen to know the performance of proposed system for learn and review. These result response the Coyle (2008) that the vital value of e-book is depends on how to find out the applications that we have not to pay close attention for them. That is why the relevant issues of e-book still attracted the attention of researcher form different disciplines. It also because that when the traditional paper-book or traditional e-book matured, the innovation idea for e-book still can improve the e-book and become a popular research domain. For these reasons, this study tried to provide a novel system to create the keyword concept map to strengthen the
consider the result of experimental, the usability of experimental group still better than control group which means that it still has the chance to improve it and match our expected. In the future work, we will try to improve the flexibility of the propose system, i.e., user can choose multiple section to create the concept map not just only can choice one section each time, and try to find or develop better methods to accurate choice the keyword automatically to avoid the loading of teacher to further make the proposed system can create the concept map fully automatically on overall process.

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AUTHORS

Using Semantic Transition Tree Grammar to Develop Web-based Natural Language Query Interface

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ABSTRACT

The vogue of internet brings immense cyclone to all various vocations. The features of boundless distance and standardization have stirred up information windstorm today. The combination of internet and database can not only possess the merit of client-server, but also provide uniform operational environment for various platforms. It is an essential framework for the integrated application systems. The most important purpose of database is to provide information. Up to the present, the research of query interfaces has been provided with diversified developments. Natural language query interfaces offer the overwhelming advantage of requiring the least end-user training. Many systems have been implemented (Grosz, Appelt, Martin, & Pereira, 1987; Hendrix, Sacerdoti, Sagalowicz, & Slocum, 1978; Waltz, 1978). We tried to transplant natural language query interface into internet environment. By way of the characteristics of internet, information retrieval will be much personalized and efficient. We combine the syntax and semantics of semantic transition tree grammars, then apply it to the inner logical representation of the natural language query and translate it into a structure query language (SQL) statement. The framework of this study expects to transplant into Chinese environment in the future, in order to raise the native values of the system.

Keywords: Database Query Interface, Natural Language, Semantic Transition Tree Grammar, Web Database

INTRODUCTION

The application of databases has been developed for many years. It achieves widely on the methods of storage, the capacity, and the response time. But these efforts are to let nonexpert users’ access data they needed efficiently and conveniently. Now the integration of internet technology makes information to be more wide-spread.

For nonexpert users, “query” is the most interesting, complicated and variable in the application of databases, and it is one of the most utility and requisite applications. The main obstacle common users’ access databases that were developed formerly is to need to learn specific query language in advance. For system designers, they must design all query requirements in systems beforehand. But this will increase burdens of system designers undoubtedly, and restrict accessible diverseness. As regards users, if they need to know data structure of databases in advance, or need to be familiar with query statements, then this perhaps results in perplexity that users can not access data they wanted. No matter problems of system designers or users, they all will lead to reduce worthiness of database systems.

The ultimate goal of designing human-machine interface is so called intelligent interface. It provides users with more personalized communication, and makes users to accept additional training no more. Natural language (NL) that is one of artificial intelligence (AI) technologies can let users use the way which is more similar to human being communication to access databases (Hancock & Chignell, 1989). The augment of specific domain knowledge and meta-data of database can infer mistakes of query, then this will increase system friendliness (Kao, Cercone, & Luk, 1988). Because of former reasons, this research draws together natural language technology-semantic transition tree grammars (Winston, 1992). The combination hopes to develop a database query interface based on natural language.

By way of semantic transition tree grammars which were defined in advance, translate natural language that users entered into international standard structure query language (SQL) to access databases.

The applications of internet have been international trend. Because of open framework of internet, so systems just follow TCP/IP protocol can connect with internet. On account of the reason, internet has been most rapid and convenient way of information circulation today, then researches of web database mushroom (Khurana & Gadhok, 1997; Mohseni, 1996). In order to reach goal of location transparency, this research will transplant former natural language interface into the platform of internet environment. By means of merit of client-server framework, let users can access data from home or any place that were linked to internet.

Because the technology of Chinese natural language is not yet mature, in restraint of the bottleneck, this research will use English language as dialogic mechanism of system. Because English natural language has developed for many years abroad, and its syntax possesses regularization, so success of computerization is higher. So this research uses English natural language to demonstrate semantic transition-tree grammars first. After the technology of Chinese natural language is mature, we believe that the outcome of this research shall be able to be transplanted into Chinese

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environment, and this can raise native worthiness of system.

**DATABASE QUERY INTERFACE**

The spreading application of databases for information retrieval systems dictates that nonexpert users be able to access the information in them easily. During the brief history of research into interfaces for information retrieval systems, some solutions which were proposed include:

1. Formal query languages which were supposedly easy to learn, for example, SQL (Astrahan et al., 1976; Chamberlin & Boyce, 1974) and VERDI (Wald, 1985);
2. Menu selection or graphic forms based interfaces, for example, CUPID (McDonald & Stonebraker, 1975);
3. Generalization from examples, for example, Query-by-Example (QBE) (Zloof, 1975);
4. Query clarification dialogs, for example, RENDEZVOUS (Codd, 1974);
5. Understanding natural language queries, for example, LIFER (Hendrix et al., 1978) and PLANES (Waltz, 1978).

Among database query interfaces which mentioned formerly, natural language query interface almost possesses overwhelming advantages that users can query computer by common language. If users must use specific query language to query complicated requirements, then users perhaps feel embarrassment of querying nothing. So as to the researches of natural language interface appear more and more (Grosz et al., 1987; Hendrix et al., 1978; Waltz, 1978).

For the most part, former researches of natural language interface almost aimed at the part of query, other data processing (for example, insert, update and deletion) are discussed little. On the whole, the basic model of natural language query interface outlines in figure 1. Natural language users enter shall be translated into some specific query language (for example, SQL), then data users require can be accessed by way of the specific query language. In the future, we expect to expand the other data processing applications, to magnify applied scope of database interface, except for query processing.

![Figure 1: Basic model of NL query interface](image)

**WEB DATABASE**

In the era information explode, in the face of huge and complicated data or information, we can resolve the problems of data gathering, processing and applying easily by way of help of database. Though database technologies have developed for a long time, but a technical kernel does not still resolve yet. That is the deficiency of common standardization between databases. All of syntax, data structure and application interface almost do not follow the common standardization. After appearance of internet standardization, it brings the first light of morning to former deficiency. Except for boundless distance and standardization features of internet, strong capability that database processes data will bring revolutionary influence to the intelligent accumulation and information sharing of human being.

The majority of user interfaces do not think about the problem of different platforms. The system can just be used on the specific operation platform. The problem was resolved by the appearance of web, because the most part of browsers can support different platforms. So no matter we choose what kind of program language to be database interface, web database can use on different platforms without coding again. The convenience of across platforms makes the worthiness of web databases to raise, and reduce the cost of maintenance.

Another advantage of using web database is the consistence of user interface. Even though on different operation platforms, browser makes the consistence of user interface to keep. For nonexpert users, they do not need to learn again on the different operation platforms or computers. On the other hand, for programmer designers, they also do not need to spend too much time on writing user documents. This is very helpful to saving cost.

General model of web databases outlines in figure 2. Information technologies of the connection between WWW server with database change with each passing day, more visual software have been developed, for example, IntraBuilder and PowerBuilder and so on. Their design environment is the style of objects. They encapsulate the link with database into objects, this simplifies the time of developing systems (Mahar & Henderson, 1997).
RESEARCH FRAMEWORK

System Architecture

The development environment of this research is built upon the internet platform. The connection between database server with internet constitutes a client-server system. Users get into WWW server that stores the HTML formatted natural language query interface from client computers (browsers). After they enter the request of natural language, semantic transition-tree grammars that were written by CGI program translate the request into structure query language, then the system passes it to WWW server. Ultimately, the retrieved data which are indicated in the HTML form are then passed back to the client computer of users.

System architecture of this research is outlined in figure 3. The units of parser and semantic interpreter in Figure 3 are preceding processes of natural language front-ends. A typical natural language system, the inputs of original natural language are passed to parser to process syntactic analysis, in order to judge if the syntax are erroneous. If not, the parser produces relative parser trees, its form is so-called augment transition network (ATN). The next process is semantic analysis, this is probably difficult stage. Because a word has perhaps a little different meanings, and different sentences represent perhaps the same meaning too. The outcome of semantic analysis is represented generally by the internal logical form of semantic network (Winston, 1992).

The important point of this research’s natural language interface is the translation of semantic transition-tree grammars into structure query language. Semantic transition-tree grammars are combined representation of syntax and semantic. So the front-end process of natural language in this system adopts the method is like LIFER (Hendrix et al., 1978), the sentences that users can enter are restricted. For example, “Give me the 2000 Toyotas” or “Count the 2000 Toyotas” and so on. This restriction can not only reduce difficulty of natural language processing, but also increase success in the development of system. But this restriction decreases the contributions of system. In successive researches, except for the breakthrough of natural language’s bottlenecks, we must add domain knowledge and meta-data of database to the system. So we can reach the goals that users do not need to know the contents of database, or that users do not accept extra training.

From figure 3, we can see the function of query
Using Semantic Transition Tree Grammar to Develop Web-based Natural Language Query Interface

Query interpreter is to translate natural language into standard structure query language, that is to say, it is the intermediary processor between users and databases. Query interpreter is generated by CGI program, and stored in WWW server. Because general HTML languages don’t support the capacities of computing and logic, so this research uses Visual Basic 5.0 to be our developmental tool to construct program interface of this part. Though other tools that construct web databases, for example IntraBuilder or PowerBuilder and so on, simplify developmental time by way of the design of visual environment, but the supportable capacities are not stronger than Visual Basic. Furthermore, Visual Basic 5.0 supports also the function of designing CGI program. So we choose Visual Basic 5.0 as the developmental tool. In order to set up WWW server, we choose Microsoft Windows Server 2008, and it provides the capacity for executing CGI program too. In the database aspect, we choose Microsoft SQL Server as our database server. Microsoft SQL Server can not only process structure query language, but it is also one of the database drivers of Visual Basic prepares to support in advance.

Semantic transition tree grammar

Semantic transition-tree grammar is evolved from augment transition network (ATN) (Allen, 1987). The difference is that the former is tree structure, not network structure. Tree structure can represent paths we want to move through clearly. Semantic transition-tree grammar is different from other natural language representations, according to former mention, because database pertains to specific domain, and involves semantic problems, so we choose the grammar that contains semantic as natural language representation.

Database this system uses is about vehicles. There is a Vehicles relation table in the database, its data structure is outlined in table 1. The Vehicles relation includes four data fields that is TITLE, COLOR, CC, and ORIGIN.

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<tr>
<th>TITLE</th>
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<td>Domestic</td>
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</table>

Table 1: Vehicles relation

Semantic transition-tree grammar that the system uses is a restricted natural language which is classified according to verbs, for example, ‘give’, ‘count’, ‘how many’ and so on. The part grammars are shown in figure 4. In order to get the last structure query language, we must try to move along a series of links from the initial node in the question tree net to a terminal node-one with a circle in the center- using the words as directions. If a particular string of words enables you to reach a terminal node, then that string is said to be accepted by the transition-tree grammar.

In figure 4, a single circle is represented as nonterminal node, that is to say, after a nonterminal node the system has still paths to traverse. A double circle is then represented as terminal node. The terminal node of each tree has a pattern that can store value. A pattern can be distinguished into two kinds. One is said to template-like pattern, is also said to tree variable, which is located at terminal node. Template-like pattern, marked by left bracket symbol ‘<’, is a mnemonic preface meant to suggest bring a binding up from a subtree, for example ‘<attribute<attributes’ in Figure 4.
The other is said to variable-free pattern, which is also located at terminal node. It stores constant value, for example ‘cc’, ‘color’ in Figure 4. Another symbol, marked by right bracket symbol ‘>’ and the name of a subtree, is a subtree link, for example ‘>object’ in Figure 4. It tries to traverse the subtree. If the traversal is successful, bind the subtree name to the instantiated pattern found at the terminal node of the subtree.

Now we demonstrate the traverse algorithms of semantic transition-tree grammars summarily. According to the grammars in figure 4, we assume that users input the restricted sentence “count the 1600 Toyotas”. The top-level tree, the question tree, is the first used. One link leading out of the entry node is labeled...
with the word ‘count’, which matches the first word in the example sentence, taking you to the link labeled ‘objects’. So we traverse the ‘objects’ subtree. We choose the first path, so move through the ‘determiner’ subtree. Because the next of the remaining words in the sentence is ‘the’, so the determiner subtree is traversed successfully. But the terminal nodes of the determiner subtree have no template-like pattern, so do nothing and back to the break point. Under the first path of the ‘objects’ subtree, we go on traversing the ‘objects’ subtree. We find the first path of the ‘objects’ subtree is wrong, so we choose the second path of the ‘objects’ subtree. According to ‘>values’, so we turn our attention to the ‘values’ subtree. The same reasons, we traverse the first link of the ‘values’ subtree {‘*’}. It is found that we must traverse the ‘value’ subtree. Under the first link of the ‘value’ subtree, we consume the third word ‘1600’ in the sentence. So the template-like pattern ‘<value’ stores the constant value “cc=1600” and backs to the break point. Next we keep going to traverse the ‘values’ subtree. But now the three links of the ‘values’ subtree can not conform to the fourth word ‘Toyotas’ in the sentence, it means that the first link in the location ‘{‘*’}’ is wrong. Now we need to clear the value of the template-like pattern ‘<value’, and we traverse from the third word ‘1600’ in the example sentence again. That is to say, we must turn attention to the second path of the ‘values’ subtree again.

According to the algorithms mentioned formerly, the request of natural language users entered, “count the 1600 Toyotas”, will be translated into the structure query language, “\texttt{COUNT [SELECT \texttt{from Vehicles where title=Toyotas] where cc=1600]}”, by means of semantic transition-tree grammars in figure 4. Eventually, the outcome of structure query language is sent to the database server to access data.

Semantic transition-tree grammars differ from the traditional syntactic transition-net grammars in several ways (Winston, 1992):

1. The links between nodes can be a subtree link, for example ‘>:determiner’ in figure 4, and be also a specific word, for example ‘count’ in figure 4.
2. Some link transitions specify phrases semantically, for example ‘>:determiner’ in figure 4, rather than syntactically, for example ‘<:adjectives>’ in figure 5.
3. There are no nodes with two inputs. Not like nodes of augmented transition-net grammars (ATN) with many paths, shown in figure 5, are perhaps able to cause semantic ambiguity.

Figure 5: Semantic ambiguity of ATN (Winston, 1992)

**SYSTEM DEMONSTRATION**

This research develops a prototype system of web-based natural language query interface, Figure 6 outlines the user interface on the browser of client computer.

![Figure 6: User interface of the system](image)

After users input natural language, WWW server delivers request and CGI profile file (*.ini) to CGI external program that this research develop. The main function of this external program is to translate semantic transition-tree grammars into formal structural query language, and pass the output of SQL form to database server by means of ODBC drivers. After executing SQL, then database server passes the outcome of querying database to WWW server back. The translation of semantic transition-tree grammars is accomplished by the method of recursion. So the response time of system execution perhaps is restricted by the size of semantic transition-tree grammars and the tempo of computer hardwares.
After the database server deals with request, the outcome is passed back to CGI external program. CGI external program passes the outcome that was formatted as HTML document to WWW server again. By way of browsers, users can see the outcome of query. The outcome is shown in Figure 7.

**CONCLUSION**

The applications of internet increase day by day. The introduction of natural language is a new attempt, but this raise level of user interface development too. Furthermore, if the application would like to reach the goal of data independent, that is to say, users do not need to know anything about internal details of database when they use the system, then the application must add knowledge base component. The component consists of specific domain knowledge and meta-data of database. The component assists users in inference of query, in order to accomplish operation of accessing data.

On the part of natural language processing, in order to meet the purpose of nativism, Chinese natural language seems to conform to realistic requirement better. But as regards researches of Chinese natural language, as a result of complication of Chinese semantic, so the technology is not mature yet. Waiting for development in the future, Chinese query interface system is to be imperative.

In the future, this research can take account of introducing other data processing of insert, deletion and update into user interface except knowledge base and Chinese processing. Let the processes of data processing be simple more. Under the trend of user-oriented, it can reveal the system value more.

**REFERENCES**


AUTHORS

Tarng-Yao Yang is an associate professor in the Department of Information Management, Southern Taiwan University of Science and Technology. His research focuses on statistics education, data modeling, decision modeling and related topics of digital opportunity center and knowledge management in project teams. He has published his work in journals such as Asia Pacific Management Review, Journal of e-Business, Journal of Information Management, NTU Management Review, and Journal of Technology, Journal of Southern Taiwan University of Science and Technology, among others.
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4. **TITLE, AUTHOR AND ABSTRACT**

   The title should be in the style as indicated in the sample (only capitalize the first letters of proper names). Author(s), affiliation(s), city and country should use first capital letter and lower case. Do not abbreviate the affiliation.

5. **ABSTRACT**

   Please write a 75-100 word abstract (with keywords) of your paper, which should include your main idea and your major points. You also may want to mention any implications of your research. Place the abstract on its own page immediately after the title page. Center the word “Abstract” and then follow with the paragraph.

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   Arrange the text of the paper in two columns. The text (or first heading) of the paper must start two lines beneath the abstract. The second and consecutive pages must start from the top of the new page. Do not leave space at the top of the new page. Make sure that left-hand and right-hand columns of text are balanced, top and bottom. Please ensure that the columns on the last page of the paper are evenly balanced.

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* Publication committee have right to determine accept, modify or refuse by reviewers comments.
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