Code: P-4

THE LEARNING MEDIUM ENGINEERING BASED ON EXPERT SYSTEM FOR INFORMATION SERVICES SOURCES COURSE IN THE STUDY PROGRAM OF LIBRARY AND INFORMATION SCIENCE

Ardoni

Padang State University

ardoniyonas@yahoo.co.id, ardoni@fbs.unp.ac.id

Abstract

The objectives of this research is to design an expert system prototype that is expected to be used as a learning medium in a course of Information Services Resources in the study program of library and information science. The learning medium is expected to play a role as one component of networking connectivism-based learning. A research and development method was used to design the prototype. The expert system knowledge base drawn from the purpose and scope of reference books which are grouped according to the classification paradigm. Then based on the principle of subsets and intersections on the set theory, the items of information in reference books are categorized and described in the form of a tree diagram. By using MS-Visual FoxPro 9.0, the prototype then designed by options and radio buttons as the main objects.

Keywords: *reference, connectivism, learning media, learning medium, library, expert system, information, set theory, purpose and scope*

INTRODUCTION

According to Google (Forum.VivaNews, 2009), in modern world, there have been published 129,864,880 titles of books. Actually, that is not an accurate numbers since there are so many different definitions of "book". However, the numbers can be used as initial guidelines to estimate how much the amount of information published in the books and also in many other media like newspaper, journal article, website, etc. in many forms, i.e. printed, electronic, audio, audiovisual, etc. All of the diverse media transfer the large amount of information and the amount becomes greater and faster over time. The rapidity of information invention and dissemination goes beyond human ability to cope with and makes knowledge development becomes faster as well.

Irrefragable, someone, especially the student does not have to read or process all of information invented or disseminated because the knowledge are not contained in all of information. However, to update information "recorded" in his or her brain, particularly in the area of science he or she studied, a person still faces to difficulties which are not only because of the high quantity of information, but also because the information is transferred in various media and must be accessed in various manners. The rapid development of knowledge make humans may not be able to have the experience of everything that happens, even in the field of science (Stephenson, 1996; Siemens, 2005). Moreover, there is no certainty that information can be accessed by anyone, including by the student. Consequently, the students only can access a very small piece of the huge cake of knowledge.

Fortunately, there are reference books that can be used for students to overcome such difficulties. The reference books or well known reference works are a compendium of information, specially arranged, compiled in a book to be used as a reference source (Wikipedia, 2012). Thus, the reference books are the main source for the information that it contains knowledge or information of a scientific nature. Therefore, the reference books can be used to access knowledge quickly according to one's needs.

The existence of the reference books as a collection of reference services at the library, does not necessarily resolve the issue of accessing resources. The cause is not all library service users knows surely the information (or information source) he or she needed, for example, they do not know the title or the author of resources. Not infrequently, the users do not even know the information source he or she should access to gather the information. In such cases, the help of a librarian is a necessity.

In education for librarianship institutions, Information Services Source (ISS) is a subject related to reference services. Respondents 1, lecturer of ISS on the School of Information Science Library and Archives (IIPK) Faculty of Languages and Arts, Padang State University (Interviewed December 3, 2011) stated that in the ISS lectures, the students were equipped with knowledge of the purpose and scope of the reference books. The knowledge was given by assigning the students to look for the reference books and reporting the purpose and scope of the books. However, the students still can not be guaranteed to master the purpose and scope of the reference books, given by the fast continuing increase in amount of the reference books to take place. Furthermore, the students do not have an ability to classify the purpose and scope of the books and to classify the users' questions since it is impossible to arrange practicum to attain the ability.

The development of information technology is expected to address the shortage of mastering the purpose and scope of the reference books and reference consulting skills. The information technology applied as a medium of learning in subjects ISS which is the main course for prospective reference librarian. Medium to be the supporter of the learning in terms of mastering the purpose and scope of the reference books as well as consultation skills is an expert system. The expert system is a system that has a knowledge base consists of the facts, the links, and reasoning (Chowdhury, 2010, p. 319). With the knowledge base, the expert system can provide answers in the form of the reference books that should be referred to satisfy library users' needs.

By using the expert system, the librarian prospective students can master not only the purpose and scope of the reference books those found, read, and learned, but also the purpose and scope of the reference books discovered or learned by other students or "learned" by the expert system. Thus, the expert system not only serves as a medium of learning, but it could be something to process information and to store knowledge could be used as a substitute for other students, including students who study at other universities.

The students can also be "trained" by the expert system to be more skilled in the focusing the users' questions on reference consultation. It should be added, the knowledge stored in the expert system can be gathered from reference books published throughout the world, of course, for that ability, the expert system should

be developed into a web-based computer program and be executed in the global network of the internet. The expert system resulted from this study is the prototype of the web-based expert system.

Research Questions
This research and development was conducted to answer the question: how to build the expert system based on the purpose and scope of the reference books as its knowledge base that potential to be used as a learning medium in ISS Course at IIPK Padang State University (UNP)?

Research Aims
The purpose of the research is to describe the procedure of engineering the expert system that use the purpose and scope of the reference books as its knowledge base.

Research Methods
This expert system was developed by using the Plomp's general model as seen at *Figure 1* (Plomp, 1997, p. 5). According to Plomp (Plomp & van de Wolde, 1992, p. 8),
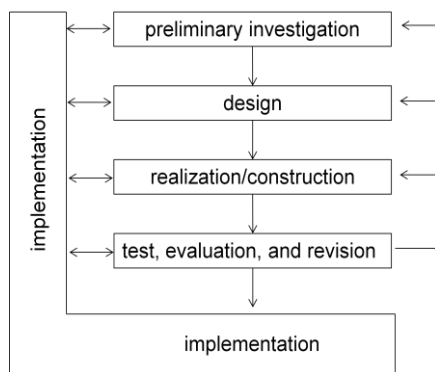

Figure 1. General Model to Solve Education Problems (Plomp, 1997: 5)

there are three important elements in the preliminary investigation stage, which collect and analyze information, define problems, and plan for the continuation of the development being carried out.

The activities carried out at second phase (design) are filing alternative to solve the problem found at the investigation stage. If the proposed solutions is more than one, then the comparison and evaluation of each solution must be done to produce a design or blueprint of the most promising solutions (Plomp, 1997, p. 6). On this stage, it was determined the knowledge base sources, knowledge acquisitions, and knowledge representations which would be used as the expert system knowledge base. It was also determined the software to be used.

The third phase (realization/construction) is the phase in which plans are made at the previous stage is realized or made. In other words, the second phase is the departure point of the third stage (Plomp, 1997, p. 6). In this phase was describe the construction of database.

Determination of whether the problem can be solved with product that have been built is done through test, evaluation, and revision (Plomp & van de Wolde, 1992, p. 11). The product can be said to be valid when tested against the subject mentioned in the formulation of the problems, in this case the students of Library and Information Science Archives. Before tested, validated products by some experts as suggested by Tessmer (1998, p. 55).

After going through the four stages, the product can be implemented. Plomp (1997, p. 6) stated, "solutions have to be introduced, in other words, have to be implemented."

However, according to the research questions, in this article only three stages were

presented because this article is a part of the dissertation which includes the four stages.

The Procedure of the Expert System Engineering

Preliminary Investigation
In The First South East Asia Design/Development Research Development Conference, April 22-23, 2013, Dolly van Eerde stated that research and development (R & D) is conducted not to prove, but to improve. Furthermore, she mentioned four stages to make the development done sistematically, such as (a) description of what happens in a traditional situation or pre-R & D designed, (b) problems in the situation, (c) an opportunity that is probably can be done to solve the problems, and (d) the design.

Traditionally, the students of ISS course be assigned to describe the purpose and scope of the reference books they met in the library. The task is then submitted to the lecturer. With the task, students are expected to explore and once mastered the purpose and scope of the reference books. Although the students have been assigned such knowledge, they still cannot enough knowledge to do their job helping the user to use the books. At least, there are two reasons, such as (a) the reference books are still always published and become more specific and (b) the students do not have an ability to classify the purpose and scope of the books and to classify the users' questions since it is impossible to arrange the practicum to attain the ability.

In the mean time, the Siemens' connectivism learning theory that proposed to meet the challenges and the facts contained in the current digital era, reveals that the technology can be use as a mediator between the lecturers and the students. George Siemens (2005) suggested the theory of learning that complements the previous three theories, namely behaviorism, cognitivism, and constructivism. According to Siemens, learning is a networking phenomenon. Furthermore, learning is not only a process that occurs in humans, but can also occur outside of human beings, either on another human being, as well as on technology. This is the main difference between the three connectivism and learning theory that preceded it; these three is stated learning occurs within the individual or the students and occur based on experience.

George Siemens' opinion supported by, among others, Cynthia D. Kennedy (Kennedy, 2009), Frances Bell (Bell, 2011), Rita Kop (Kop, 2011), Andrew Ravenscroft (Ravenscroft, 2011). However, that is connectivism learning theory refuted by Pløn W. Verhagen, Professor of Educational Design, University of Twente, Netherlands. Verhagen (2006) stated, that a theory must explain the phenomenon and the explanation must be verified. The information presented by Siemens was not specific enough and reasonable and do not cover these aspects. According to Verhagen (Connectivism, 2012), connectivism is simply a pedagogical view, instead of learning theory.

Beyond the dissention, the technology that role as a node in the connectivism network is available. Such technology is a computer program that is built in such a way that it becomes a model of expert, namely expert system (Jensen, 2007, p. 47; Chowdhury, 2010, p. 318). The discovery of an answer in the expert system is similar to the process of human answer discovery. The expert system has an ability to do a consultation in the form of questions and answers, give answers, and explain the reason for the answer (Honggowibowo, 2009, p. 188). Therefore, the expert system is different than a conventional computer program. Users of conventional computer

program do not know the process that occurs when a program converts the input into output. The expert system actually provides a facility for users to know the process of acquiring an answer or decision it made, so that users can learn the knowledge and the ways of reasoning that present in the system. Such facilities make the expert system potential to be used as a learning tool or a learning medium (Chowdhury, 2010, p. 326).

The expert system has a knowledge base which it consult to find the answers. The purpose and scope of the reference books are potentially built as the expert system knowledge base. The reason is the purpose and scope can be classified in such a way and so as to fit the production rules in the form of tree diagram which is then converted into syntactic logic "if ... then ..." as the knowledge base. In addition, ONeil & Morris (1989, p. 295) argued that the knowledge base does not always have to be built based on the knowledge of an expert, but can be of text or regulation. Similarly, the written information is one of the sources of knowledge (Carrico, Girard, & Jones, 1989, p. 43 at seq.).

Design
There seven points those will be discussed below, i.e. knowledge base, knowledge acquisition, knowledge representation.

Knowledge Base
The expert system knowledge base is the information about the purpose and scope of the reference books collected in the Library of UNP, the Library of the Imam Bonjol Institute of Islamic Religion Padang (IAIN), the Library of Bung Hatta University, and uploaded on the websites of the reference books vendors. To build a knowledge base, it was also conducted non-directed/inguided interviews to the reference librarians of UNP and IAIN who are or have served in the reference service. A similar interview was conducted to two ISS lecturers from UNP and IAIN.

Knowledge Acquisition
In accordance with the classification paradigm, reference books grouped by the scope and reference questions classification that can be answered by using the reference books. The group is (Sulistyo-Basuki, 1993, p. 439): (1) general/backgrounds, (2) trends, (3) locations, (4) illustrations, (5) organizations/institutions, (6) peoples, (7) facts and activities, (8) documents listing, and (9) languages.

The items of information contained in the purpose and scope of the reference books grouped into the nine groups. Then, each item of information described and grouped again according to its characteristics or facet. The result was a faceted classification system.

The faceted classification itself is a multidimensional description of the method and arrangement of information resources with its concepts, attributes or "aboutness". This method refers to the fact, that the library users search a document from various angles according to the attributes of the document. By summarizing the attributes or dimensions different as "facets", the classification system can produce multiple facets, or the major categories of information, which allows the users to seek or to browse with a higher degree of flexibility (Uddin & Janecek, 2007, p. 220; Louie, Maddox, & Washington, 2003, p. 6; Rao, 2002, p. 1).

The items of information in every facet described again be one or more subfacet(s) of the items. For example, the item about, "the companies in West Sumatra"

decomposed into three subfacets, namely: Corporate, Regional, and West Sumatra. All the reference books that contain either one or three subfacets were listed as one group. Reference books that have subfacet "company" become members of the group namely "COMPANY". Thus, any reference book can be a member of one or more subgroups.

Grouping was continuing when group members have different subfacets than the subfacet of the group and the subfacets were different as well. The subfacets was becoming the basis of grouping ordered by the following rules:

1) the first subfacet was not a more specific subfacet than the second subfacet which was characterized by (a) there was at least one member of the first subfacet that not a member of the second subfacet because according to set theory which states that $B \subseteq A \equiv \forall_x\, x \in B \rightarrow x \in A$ (Lipschutz, 1981, p. 2 et seq.) or (b) the meaning of the first subfacet (applied to subfacet that equal to or similar to another subfacet);
2) if the members of both of the subfacet were combined, then the result was the entire reference books that being members of prior group; and
3) the subfacet were equivalent or similar, such as "Indonesian" and "America" said to be equivalent because both are the name of the country.

Grouping based on such rules was done if grouping based on another subfacet would cause the numbers of groups become increased. However, the determination of two or more subfacets being equivalent/similar or not was subjective. By using the rules, grouping was done repeatedly until found out a group that had unique subfacet member(s), so there might not be further subdivided (Miswan, 2003: 3-4). It should be added, the grouping of in each classification could be different depend on the subfacet owned by each member of the group.

The division results depicted in a tree diagram which was needed as a guide in making an algorithms and developing the series of the expert system menu. For example, a part of the tree diagram is shown below.
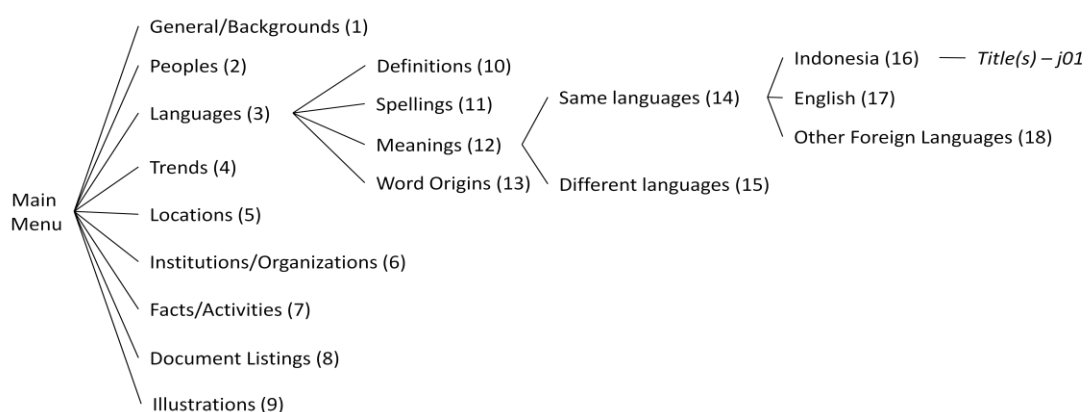

Figure 2. Part of the Tree Diagram

Knowledge Representation

Production system (Hjerppe & Olander, 1989, p. 4) was used to represent the knowledge. By using this method, the knowledge was represented in the form of

logical implication "if-then" that ends with "endif". This method was chosen because (1) more in line with the classification paradigm, (2) prototype system design becomes modular, (3) programming with database management system program is easier to do if the knowledge represented in the form of production system, and (4) production system developed by Newell and Simon in 1972, is a popular method in artificial intelligence researchs and systems (Belkin & Vickery, 1985, p. 164). By using this method, the rules those being the knowledge base are called production rules (Carrico, Girard, & Jones, 1989, p. 79).

The Expert System Development Software

Microsoft Visual FoxPro 9.0 (VFP), a data-centric object oriented and procedural programming language, was used to develop the expert system. VFP was used because the following reasons (Suparno, 2011, pp. 1-49): (1) VFP has IDE (*integrated development environment*), so the system is easier to designed, developed, and tested; (2) VFP is complemented by blank windows to design an aplication and user interface system; (3) VFP has a collection of information about the appearance of various types of objects required to display system (extensive class library); (4) VFP has code editor to monitor the code, rules, and logic used; (5) VFP has a project manager which can manage one or more collections of files for various activities; (6) VFP is a programming language that is fast becoming popular according to TIOBE Programming Community Index (Wikipedia, 2012), which lists the programming languages according to the frequency of search via Google, Google Blogs, MSN, Yahoo!, Wikipedia, and YouTube; and (7) VFP makes the expert system users able to do the system's knowledge addition because it can be designed to have such facilities, while when using an expert system shell, knowledge addition can only be done by the system's programmer(s).

Realization/Construction

The expert system shaped up the application files are written with VFP. Data is stored in a table in the form of knowledge called extension dbf (database file). Subroutines (Courant program) derived from the file name extension prg (program) and main courses from frx file name extension (form document) compiled into a file named extension exe (executable).

Knowledge base system that is in the form of data tables DBF extension. There are four tables are required for it, the table: the term (containing the term), title (title contains reference books), the title-term (containing the title of the link code and code terms), the position-term (containing the link code term and position menu).

Each table has two fields. The table consists of the term-term field code and terms. Table titles consist of field-title and title code. The table consists of a title-term field-code and code-term title. Table-term positions consist of field-term and menubaris code. Fourth tables strung in relational database systems.

For example, in Figure 2, there are 18 terms that are spread into four levels of menus. The first menu contains 9 terms, the menu contains 4 2nd term, 3rd menu contains two terms, and the 4th menu contains 3 terms. The term "same languages" have a code term 14; term "different languages" have a code term 15. The second term and the term code is stored in the table terms.

Code title is "J01", both "title" and "J01" is stored in the table title. Title (J01) has facets Languages (3), Meanings (12), Same Languages (14), and Indonesia (16). Judul_istilah table has 4 records: record 1 contains "J01" and "3", record-2 includes "J01" and "12", record-3 includes "J01" and "14", record-4 includes "J01" and "16".

Facet Languages (3) has menu_baris code "3", the facet appears on the menu to-1, row 3; facet Meanings (12) has menu_baris code "03", the facet does not appear on the menu to-1, appears on the menu to -2, row 3; facet Same Languages (14) has menu_baris code "001", the facet does not apper on 1st and 2nd, but on the menu to-3, line 1. So, posisi_istilah table has 3 records: record 1 contains "3" and "3", record-2 contains "12" and "03", record-3 contains "14" and "001".

Test, Evaluation, and Revision
Design validation is required to assess the effectiveness of the design. The expert system prototype design validation will be carried out by three groups of experts (Tessmer, 1998, p. 55), which is a computer expert (construct validation), lecturer in ISS (content validation), and media experts. Validation results formed the basis for the revised design.

Product testing and revisions will be made after the prototype is completed designed up. Implementation trials will be conducted by researchers in the form of Self-Evaluation and Small Group (Plomp, 2007, p. 28). Results form the basis of the revised test products.

CONCLUSION

ISS requires learning media as a replacement for the task of finding and reporting the purpose and scope of reference books. The purpose and scope of reference books themselves can be built into a knowledge base of expert system as a medium of learning. Expert systems can be built using a data base management system by doing some modifications to the knowledge base. To that end, the knowledge base is placed in the database tables are linked suitable to production rules, and knowledge representation.

Furthermore, the implication of this expert system development research is that the similar expert system can be built and be applied as learning media in the subjects of other courses and fields of science. The condition that must be fulfilled is the subjects can be built as a knowledge base. If it can be done, then the media will have a role not only as a tool, but also as a "teacher". The expert system may have the students be able to learn the knowledge from all the world when the system runs in a global network environment.

Suggestions
It is hoped that the result of this research can be used as a learning medium in ISS course at the education for librarianship institutions and as a mediator between lectures and the students of the course in connectivism-based learning. Moreover, the expert system can be developed into a web-based computer program and be executed in the global network of the internet as a learning medium and as an information and knowledge storage, particularly in the field of the reference works. So, other researchs and developtments of the expert system development in other fields of science may be conducted in a future.

REFERENCES

Belkin, N. J., & Vickery, A. (1985). *Interaction in Information Systems: a Review of Research from Document Retrieval to Knowledge-based Systems.* Cambridge: British Library.

Bell, F. (2011). Connectivism: Its Place in Teory-Informed Research and Innovation in Technology-Enabled Learning. *International Review of Researh in Open and Distance Learning. Vol. 12.3 March 2011* , 98-118.

Carrico, M. A., Girard, J. E., & Jones, J. P. (1989). *Building Knowledge Systems: Developing & Managing Rule-based Applications.* New York: McGraw-Hill Book Company.

Chowdhury, G. G. (2010). *Introduction to Modern Information Retrieval.-- 3rd Edition.* New York: Neal-Schuman Publishers, Inc.

Connectivism, A. R. (2012, Februari 16). *Education, Technology and Entrepreneurship.* Retrieved Februari 17, 2012, from Stirring The Pot: http://johngschroeder.wordpress.com/page/2/

Forum.VivaNews. (2009, August 1). *Inilah Jumlah Buku yang Diterbitkan di Zaman Modern.* Retrieved February 17, 2012, from Vivasocio: http://forum.vivanews.com/aneh-dan-lucu/74769-inilah-jumlah-buku-yang-diterbitkan-di-zaman-modern.html

Hjerppe, R., & Olander, B. (1989). Cataloguing and Expert Systems: AACR2 as a Knowledge Base. *Journal of the American Society for Information Science (1986-1998); Jan 1989; 40, 1* , 27-44.

Honggowibowo, A. S. (2009). Sistem Pakar Diagnosa Penyakit Tanaman Padi Berbasis WEB dengan Forward dan Backward Chaining. *Telkomnika Vol. 7, No. 3, Desember 2009* , 187-194.

Jensen, M. L. (2007). *The Effects of an Expert System on Novice and Professional.* The University of Arizona, Graduate College. Ann Arbor: ProQuest Information and Learning Company.

Kennedy, C. D. (2009). *Connectivism and the Technology Age.* Boise, Idaho: Boise State University.

Kop, R. (2011). The Challenges to Connectivist Learning on Open Online Networks: Learning Experiences during a Massive Open Online Course. *International Review of Research in Open and Distance Learning. Vol. 12.3 March 2011* , 19-38.

Lipschutz, S. (1981). *Set Theory and Related Topics.* Singapore: McGraw-Hill Company.

Louie, A. J., Maddox, E. L., & Washington, W. (2003). Using Faceted Classification to Provide Structure for Information Architecture. *2003 IA Summit* (p. 6). Washington: Program for Educational Transformation Through Technology (PETTT) University of Washington.

O'Neil, M., & Morris, A. (1989). The Contribution of Library and Information Science to Expert System Development. *Electronic Library. Vol. 7 No. 5. October 1989* , 295-300.

Plomp, T. (2007). Educational Design Research: an Introduction. *Proceedings of the Seminar Conducted at the East China Normal University Shanghai (PR China), November 23-26, 2007* (pp. 9-36). Enchede: Netzodruk.

Plomp, T. (1997). Educational Design: Introduction. In T. Plomp, *Educational & Training System Design: Introduction.* Utrecht (the Netherlands): Lemma. Netherland. Faculty of Educational Science and Technology, University of Twente.

Plomp, T., & van de Wolde, J. (1992). The General Model for Systematical Problem Solving. In T. Plomp, *Design of Educational and Training (in Dutch)* (p. 8). Utrecht (the Netherlands): Lemma. Netherland. Faculty of Educational Science and Technology, University of Twente. Enschede the Netherlands.

Rao, R. (2002, Agustus 1). *Information Flow*. Retrieved Februari 20, 2012, from Ramana Rao's: http://www.ramanarao.com/informationflow/archive/2002-08.html

Ravenscroft, A. (2011). Dialogue and Connectivism: A New Approach to Understanding and Promoting Dialogue-Rich Networked Learning. *International Review of Research in Open and Distance Learning. Vol 12.3 March 2011* , 139-160.

Siemens, G. (2005, April 5). *Connectivism: a Learning Theory for the Digital Age.* Retrieved Februari 3, 2012, from elearnspace: everything elearning: http://www.ingedewaard.net/papers/connectivism/2005_siemens_ALearning TheoryForTheDigitalAge.pdf

Stephenson, K. (1996). *What Knowledge Tears Apart, Networks Make Whole.* Retrieved Februari 20, 2012, from Internal Communication, no. 36: http://www.netform.com/html/icf.pdf

Sulistyo-Basuki. (1993). *Pengantar Ilmu Perpustakaan.* Jakarta: Universitas Terbuka.

Suparno. (2011). *Modul Praktikum Microsoft Visual FoxPro 9.0.* Palangkaraya: STMIK.

Tessmer, M. (1998). *Planning and Conducting Formative Evaluations: Improving the Quality of Education and Training.* London: Kogan Page.

Uddin, M. N., & Janecek, P. (2007). The Implementation of Faceted Classification in Web Site Searching and Browsing. *Online Information Review Vol. 31 No. 2* , 218-233.

Verhagen, P. W. (2006, November 11). *Connectivism: A new learning theory?* Retrieved February 12, 2012, from Surf e-learning themasite: http://elearning.surf.nl/e-learning/english/3793

Wikipedia. (2012, Februari 24). *Reference Work*. Retrieved Maret 1, 2012, from Wikipedia: the Free Encyclopedia: http://en.wikipedia.org/wiki/Reference_works

Wikipedia. (2012, Maret 7). *Visual FoxPro.* Retrieved Maret 24, 2012, from Wikipedia: Free Encyclopedia: http://en.wikipedia.org/wiki/Visual_FoxPro#cite_note-1