PARAMETRIC EXPLICIT KNOWLEDGE MAPPING IN A LEARNING ENVIRONMENT

Charles Robert
University of Ibadan, Nigeria
abc.robert@ui.edu.ng

Abstract:
Problem of knowledge sharing is common among students in computer science. One of the fundamental problems in sharing programming knowledge is related to identifying a student that has similar experience and thinking patterns. This is particularly an issue when programming knowledge level varies. Six learning levels and three learning types in taxonomy of educational objective were used to solve this problem. The six levels can always be identified where there is learning. Incidentally, each learning level expresses a degree of knowledge in learning. The work characterized the learning levels and used the characteristics to map learning level of students in a programming environment. Eighty students in second year university were given programming assignments in two programming courses of JavaScript and PHP. The learning level of each submission of each student was identified and was used for mapping. Where two students expressed similar learning concerns they were identified as potential partners in programming. Potential application of this mapping was discussed.

Keywords: Knowledge mapping, set of belief, knowledge sharing, explicit knowledge

1. INTRODUCTION

Knowledge mapping has been seen as "*guide to, or inventory of, an organization's internal or external repositories or sources of information or knowledge. These sources may include documents, files, databases, recordings of best practices or activities, or webpages*" (Business Dictionary, 2013). This presupposes that explicit knowledge can be accessed in documents, files and recordings. It isolated the fact that users of information are responsible for knowledge creation. Alternative view to this is to consider how to map explicit knowledge with the consideration of the creators of such knowledge.

Knowledge in its generic form is defined as a set of related belief about relationship among specific object or similar objects or dissimilar objects (places, events and personalities). The belief is generally constructed on information about these objects over time. Each belief can be seen as mental aggregation of stages or phases of information about the objects in question. This kind of aggregation is similar to the mental generation and compilation explained in cognition theories (Meltzoff, 199) (Siegal et, 1996)(Schick and de Villiers, 2007)(Schick, 2012)

The process of establishing a belief is based on following systematic logical assumptions usually as rational steps and sometime in unwritten algorithms. Establishing a belief does not really depend on a set objective but is strongly influenced by environmental factors like culture and experiences of the knowledge producer.

There are different kinds of knowledge topology. Generally speaking, knowledge topologies always include explicit and tacit knowledge. However, for knowledge to be useful for human activities, the common suggestion in these categorizations is the explicit type. The concern in this work is in explicit knowledge and its use for collaborative learning. This is because explicit knowledge can be qualified, characterized and evaluated in perspective of it use. The characterization is of paramount importance in a case where we have a number of objects. This is emphatic in this work. The question at the heart of the work is: How do we characterize logics and algorithms embedded in a set of belief while establishing an explicit knowledge?

After characterization of set of beliefs used in establishing knowledge, knowledge mapping can be done unambiguously. In knowledge mapping our interest is to characterize the set of sequences that were used in creating the knowledge type/state formally. When this is done common border can be established between sequences that were used.

Earlier report on knowledge mapping shows that it can contribute significantly to better knowledge management in complex policy discussion and decisions (Horn, 2001). This is particularly important when collaborative work is to be undertaken. The kind of knowledge presented in (Horn, 2001) was visual cognitive maps. This can be applicable to mental map of knowledge of students

2. RELATED WORK

Works in knowledge organization and knowledge mapping is generally skewed toward classified knowledge. Information science and archival studies are interested in organizing knowledge for its access. From this perspective, it was argued that mapping or classifying knowledge was important because universal maps depended on the fact that they affect our cognitive maps and thus affect the way we understand the world and act in it (Zins, 2007). The overall objective of this kind of mapping was to enables us to understand the structure of the information science knowledge domain and the conceptual relations among its major parts. Several other works looked at knowledge mapping as it apply to health delivery system and its application was to the health-system levels of (a) policy-making (b) institutional management (c) technology R&D (d) clinical practice and services (e) the community (Ebener et al, 2006) (Grimshaw et al, 2012)

An interesting discourse on knowledge transfer in an organizational setting proposed a formalized explication of the parallel division of knowledge development that was rooted in knowledge transfer process across an outsourcing context whereby the knowledge vendor was tasked with developing, documenting and sharing his explicit knowledge base of testing processes as both working tool and in respect of customer service owed to and owned by the client, while the knowledge client maintained tacit approach to skill development (Stafford et al, 2007). This view is not just knowledge transfer but an inter-personal knowledge mapping from creator to user in an organizational setting.

Social network essentially provided forum for measurement of tacit knowledge. Social Network Analysis was defined as a map and a measuring of relationships and flows between people, groups, organizations, computers, or other information or knowledge processing entities (Pollock, 2002). With good tools, flow of knowledge and changes in knowledge stages and topology can be measured.

3. EXPLICIT KNOWLEDGE MAPPING FOR COLLABORATION

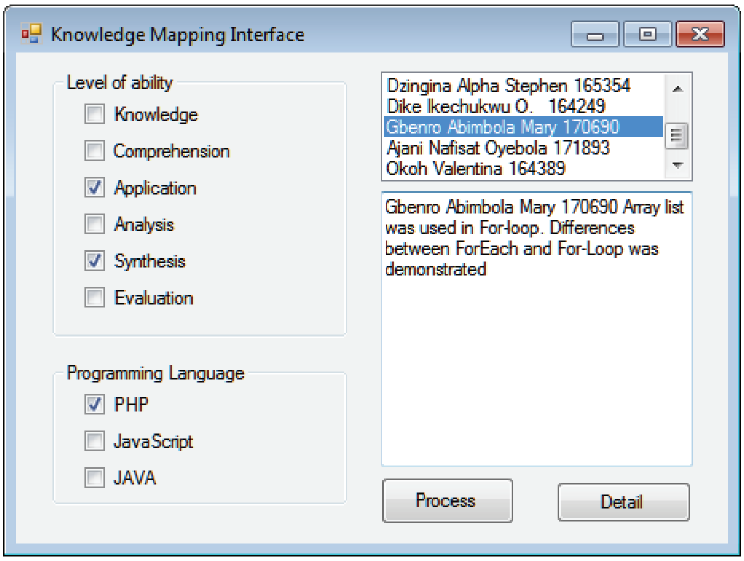
Bloom's work of Taxonomy of Educational Objectives (Bloom, 1956) identified three domains of educational activities as (a) Cognitive: mental skills (Knowledge) (b) Affective: growth in feelings or emotional areas (Attitude) and (c) Psychomotor: manual or physical skills (skills). The cognitive domain (Bloom, 1956) was explained from the perspective of knowledge and the development of intellectual skills. It detailed it as intellectual abilities and skills with six major categories starting from the simplest behaviour to the most complex. The categories were (a) Knowledge, (b) Comprehension (c) Application (d) Analysis (e) Synthesis and (f) Evaluation. These categories of intellectual ability were used for knowledge mapping for collaboration in a University setting.

Eighty second year student in a University were made to work on six programming projects. Their knowledge of programming was scaled according to the intellectual ability in learning taxonomy. The students were asked to state their knowledge of programming explicitly while they participate in the programming. Two languages of JavaScript and PHP were administered for a period of twelve weeks. The knowledge of students for the six different tasks was recorded. Implicit parameters of students were also recorded in XML format. Using the DOM technology knowledge of students was extracted comparatively to match the requirement of other students who are in need of collaboration. This is particularly important for students during their industrial (practical training) period when they will not have opportunity to share programming experiences physically. The mapping of knowledge was also needed for their final year project grouping.
When a student request for knowledge that is relevant to his need, the database containing knowledge of students is searched and relevant experiences are presented based on frequency of shared experiences.

4. RESULTS AND CONCLUSION

After characterizing learning ability level a system was developed to allow participants to share their experiences. Users of the system could request for users that has some levels of abilities in one or more programming languages. For example, in Figure 1, a user is interested in participants that have one of the two levels of ability (Application and Synthesis) in PHP programming language. The list of students meeting the criteria is displayed in the upper right section of the system. The user of the system can now select the detail experience of the student selected. Users have freedom of selecting detail information about selected student including other shared experiences of selected participant.

Figure 1: Interface for connecting to users who has similar experience



Sixty percent of the requests are of the learning level “Application”. Fifteen percent are they type “Synthesis”. Ten percent are the learning level “knowledge”. Seven percent are type “Comprehension”. Three percent are type “Evaluation” and five percent are type “Analysis”. It is clear that participants are interested in “applying” their learning to new areas outside the class-based application. The major request took place after the first three weeks of activities. Request for knowledge took place in the first two weeks of activities. Request for learning ability of type “Synthesis” and “Evaluation” took place in the last two weeks of activities.

Application of this method of knowledge mapping is not limited to collaborative learning but to personalized learning. A participant may want to learn programming from the perspective of knowledge only. This is necessary when a student is not familiar with a programming language and he is interested in several experiences based on that level. He could grow up the scale systematically until synthesis and evaluation. This work is also important if an instructor is interested in knowing the composition of his class to enable him decide the content of his teaching.

The work demonstrated a solution to one of the fundamental problems in sharing programming knowledge common to identifying a student that has similar experience and thinking patterns in a collaborative learning. It spelt out sharing programming knowledge when level of ability varied. However detail work is needed as to know the initial and final ability level and composition of the participants.

REFERENCE LIST

1. Bloom B. S. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co Inc.
2. Ebener, S., Khan A., Shademani R., Compernolle L., Beltran M., Lasang M.A., and Lippman M, (2006). Knowledge mapping as a technique to support knowledge translation; *Bulletin of the World Health Organization, 84*(8), 636-642
3. Business Dictionary, (2013). Knowledge Map Definition, Retrieved January 10 2012 from http://www.businessdictionary.com/ definition/knowledge-map.html
4. Grimshaw J. M., Eccles M. P., Lavis J. N., Hill S. J. and J. E. Squires. (2012). Knowledge translation of research findings, Implementation Science 2012, 7:50 doi:10.1186/1748-5908-7-50, Retrieved 13 December 2012 from http://www.implementationscience.com/ content/7/1/50
5. Horn R. E. (2001). Knowledge Mapping for Complex Social Messes, A presentation to the “Foundations in the Knowledge Economy” at the David and Lucile Packard Foundation, July 16, 2001, Retrieved from http://www.stanford.edu/~rhorn/SpchPackard.html
6. Meltzoff A. N., (1999). Origins of Theory of mind, cognition and communication, *Journal of Communication Disorder*, *32*, 251-269 Retrieved February 10 2013 from http://ilabs.washington.edu/ meltzoff/ pdf/99Meltzoff_JCommDisord.pdf
7. Schick B. (2012). Social Cognition & Theory of Mind Hands & Voices Communication considerations A-Z, Retrieved from http://www.handsandvoices.org/comcon/articles/pdfs/ socCogTheoryMind.pdf
8. Schick B. and de Villiers P. (2007). Language and Theory of Mind: A Study of Deaf Children Child Development ,*78*(2), 376-396, Retrieved 12 February 10 2013 from http://pavlov.psyc.vuw.ac.nz/ courses/Psyc%20443/ 415%20Papers/ Schick_et_al.pdf
9. Siegal M., Carrington J. and Radel M., (1996). Theory of Mind and Pragmatic Understanding Following Right Hemisphere Damage, Brain and Language *53*, 40-50. Article No. 0035. Retrieved 10 January 2013 from http://pavlov.psyc.vuw.ac.nz/ courses/ Psyc%20443/415%20Papers/ Siegal_et_al.pdf
10. Stafford T. F., Gillenson M.L., Richardson S., (2007). The Division of Knowledge: Knowledge Transfer Practices in Outsourcing, Workshop on Advances and Innovations in Systems Testing. Memphi, TN
11. Pollock, N. (2002). Knowledge Management and Information Technology (Know-IT Encyclopedia), Defense Acquisition University Press, Fort Belvoir, Virginia, First Edition
12. Zins C., (2007). Knowledge Map of Information Science, *Journal of the American Society for Information Science and Technology, 58*(4), 526-535