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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

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APPENDIX/ANNEXURE

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DATA MINING IMPACTS ON HIGHER EDUCATION

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ABSTRACT

Data Warehouse can serve as a storage medium for keeping the business memory, or at least involving certain types of data. It helps gaining new knowledge by delivering well integrated data to analysis tools and thus becomes an important part of Decision Support Systems or Executive Information Systems. Sharing and reuse of relevant knowledge during project could prove significant benefits. In this way a Data Warehouse; storing, managing and sharing data; results in growth of knowledge and may lead to enhance the enterprise's quality and success. Data mining can be considered a way to discover knowledge in large databases. New knowledge may be further managed by the applications of knowledge sharing and reuse. As a new technology, data mining has emerged with the development of database technologies, which allow the user to access or process a large amount of information. The present work relates Data Warehousing and Data Mining to Knowledge Discovery and Knowledge Management (including knowledge sharing and knowledge reuse). Apply this to the higher education sectors and compare their results to diagnose pros and cons.

KEYWORDS

Achievement Measure, Course Objectives, Performance Analysis, Students' Assignments.

INTRODUCTION

The process of data collection in the organizational memory generates a great amount of data requiring automatic or semi-automatic procedures for treatment and analysis for acquisition of new knowledge for next step. It is possible to create a model for organizing and measuring knowledge upgrade in systems of education with the support of Data Warehousing and Data Mining tools.

Today's organizations are creating data and information at an unprecedented pace. Much of that data comes from organizational business transactions. Traditionally, that data has resided on corporate servers and has represented operational on-line transaction processing (OLTP) data. The goal of a data warehouse is to integrate applications at the data level. The data is extracted from operational systems, cleansed, transformed, and placed into the data warehouse. Although the notion of creating an integrated data warehouse is appealing conceptually, it may be infeasible operationally. Trends indicate that federated data warehouse architectures are more practical, from the political, operational, and technical points-of-view.

Moreover, as organizations move their operations to the Internet and establish partnerships, via portals and extranets, with both their customers and suppliers, the "data" for the e-enterprise becomes distributed among many parties. This presents both challenges and opportunities in building enhanced data warehouses that reflects the information holdings of the modern organization.

Our notion of the data warehouse must be extended to include not only operational transaction-oriented data, but also data created by knowledge workers within the enterprise. We can then include technical reports, correspondences, presentations, audio, video, maps and other heterogeneous data types, as well as unstructured data.

Increasingly, we view the Internet and the World Wide Web as data sources that complement e-enterprise information holdings. The data collected from the Web must be incorporated into the data warehouse for business decision-making.

Data warehouse holdings can be used for business intelligence, based upon knowledge created by means of data mining and knowledge discovery. However, in order to acquire, catalog, organize, index, store and distribute the enterprise's information holdings, we need to address issues related to the management of knowledge resources, termed knowledge management. In this proposal, we present suggestion for the management of higher educational institution knowledge assets in the context of data warehouses and data mining.

DATA MINING AND DATA WAREHOUSING IN EDUCATION

Data Warehouse (DWh) can serve as a storage medium for keeping the business memory, or at least involving certain types of data while Data mining can be considered a way to discover knowledge in large databases. As a new technology, data mining has emerged with the development of database technologies, which allow the user to access or process a large amount of information. The purpose of data mining techniques is to generate automatic tools to investigate and extract information from databases. The extracted knowledge is finally presented in terms of models and rules among variables.

Data mining techniques are very powerful tools and can be used to describe the database in a concise way by capturing important properties, or to predict new data based on a set of models/rules extracted from the database. Due to their multidisciplinary application, a multitude of data mining techniques may be studied, applied and proposed in a variety of different fields. Visual data mining can be considered a data mining process enriched by visualization methods.

By the advancement of information technology, the global economy has been greatly affected by knowledge growth rate. Knowledge (and the reuse concept of knowledge) is the most important asset for organizations. Effective Knowledge Management (KM) and knowledge discovery have been not only becoming the possible solution for enterprise while it has also been becoming a difficult to manage knowledge more effectively in a competitive environment. Now days we can realize that managing and discovering knowledge is a much more complicated process than previously thought due to rapid changes are being taking place in an electronic age.

The goal of data warehousing has been to create a centralized and unified view of enterprise data holdings. Many factors contributed to this, such a problem of semantic heterogeneity, terminology conflicts, etc. However, one of the overriding factors has been the need for organizations to assert ownership over the data. Organizations wish to own their data, wish to assume responsibility for the stewardship of their data, and wish to share and reuse their data according to well defined agreements. Some works, that apply Data Mining techniques in education, concentrate on the data gathered during student interaction with communication tools: chat, forum and e-mail.

We are interested in applying data mining on students 'performance-data' obtained through different assessments with the help of an online database system. (See the figure.) The basic idea is to prepare the data collected from a student's several assessments, in each item of the ontology (subjects) and relate them (cross over) by using their hierarchical organization, in order to discover new knowledge about the student learning by using data mining and data warehousing tools. (See the figure) A method of survey may be employed where statistical tool like SPSS can boost analytical power of the performance measurement.

We will try to point out in which way the DWh could contribute to an organization wide knowledge management, knowledge sharing and reuse. In fact, a DWh could serve as one main component in a knowledge management system. The data contained in a DWh represents a large part of a company's knowledge, e.g. the company's clients and their demographic attributes. The DWh represents an organisation wide data collection, which is central and defines a common basis for several organisational units accessing it. From the stored data, new knowledge can be derived as well shared and reused using technologies such as Knowledge Discovery in Databases (KDD) and related tools.

Knowledge sharing and knowledge reusability could be the issues when we exploit the maximum performance of a given Data warehouse. It could not only increase the quality and reliability while it substantially helps in increasing the output. Knowledge Management, sharing and reusability issues taken together with other aspects of the database can help us in optimising and hence maximising the available knowledge in the organization. It will also help in the enhancement of the quality of data and knowledge because of its reusability and sharing. Reusability makes the data and knowledge qualitatively better because of its repetitive use.

The proposed model for continuous accompaniment of the learning, through the monitoring of the student's Knowledge Acquisition Level (KAL) in each item of the knowledge domain, making the identification of the learning gaps possible. (See the figure.) The model also supports the monitoring and the development of metacognitive processes in order to allow the student controls his own learning through the process of self-regulation, which comprises self-monitoring, self-evaluation, and self-reinforcement.

However, this process of data collection generates a great amount of data requiring automatic or semi-automatic procedures for treatment and analysis for acquisition of new knowledge for next step. This model is for organizing and measuring knowledge upgrade in systems of education and learning with the support of Data Mining. Some works, that apply Data Mining techniques in education, concentrate on the data gathered during student interaction with communication tools: chat, forum and e-mail.

In our work, we are interested in applying data mining on students 'performance-data' obtained from several assessments (for example, Test1, Test2, Assignment1 and Final Examination). The basic idea is to prepare the data collected from a student's several assessments, in each item of the ontology (subjects) and relate them (cross over) by using their hierarchical organization, in order to discover new knowledge about the student learning by using for data mining tools.

Assessment module table 1 presents a sketch of the table (from database) that contains assessment data (performance) stored in relational database model that must be prepared to generate a multidimensional model, as shown in the Table 2 of the Student module.

Each objective (O1.1 for example) can be measured in several assessments. The Knowledge Acquisition Level (KAL) indicates the student knowledge level in a specific item of the knowledge domain and can be calculated, for example, as the arithmetic average of the student performance data in that item in the several assessments. For instance, for objective O1.1 the KAL value after two assessments would be:

(75+95) / 2 = 85

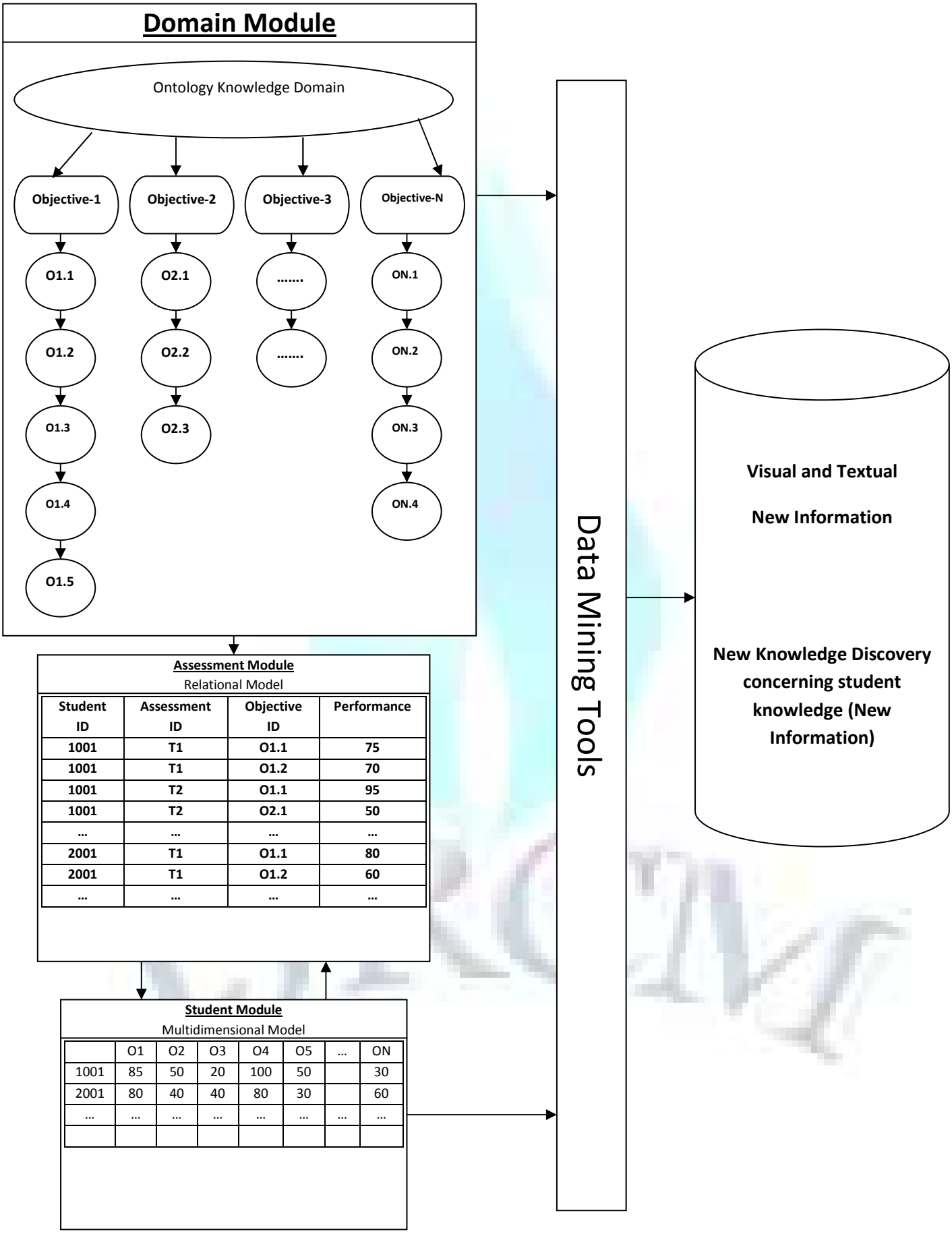
In the multidimensional table of the Student Module, the objective (O1, O2,…,ONN) correspond to the objective evaluated (each line of the table in relational model) and the measures correspond to respective KAL. (The objectives are all specified clearly and distributed to the students at the beginning of the course along with the syllabus for that course.)

After the treatment of original data, some data mining techniques could be applied for knowledge discovery, such as: clusterization, segmentation, classification, association, etc. Moreover, visual data mining tools can be used too. The use of Data Mining is justified since in an ongoing accompaniment learning model the historical data must be kept and processed for new knowledge discovery. Moreover, the decisions based on historical data help the educators to see who their pupils are and which qualities and difficulties they share. The implementation of a program of data and analysis can take to improvements in education as no other innovation has done so far.

Based on the principle that it is necessary to identify continuously what the student knows (cognitive and metacognitive measures) and to keep this information so that it can be used for instruction, this work propose a model for knowledge organization and measure based on ontology, and with the data mining techniques support, to make the discovery of new information automatic from the data gathered with the several assessments.

The proposed model is based on knowledge organization using ontology (module of the domain) representing the learning hierarchies. Each problem or question assessment must be associated with the ontology items indicating clearly the objectives of the evaluation, or rather, what is being evaluated (assessment module).

In this way, it is possible to establish a knowledge measure (KAL) for each ontology item in the model. The establishment of the measure in each ontology item will allow the selection of more adjusted evaluations to the current student KAL. Moreover, it will favour an adjusted instruction in accordance with the student learning gaps due to his learning necessities. Based on knowledge organization using ontology (Domain module) and the current student knowledge (Student module), the proposal is to apply data mining techniques for new knowledge discovery concerning the student knowledge (new information). The use of visual tools will assist in the new knowledge reading and interpretation.


Domain Module
Ontology Knowledge Domain
Objective-1
Objective-2
Objective-3
Objective-N
O1.1
O1.2
O1.3
O1.4
O1.5
O2.1
O2.2
O2.3
.....
.....
ON.1
ON.2
ON.3
ON.4
Assessment Module
Relational Model
Student ID
Assessment ID
Objective ID
Performance
1001 T1 O1.1 75
1001 T1 O1.2 70
1001 T2 O1.1 95
1001 T2 O2.1 50
... ...
2001 T1 O1.1 80
2001 T1 O1.2 60
... ...
Student Module
Multidimensional Model
O1 O2 O3 O4 O5 ... ON
1001 85 50 20 100 50 30
2001 80 40 40 80 30 60
... ...
Data Mining Tools
Visual and Textual
New Information
New Knowledge Discovery concerning student knowledge (New Information)

CONCLUSION

Knowledge-based support for decision-making is becoming a key element of a Higher Educational setting. Traditional data warehouses with the combinations of knowledge management environments and its related tools may influence Higher Educational decision-makers. This work proposes a knowledge oriented model together with a collection of services that can be used to manage and encourage knowledge activities within the Higher education through the data mining and data warehousing techniques.

The learning assessment process that aims to diagnose the learning gaps in order to improve the instruction can generate a great amount of data. Thus the collected data need to be treated and interpreted so as to provide new and necessary information concerning the student knowledge level. The model for organizing and measuring knowledge upgrade in systems of education and learning with the support of Data Mining tools in order to generate new information from the assessment data in an automatic or semi automatic way. The model is based on knowledge organization using ontology that allows to represent the learning hierarchies. Thus it makes possible to establish the knowledge acquisition level in each item of the domain. Intention is to sort out and test some data mining techniques and tools and implement the prototype to test and validate the proposed model.

Successful knowledge management (including knowledge sharing and reuse) needs to integrate data bases, information systems, and knowledge based systems. As it has been shown in the figure above, a Data Ware-house can connect these kinds of systems. It provides a wide basis of integrated data. This data can be presented and utilized via proper knowledge management; knowledge sharing and knowledge reuse activities with the help of data discovery or related tools.

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