Hierarchical Structures of Content Items in LMS

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Of the many applications enabled by new technologies, the most commonly used in higher education are Learning Management Systems (LMSs), e.g, Moodle, BlackBoard, which enable a wide range of Web-supported courses. LMSs enable the instructors to develop websites for their courses to support face-to-face teaching by means of different tools. Although most of the LMSs offer an enriched environment that goes beyond the usual content management tools (including communication tools and course management modules), these systems are mainly used for transferring information and increasing accessibility of learning materials [1-3]. Usually, the content modules in these systems enable the construction of a hierarchical repository of information items; consequently, the instructor is able to create folders and upload files creating variety of repository structures, which are presented to students in the course site.

The main purpose of this research is to empirically study the types of online hierarchical structures of content items presented to university students in Web-supported courses. Three research questions are addressed in the study: 1) What is the extent of content items presented to university students in online repositories within Web-supported courses? 2) Which types of hierarchical structures of content items are empirically revealed? 3) What are the associations between the types of structures and *Number of Items*, *Course Size*, and *Content Consumption*? Three groups of variables were defined, describing characteristics of each course, as following:

Repository Size Variables

    A. *Number of Items*: total number of content items in the repository

    B. *Number of Folders*: total numbers of folders in the repository

Repository Structure Variables

    C. *Average Folder Size*: *Number of Items* divided by *Number of Folders* (=A/B)

    D. *Largest Folder*: number of items in the largest folder in the repository

    E. *Largest Folder Share*: ratio of *Largest Folder* to *Number of Items* (=D/A)

    F. *Hierarchical Depth*: maximal repository depth (i.e., length of a path from the root)

    G. *Visible Width*: number of folders located immediately under the root; this number represents the width of the repository as presented to the students.

    H. *Width-depth Proportion*: ratio of *Visible Width* to *Hierarchical Depth* (=E/F).

Course Characteristics (Independent)

    I. *Course Size*: number of registered students

    J. *Content Consumption*: average consumption of content item per student

The research was carried out on a full sample of Fall term courses in Tel Aviv University (academic year 2008/9) which were accompanied by a Website within the HighLearn LMS (by Britannica Knowledge Inc.), N=1,747. Raw data was extracted using SQL queries on HighLearn databases. In this data file, each row corresponds to a single content item within the system, and documents the unique ID of the course to which the item belongs and its full path within the repository. The data file consisted of 72,753 rows (i.e., content items) of 1,747 courses. Revealing types of repository structures was done using Two-step Cluster Analysis on a reduced population which included only courses the repositories of which consisted of 15 content items or more, N=1,203.

Results suggest that *Number of Items* is largely varied between 1 and 1,029, with an average of 41.64 files (SD=69.10). The mean of *Number of Folders* was found to range between 1 and 185, with an average of 10.69 (SD=16.78). This average demonstrates a large growth in content items delivery at Tel Aviv University, comparing to earlier studies of the very same LMS [1,4].

Regarding the repository hierarchical structures, five types were found: 1) **Main-folder Structure**: no depth, almost all files piled, large folders (n=67); 2) **Extensive Filing**: high depth, small folders (n=120); 3) **Flat Small Folders**: flat hierarchy, small folders (n=222); 4) **Pile in Hierarchy Filing**: pile exists, small folders (n=354); 5) **Pile in Flat Filing**: flat hierarchy, big pile exists (n=440).

Association was found between the repository structure and *Number of Items*, according to which large repositories are associated with extensive filing. It was also found that *Course Size* is statistically significantly different between courses demonstrating Main-folder and Extensive Filing structures: The average *Course Size* took the highest value in the Extensive Filing courses (63.49, SD=61.95), and the lowest in the Main-folder courses (34.78, SD=34.43). In addition, association was found between the repository structure and its consumption, as measured by *Content Consumption*. On average, lowest *Content Consumption* was demonstrated in the Extensive Filing courses (0.77, SD=0.51), and the highest – in the Pile in Flat Filing courses (1.46, SD=0.72).

LMSs are often being studied using usage analysis for various purposes [5]. In this study, we used automatically collected data describing the structures of content items presented in Web-supported courses. However, it is not clear that this research falls into one of the 3 classical categories of Web mining (usage mining, content mining, and structure mining) [6]. As EDM research widens its horizons and examines a wide range of data originated in many different learning contexts, the categorization of Web mining studies might be re-examined.

References:

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