



Research Article

Taxonomy Approach for Organizing Knowledge in Academic Institutions

Suzana Basaruddin¹, Haryani Haron² and Siti Arpah Noordin²

¹Universiti Selangor, Bestari Jaya, Selangor, Malaysia

²Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia

Correspondence should be addressed to: Suzana Basaruddin; suzana_b@unisel.edu.my

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Abstract

Knowledge organisation is critical to ensure that knowledge is being distributed widely in an organisation. There are a lot of approaches to organise and manage knowledge. One approach that has been found for so long but has not been explored to its optimum is taxonomy approach. This paper presents how taxonomy approach is able to provide an alternative solution to managing and organising knowledge in the institutes of higher learning (IHL). In the study, qualitative methods namely document analysis using thematic analysis, observations, and semi-structured interviews were employed during data collection. This study highlights the taxonomy concept and approach, and proposes a corporate taxonomy framework in IHL environment. A clear taxonomy concept and approach discussed in this article is for the future development and implementation of the taxonomy in IHL.

Keywords: Corporate taxonomy, knowledge organisation, knowledge management, institutions of higher learning, academic institution.

Introduction

Academic institutions and knowledge are two components that complement each other. Institutes of higher learning (IHL) are responsible for making the society better in terms of knowledge in all domains, and for developing knowledgeable societies for countries in many domains. Among the responsibilities of IHL in knowledge provision are in advancing products and services, commercialisation, publications, strategy, policy, teaching and learning, curriculum, promotion, and performance in public and private sectors (Basaruddin et al., 2013).

This huge expectation of the society has put a high pressure on IHLs' stakeholders in terms of organizing knowledge shared, distributed, and reused freely in the institutions. Many research studies suggested to the IHLs' knowledge organisation and knowledge management to support the stakeholders' expectation. However, there are still loopholes in the process of organising and managing knowledge. The knowledge organisation and knowledge management approaches must suit to the dynamic and multi-dimensional components of the IHLs.

Taxonomy approach is supporting dynamic and multi-dimensional components and has been introduced to classify living things. It was then applied to the other areas using the concept of classification, controlled vocabulary, and thesaurus. Well-developed taxonomy is able to act as a single central reference, and therefore eliminates the problem of distributed knowledge source in the organisation.

Literature Review

Roles of Knowledge

The researcher has found and analysed 14 academic articles that highlight the roles of knowledge in IHL. The results of analysis, organised by education, industry and government sectors, are depicted in Table 1.

Table 1: Roles of Knowledge in Education, Industry and Government

Sector	Roles of knowledge	Author/s
Education	Stimulating academic publications	Consilz (2008)
	Accomplishing the national higher education strategic plan 2020	Sirat (2010); Morni et al. (2009)
	Improving the teaching and learning	Consilz (2008); Yin (2007); Rogers (1999)
	Enhancing curriculum to meet rapid technology changes	Chandran et al. (2010)
	Fulfilling individual academic promotion criteria	Hassan et al. (2008); Yu (2009)
Industry	Extensive study impact on product and services	Rothaermel and Thursby (2008); Rogers (1999)
	Promoting the commercialisation	Geuna and Muscio (2009)
Education, Industry and Government	Monitoring the implementation of policies and programs, and in refining policy	Power (2007)
	Fulfilling organisation performance criteria	Yu (2009)

The nine important roles of knowledge in the three sectors shown above reveal the role of knowledge and its contribution to the development of human capital that is important for country development. IHL contributes by stimulating knowledge exchange, conducting knowledge base activities like workshops, seminars and conferences, and producing graduates that fulfil the requirements of the industries. Knowledgeable societies and communities are expected to contribute to the economy and development of countries. While knowledge plays an important role in country development, in the knowledge providers' environment (IHL); knowledge has not being optimised (Barnett 2000; Mohayidin et al. 2007; Geuna and Muscio 2009). Among the issues are i); knowledge is not supporting decision making (Rahman and Hamidi 2006; Daud 2010; Morni et al. 2009; Hamidi and Jusoff 2009), ii); knowledge is scattered (Hamidi and Jusoff 2009, Rahman and Hamidi 2006), iii);

knowledge is unstructured (Mohayidin et al. (2007) and, Hamidi and Jusoff (2009), iv); knowledge is not recognised as strategic knowledge asset ((Rahman and Hamidi 2006, Metcalfe 2006); and finally v) knowledge is not classified and presented as a central and as a standard element (knowledge taxonomy) (Lambe 2011; Abdullah et al. 2004). All of these problems laid the foundation of this research (Basaruddin et al. 2013).

The researchers of the previous studies related to knowledge in IHL also proposed a few solutions related to managing IHL knowledge. Hassim et al. (2005) and Mohayidin et al. (2007) proposed a general knowledge management system for IHL; Hamidi and Jusoff (2009), Rahman and Hamidi (2006) and Basaruddin and Haron (2011), developed Organisational Memory Information System (OMIS) and Organisational Memory System (OMS). All of the solutions suggested a computer-

based system to manage knowledge. Anyhow, Sheng et al. (2010) found that developing more computer-based systems shall not help in finding a solution to the scattered knowledge asset. Instead, this will actually invent more distributed knowledge resources instead of the unmanaged existing ones. Due to that, taxonomy approach has been highlighted to provide an alternative solution to manage existing knowledge resources in IHL.

Taxonomy is able to act as a map of knowledge domain (Nickerson 2009). Lambe (2011) and Wyllie et al. (2011) clearly mention that knowledge taxonomy could provide standard and common understanding of subjects in organisations. Malafsky (2011) describes knowledge taxonomy as being precise, does not overlap, has independent content, reflects organisational access needs and is a

recognised industry standard. Therefore taxonomy is able to be the centralized reference and to solve the scattered knowledge assets issues. Knowledge taxonomy focuses on ensuring efficient knowledge sharing and access among organisational members (Sharma et al. 2010; Nickerson 2009; Malafsky 2011).

The Advantages of Having Taxonomy

Taxonomy offers huge benefits and is crucial for the processing, storage, management and searching of knowledge in organisations (Subramaniam et al. 2010; Jung 2008). It has universal applications of grouping knowledge so that it can be systematically developed, stored and reused (Malafsky 2011). The following table elaborates on five advantageous points of taxonomy derived from the literature review.

Table 2: Advantages of Taxonomy

No	Advantages of Taxonomy	Description
1	<i>Taxonomies contribute to making explicit knowledge available when necessary.</i>	The knowledge domains and benefits associated with taxonomies show that the latter are limited to the content of documents and databases, but able to activate the tacit knowledge that resides within people (Nickerson et al. 2009). They help the mapping and categorisation of tacit knowledge embedded in staff expertise (Nickerson et al. 2009; Malafsky 2011).
2	<i>Taxonomy is meant for managing local resources; managing experts and internal information (Delphi group 2004, Malafsky 2011).</i>	Taxonomy has to be treated as an integral part of the knowledge management strategy of the organisation. When the strategy is implemented as a project, taxonomies are a key task that needs to be planned and implemented by teams equipped with the necessary knowledge and skills. All organisation's strategies (vision, mission and plan), resources (assets and liabilities), and stakeholders (staffs, customers, and suppliers) should be reflected in their corporate taxonomy.
3	<i>Taxonomy as a search tool</i>	The main benefit of taxonomy is that, when information is well-organised and consistent across an organisation, staff will spend less time searching and browsing. As a search tool for investigation, alternative search shows that the user does not want to navigate more than four layers down in the hierarchy, and with extensive searching using taxonomy, the user will get the result faster and intuitively to enrich their research experience and leverage their expertise (Woods 2004; Cisco and Jackson 2005; Hedden 2008; Lytras and Pouloudi 2006; Serrat 2010; Sarmiento et al. 2005; Malafsky 2011).
4	<i>Taxonomy may support the way of working</i>	The purpose of taxonomy is to find information and documents and to contribute to a broader vision of knowledge management and then, identify different ways for the organization staff to work together. This is because memory structures could become

		taxonomy structures (Nickerson et al. 2009). Collective tacit memories of staff shall help in completing taxonomy construction. Taxonomy is able to promote collaboration and sharing and distribution between units and departments of an organization (Woods 2004; Cisco and Jackson 2005; Sharma et al. 2010; Malafsky 2011). It also helps put knowledge into practice by making sense of the knowledge of the organization and creating a common item and way of working.
5	<i>Taxonomy can perform at an initial navigation level to assist and accelerate research and discovery or exploratory guide</i> (Hedden 2008; Serrat 2010; Sharma 2010).	It helps in understanding the conceptual organisation structure and categorisation of business documents; standardising things, linking ideas, concepts and words (Choksy 2006; Gilchrist 20110; Muhammad 2010; Lytras and Pouloudi 2006; Forward and Lethbrige 2008; Sarmiento et al. 2005; Wyllie et al 2011). It will also act as a front-end to search so that a new comer of the subject area may begin the research process by navigating through taxonomy (Woods 2004; Cisco and Jackson 2005). This shall help as a communication and training device and shall provide history as well (Malafsyk 2011). The well structured business systems should be able to drive better design of business systems, information and knowledge flow (Serrat 2010). Taxonomy has also been described as having the ability to enable business processes, protecting intellectual property (Gilchrist 2001) and depicting a network of relationships as well as intensifying the information and knowledge flow (Sarmiento et al. 2005). A well-structured corporate taxonomy shall be able to support enterprise portal (Barquin 2001), especially in the construction of contents as required by the organisation. Figure 1 projects the main five taxonomy benefits to an organisation derived from the study on taxonomy benefits from related literature.

As the foundation for all activities within the corporation is related to documents, taxonomy can gather a wide range of corporate objectives, such as enabling business processes, protecting intellectual property, and building the foundation for compliance (Gilchrist 2001). Ultimately, taxonomies need to *reflect the working environment and culture* of the organisation for which they are created (Wyllie et al. 2011). Since working environments change continuously, taxonomies should also be flexible and adaptive to the changing environment (Cisco and Jackson 2005). This study shall address taxonomy from the dimensions of knowledge for IHL. Before that, the study explores on taxonomy applications, concepts and approaches.

Taxonomy Applications

Taxonomy is a structured and classified information and knowledge in an organisation (Nikerson et al. 2009; Sharma et al. 2008; Lytras and Pouloudi 2006;

Malafsky 2011]). In managing Science and Information System (IS) fields, the importance of taxonomy is well recognised (Sharma et al. 2010). This is agreed by Malafsky (2008) when he notes that in information sciences, the study of CT has been subject to considerable and longstanding interest among both researchers since the 90's. Lambe (2011) in his presentation of "Taxonomies and Knowledge Management" revealed a survey results of 187 taxonomy professionals conducted from September to October 2009. The ecosystem of taxonomy work shows taxonomy related work has been done in various disciplines. They are most populated in information and knowledge management, information science, and library science domain order by most popular domains. Following them are linguistic, information technology, cognitive psychology and business analytics domains in descending order. Other than that are philosophy, management, publishing and editorials, respectively. Taxonomy concept has been

applied to wider disciplines and domains. Most taxonomy applications have been practiced in the area of content management and metadata management, followed by archives and records management, digital asset management, document management, information architecture and data management. Zooming to the sub-level of the taxonomy work ecosystem, taxonomies have been applied to intranet management, usability design, text mining and web management

followed by business management and research management. Other application areas include instructional design, IT management, software design, system analytics and technical writing.

Lambe (2007) study was supported by Lars (2004) and Muhammad et al. (2010) who claimed that taxonomy was used to start knowledge management (KM) project. Figure 1 projects taxonomy applications in various domains.

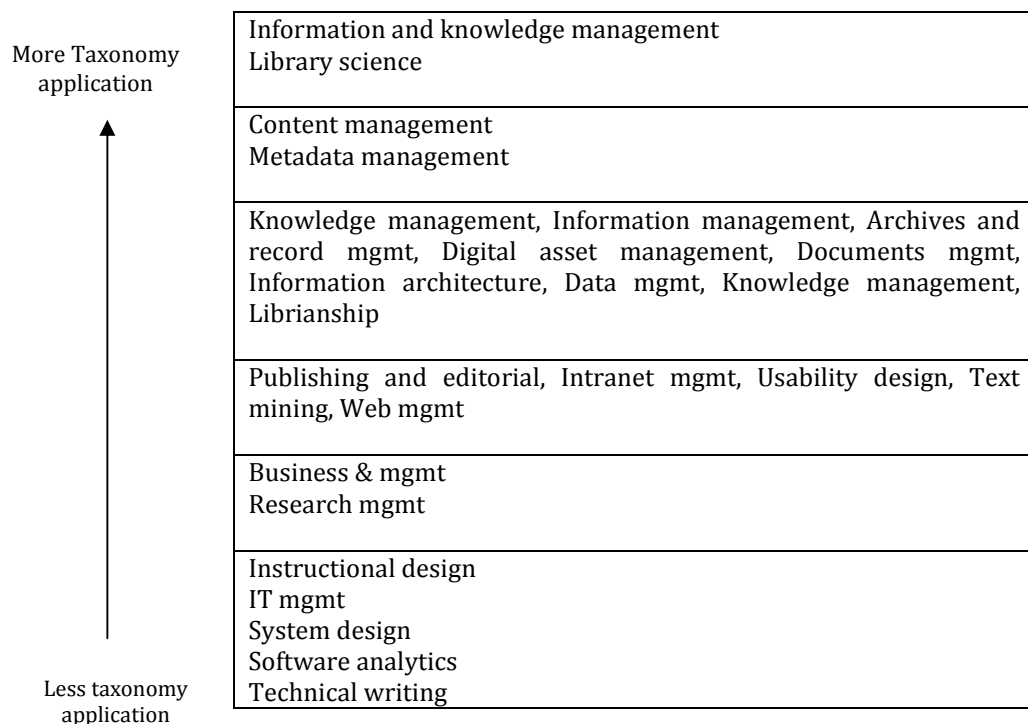


Fig 1. Taxonomy Work (Lambe, 2011)

Lambe (2011) has not directly included education domain in his study. The researcher noticed that from the lens of education, the taxonomy application falls mostly under information, knowledge management and information technology domain. Bloom's taxonomy is the widely used taxonomy in education domain (Gina and Russel 2004). Some other examples of taxonomies in education can be found on Taxonomy Warehouse website: 'Cyc Education Taxonomy Suite', 'Education, Skills & Children's Services Thesaurus', 'Gale Education Thesaurus' and 'WAND Education & Training Taxonomy'. While other taxonomies might be used internally in academic institutions, initial inspection

through observation and semi-structured interviews at one public academic institution in Selangor, Malaysia noticed taxonomy has been used in administration that is in filing – in assigning filing code and letter reference code. Other than library classification system being used, the usage of Bloom's taxonomy and filing taxonomy are the evidence that taxonomy has been used at institutions level (corporate taxonomy) and is a clear proof that taxonomy is one way to record tacit knowledge, manage internal information, as part of search tool, support way of working and as initial navigation level of related subject in IHL. Researcher believes that there's a lot more opportunities in

classifying unstructured knowledge in these institutions.

Taxonomy Concepts

In the category of semantic taxonomy, word taxonomy has been interchangeably used with classification and structure (Cisco and Jackson 2005; Nickerson 2009; Sharma et al. 2008; Lytras and Pouloudi 2006; Lambe 2011). Taxonomy has also been related to a controlled vocabulary and thesaurus. In order to understand taxonomy clearly, the researcher digs into taxonomy related words from Lambe (2007). The findings show that the three words (classification, controlled vocabulary, and thesaurus) have established a relationship with taxonomy. The basis of semantic taxonomy is when the items are classified. Classified items when sorted into alphabetical order become controlled vocabulary, and the latter when assigned a relationship with others will become thesaurus.

When dealing with bases of explicit knowledge stored in electronic format, any taxonomy utilised is tightly coupled with the body of metadata utilised to define, identify, point, describe and characterize the contents of the knowledge base (Lambe 2007). Sharma et al. (2010) have come up with Functionalities of Taxonomy Builders and Classifiers that project all the main

components related to taxonomy. Gina and Russell (2004) and Lambe (2007) categorised knowledge taxonomy into three main features or types: classification scheme, semantic representation, and knowledge map. Nickerson et al. (2009) gave an example of established classification scheme as Dewey Decimal Classification (DDC) mostly uses in libraries. An example of semantic representation given was a search engine while the knowledge map concept was said to assure the global picture of a scenario or condition.

In most taxonomy descriptions, taxonomy has been reflected in the form of a hierarchy. This is argued by Lambe (2011). He elaborated the taxonomy form could be from a simple list to a complex system map. Sharma et al. (2008) in their functionalities of taxonomy builders and classifiers mentioned four basic forms of taxonomy that are tree or node, map, star (polyhierarchies) and folder (list). Lambe (2007) reveals additional three forms from Sharma et al. (2008) that are: hierarchies, matrices and facets. Each form has its own usage preference and level of complexity. The levels of complexity generally increase from list to system maps. Table 3 depicts the taxonomy forms (Lambe, 2007 and Sharma et al., 2008) and Table 4 summarises the representation levels of taxonomy forms (Lambe 2007).

Table 3: The Taxonomy Forms

Author/Taxonomy form	List	Tree/ node	Hierarchies	Polyhierarchies/ star	Matrices	Facets	System Maps
Sharma et al. (2008)	√	√	x	√	x	x	√
Lambe (2007)	√	√	√	√	√	√	√

Table 4 : The Complexity and Representation Level

No	Taxonomy form	Suitable representation
1	Lists	< 12 items, items do not have many level sub items
2	Tree	unambiguous relationship of subordinates and superordinates
3	Hierarchies	inclusiveness, relational consistency, inheritance and mutual exclusivity
4	Polyhierarchies	more than one main organising principle at work.
5	Matrices	categorise content along with multiple dimensions
6	Facets	main type of organising principle are transparent and well understood
7	System maps	visual knowledge domain

Less complex Taxonomy
 ↓
 More complex taxonomy

Besides the above suitable criteria for choosing taxonomy forms, complexity of the taxonomy is also found to be a deciding factor for choosing the right taxonomy form. The investigator found out from the literature (Lambe,2007; Sharma et. al, 2008) that the number of words is aligned with the degree of complexity for each taxonomy form. System maps support the most complex taxonomy forms and huge numbers of vocabularies. While the list is the simplest form of taxonomy, it would contain few vocabularies. Trees, hierarchies, polihierarchies, matrices and facets are supporting simple to complex taxonomy form ranging from a small number of vocabularies to a bigger one.

While analysing articles about taxonomy, the researcher found mutual understanding of taxonomy. Taxonomy project should involve controlled vocabularies, logical business

arrangements and some representations of specific domain in conceptual map, for the purpose of generalisation in the organisation.

Taxonomy Development Approaches

The simplest taxonomy development stages done by Malafsky 2008 consist of two levels: information and knowledge identification, and Draft taxonomy development, while Sharma et al. 2008, Whittaker and Breininger (2008), Connelly 2007, Nie et al. 2007& woods 2004 went through five levels of taxonomy development phases that are: i) Information and knowledge identification, ii) Taxonomy draft development, iii) Taxonomy draft testing and verification, iv) Taxonomy finalisation and finally v) Taxonomy presentation. Table 5 depicts the compilation taxonomy development phase from the literature.

Table 5: Compilations of Taxonomy Development Phase

<i>Researcher (year)</i>	<i>Taxonomy Development phase</i>				
	<i>Information and Knowledge identification</i>	<i>Draft taxonomy development</i>	<i>Draft taxonomy testing and verification</i>	<i>Taxonomy finalisation</i>	<i>Taxonomy presentation</i>
Lambe (2011)	✓	✓	✓	✓	-
Rajesh et. al (2011)	✓	✓	✓	✓	-
Hevner and Chatterjee, (2010)	✓	✓	✓	-	-
Serrat (2010)	✓	✓	✓	-	-
Nickerson (2009)	✓	✓	✓	✓	-
Forward and Lethbridge (2008)	✓	✓	✓	✓	-
Malafsky (2008)	✓	✓	-	-	-
Sharma et. al (2008)	✓	✓	✓	✓	✓
Whittaker and Breininger (2008)	✓	✓	✓	✓	✓
Connelly (2007)	✓	✓	✓	✓	✓
Nie et. al (2007)	✓	✓	✓	✓	✓
Choksy (2006)	✓	✓	✓	-	-
Woods (2004)	✓	✓	✓	✓	✓

On average, the thirteen taxonomist compilations of taxonomy development phase show there is an agreement on the development phases of taxonomy that consists of i) information and knowledge identification phase, ii) draft taxonomy development phase, iii) Draft taxonomy testing and verification phase and taxonomy finalisation. Five taxonomists added a fifth phase that is v) taxonomy presentation phase. Some taxonomists include the taxonomy presentation during the finalisation of taxonomy phase.

Methodology

In this study, the researcher uses document analysis method to extract the literature review of taxonomy concept and approaches, and the knowledge organization and management of IHL. The articles from various journals, conferences, books and technical papers related to knowledge taxonomy and academic institutions were analyzed using thematic analysis. There are six themes analyzed and depicted in Table 6.

Table 6: Thematic Analysis

No	Theme	No of articles analyzed
1	Roles of knowledge	11
2	Advantages of taxonomy	17
3	Taxonomy applications	9
4	Taxonomy concepts	9
5	Taxonomy development	13
6	Taxonomy framework	23

For knowledge organization and management issues, the researcher conducted semi-structured interviews and observation at one public academic institution in Selangor, Malaysia. A semi-

structured interview involved one person who is in charge of IT in main library, one person in charge of archive unit, one person in charge of IT in research unit, and two coordinators of one faculty. The

interview aimed at investigating and exploring taxonomy usage in academic background. The two coordinators and three heads of curriculum units were also interviewed to investigate knowledge assets in IHL. The sub-study of knowledge assets in the IHL, also supported by document analysis, involved published vision, mission, strategic planning and all documents in curriculum unit shared links published through curriculum unit websites. Using the thematic analysis approach, it was found that curriculum management is among the most important items addressed and therefore must be organized and managed wisely by the IHL.

Result

As a result of knowledge assets studied in IHL, this exercise focuses on curriculum management. Different scenarios project

different taxonomies; most of the time, produced taxonomies only matched the studied environment and requirements. Since there is a limited amount of knowledge taxonomy in IHL context produced before, a specific and comprehensive study is necessary (Abdullah et al. 2004). Developing specialised and dedicated taxonomy, in its environment, is an advantage because it will not be influenced by the classification of an item that is not necessary or does not even exist in IHL. Lambe (2007) emphasised taxonomy as artificial memory. The action is supporting the final outcome of taxonomy produced; shall be applied as content in developing a corporate memory system (CMS) for the IHL. Figure 2 projects the proposed framework where corporate taxonomy could be used as content in CMS.

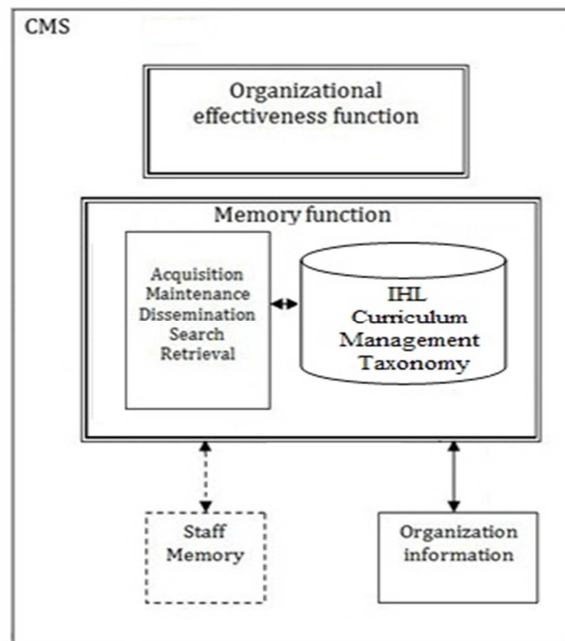


Fig 2. Conceptual Framework of IHL CMS Focusing on Curriculum Management

As a knowledge producer, IHL should play its role in managing knowledge. One of the ways to manage it is by preserving the memories in IHL; that is by having a CM. CM with the use of technology is able to act as a centralize knowledge repository (the CMS). CT shall provide pertinent knowledge structure required by IHL.

Therefore, as an alternative to manage and reuse corporate knowledge in corporate memory system, this study presents a new approach by optimising corporate taxonomy that has been said to provide various benefits to organisations.

In the proposed framework, the strategic content will be structured and classified (as

CT) to fit in as CMS content provider. CMS model is adapted from Stein and Zwass (1995) Organisational Memory Information System (OMIS) model. This model is going to be used as the basis in developing a CMS prototype for IHL. Selection of appropriate model has been based on literature study on CMS model. OMIS model by Stein and Zwass (1995) has been divided into two functions that are effective and mnemonic functions. In effective function the model concentrates on integration, adaptation, goal attainment, pattern and maintenance, while in mnemonic function, the model has been focusing on knowledge acquisition, retention, maintenance and finally search and retrieval.

Conclusions

As a complex entity that is approximate to knowledge, IHL has to take the responsibility to organise and manage knowledge so that it is available for the needs of community and society of knowledge. One approach that supports the complexity of the academic environment is taxonomy approach. The latter has not been explored extensively in IHL. As a straight forward approach, it offers a high flexibility for supporting complex knowledge organisation and management in IHL. CM in IHL should be organised and manageable using the taxonomy approach so that it can be retained extensively in the dynamic academic environment.

A detailed literature study was done and the findings have been derived to form the conceptual framework of the CMS in IHL. While the framework has drawn some lines for the study, a specific scope focusing on strategic knowledge assets of IHL is necessary to be used as a benchmark for the study. Data collection of the study should be based on the specific strategic knowledge assets of IHL before they are presented in the form of taxonomy as a content of the CMS.

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