# Portrayal Based Concept Classification for Extracting 'Operating System' E- Content

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***Abstract*—Portrayals (or cognitive structures) may be used as bases for classifying e-content documents of problem centric courses such as 'Operating System'. As concept extractions cannot be fully automated, this paper suggests a novel technique in the form of procedures for identifying portrayal based and domain dependent documents for selecting appropriate e-contents.[3] The paper has considered the 'First Principles of Instruction' (FPI) of David Merrill in the form of its four cognitive structures namely Activation, Demonstration, Application and Integration as portrayals. The paper suggests developing and storing of e-contents in the form of these portrayals explicitly. The paper points out clearly that it is quite possible to represent portrayal documents, which are tagged with the e-content documents for the subject 'Operating System'. The proposed procedure has symbolized two portrayal concept words of 'Activation' and 'Demonstration' for Operating System. Our proposed approach is based on literature support on concept mining that uses portrayals. Comparative studies through experiments on these two portrayals have been made with our suggested procedure and that of pure keyword searches of the same subject contents. The paper has validated its approach through 38 selective learner respondents who were requested to present concept based short sentences which are used for extraction of the tagged e-documents. It is proved that extraction is quick and easy, even when the e-documents did not have specified keywords. Conclusions that are drawn from the studies would be of use to e-content developers and concept extractors [1].***

***Keywords: Concept extraction, Concept portrayals, Portrayal classifications, Operating Systems e-content.***

## I. INTRODUCTION

Keywords are generally used merely for extraction of document from the internet, while concept related words particularly verbs may be used for identification of conceptual documents, such as technology oriented subject e-contents. Literature points out fully automated systems that thoroughly understand concepts might be impossible with the currently available technology [1]. Issues will be multiple, if target documents contain graphics with or without text. However concept key words may be used if such words are tagged with documents that might be used for identification. How to achieve this is a major issue. Concept word or concept keyword is a word that represents a key concept used for comprehending subject content.
(MasaruOhba et al - 2005). Machine-extracted keywords, whether representing a concept but the word itself is appearing, or a mere word that is just appearing in documents, can be extracted by methods like tf/idf (Term Frequency / Inverse Document Frequency) that produces an approximation of ideal or human selected ones.

**Manuscript received October, 2013.**

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Literature dealing with issues on identification of concepts from textual or other media documents that may not have mere words is rare. Extraction of data from instructional textual documents has been documented, so as to conceive its concept under exploratory learning environments (Saleema Amershi et al - 2009). However it is often difficult and time consuming, especially for novel applications such as exploratory learning environments of technological e-contents such as 'Operating Systems' of Computer Science and Engineering, for which there is still limited knowledge on what constitutes effective exploratory behavior. Will conceptual portrayals of such e-contents deal with such issues? Portrayals are quantifiable learning abilities (also called Cognitive structures) of a particular concept.

Instructional design theories were goal-oriented and identified methods of instruction for specific situations. These methods had sets of components, which made them flexible and adaptable. Instructional design models have been adapted, specifically for the e-mode of learning. Some instructional design theories for e-Learning were: Cognitive Education, Constructivist Learning, Multiple Approaches to understanding, Teaching and Learning for Understanding, Open Learning Environments, Learning By Doing, Collaborative Problem Solving, Problem-Based Learning and the First Principles of Instruction (FPI) (Merrill M.D - 2007)[3][5]. According to this model, the FPI, four Cognitive structures or portrayals are well defined: 'Activation' – Learner recalls his previously learnt material/concepts; 'Demonstration' – Learner observes a demonstration of the instruction, 'Application' – Learners solve numerical examples; 'Integration' – Learner is able to (ready to) apply his learned material to real life situation.

The e-documents are tagged with concept words specific for each portrayal. Extraction of portrayal based documents become easy and quick when users provide concept requirements of particular e-content in the form of short sentences. Experiments with 38 selected respondents show that most of the responses used some of the concept words that belong to the pre-defined portrayal verbs. The results shown are part of a whole research project of the authors and the e-content analyses of other concept, portrayals and social validation are out of scope of this paper.

## II. PORTRAYAL BASED CONCEPT WORDS [4]

Out of four portrayals only the first two namely 'Activation' and 'Demonstration' have been considered for the chosen 'Operating System' concept namely 'Shell and Kernel modes of operation' as sample. The selected portrayals are explained along with their concept words. Action verbs may be used, which indicate the depth of understanding expected from the learner. With the detailed definitions of the four portrayals, several action verbs can be derived (Suriyakala et al, -2007). For the purpose of arriving

at such verbs, the categories as simplified and defined according to a practical situation (Merrill (2002)), along with a set of verbs which is detailed below.

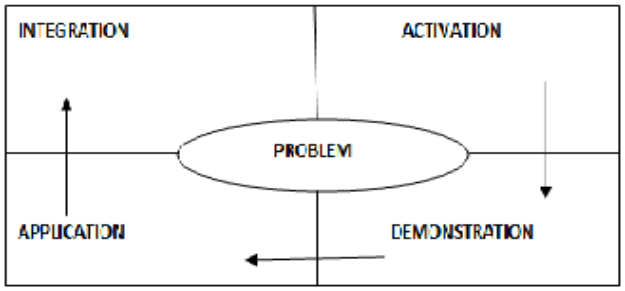


Fig 1: David Merrill's phases of Instruction: [3][5]:

### *A. Activation:*

This is the first or starting phase in the learning process as per the FPI. New knowledge builds on the learner's existing knowledge. Learners recall or apply knowledge from relevant past experience as a foundation for new knowledge. During this phase, prior knowledge (or experience) is recalled. Not only pre-knowledge should be activated during this phase, but mental models as well.

Does the instruction direct learners to recall, relate, remember, repeat or recognize the knowledge from relevant past experience that can be used as a foundation for the new knowledge (problem).

If learners have limited prior experience, does the instruction provide relevant experience that can be used as a foundation for the new knowledge?

Based on the above questions a set of action verbs for this phase, as taken from literature are presented below [4]:

List, define, tell, name, locate, identify, what, distinguish, acquire, write, underline, relate, state, recall, select, repeat, recognize, reproduce, measure, memorize.

### *B. Demonstration:*

New knowledge is demonstrated to the learner through this second portrayal. Learners learn when the instructor demonstrates what is to be learnt, rather than merely telling information about what is to be told. The learner observes while the instructor demonstrates. The media used in the process is expected to play a relevant instructional role. Explain with examples, understand information with meanings, predict consequences, order, group, and infer causes are some samples for demonstration.

Does the instruction demonstrate (show example) of what is to be learnt rather than merely providing information about what is to be learnt?

Are the demonstrations (examples) consistent with the content being taught?

Based on the above questions a set of action verbs for this phase, as taken from literature are presented below:

Demonstrate, summarize, illustrate, interpret, contrast, predict, associate, distinguish, identify, show, label, collect, illustrate, experiment, recite, classify, discuss, select, compare, translate, prepare, change, rephrase, differentiate, draw, explain, estimate, fill in, choose, operate, perform, and organize.

## III EXPERIMENTAL INTERVENTION

Fig.2.0 provides the display frame of a (sample) concept 'User/Kernel mode of operation'. This figure is the same for both 'Activation' as well as 'Demonstration' portrayals. The textual contents that accompany each portrayal based e-contents are presented below [2]. The accompanying textual document for 'Activation'. The accompanying textual document for 'Demonstration' each portrayal is described.

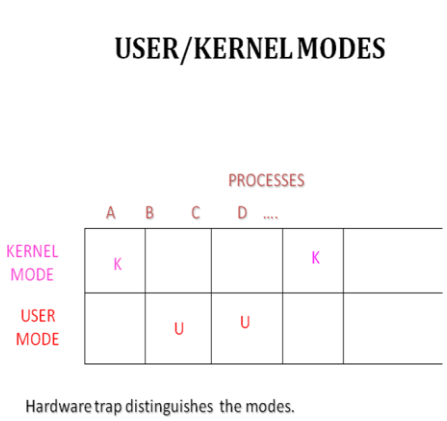


Fig. 2.0 e-Content under display on 'Activation' as well as 'Demonstration' for 'User/Kernel Modes of operation'

The contents of 'Activation' portrayal based e-content. The number of words and the number of terms of appearance of concept words are computed for the analysis. The contents of 'Demonstration' portrayal based e-content. The number of words and the number of terms of appearance of concept words are also computed for this portrayal for the analysis.
Activation Portrayal:

### *A. Unix shell*

A UNIX shell is a command-line interpreter that provides a traditional interface between users and the Unix operating system and for Unix-like systems.

### *B. Unix kernel*

A Unix kernel is that part of operating system that translates software into data processing instructions for the central processing unit and other electronic components of a computer. The kernel is a fundamental part of Unix operating system.

### *C. Process*

A process is an instance of a computer program that is being executed by the Unix Operating System. It contains the program code and its current activity.

Demonstration Portrayal:

### *D. User / kernel modes of operation*

A user designed or library program makes a system call requesting for a device, then the mode changes from User to Kernel by the kernel.

Some machine instructions are privileged and results in an error when user executes a device from user mode. For example, a user may wants to write a message in a restricted area of memory.

In the figure shown, the horizontal axis shows Processes available in memory and concurrently run by the CPU. The vertical axis shows the mode of operation.

The Kernel distinguishes between different processes and between the modes of operation, depending upon requests for devices.

It is to be noted that both the User as well Kernel processes are executed by Kernel only, although the mode may either be any one at a time.

For example, a user program wants to read a character typed by user through the keyboard, then the Kernel switch over to kernel mode, that receives the character through device driver and analyses the character in the user program in User mode.

### *E. Textual document on 'Demonstration'*

38 user respondents (e-learners) were asked to supply short sentence for the activation and demonstration portrayals in their own words. The results are shown in Table 1.0 and 2.0 for 'Activation' and 'Demonstration' respectively.

| S.No | Portrayal words | Concept link words | Domain words | Number of respondents attempted |
|---|---|---|---|---|
| **1** | *list* | | | - |
| **2** | *define* | - | Unix Shell/Unix Kernel/ Process | 5 |
| **3** | *tell* | what is | Unix Shell/Unix Kernel/ Process | 7 |
| **4** | *name* | | | - |
| **5** | *locate* | | | - |
| **6** | *identify* | what is | | 3 |
| **7** | *What* | Is | Unix Shell/Unix Kernel/ Process | 12 |
| **8** | *distinguish* | | | - |
| **9** | *acquire* | | | - |
| **10** | *write* | about | Unix Shell/Unix Kernel/ Process | 1 |
| **11** | *underline* | | | - |
| **12** | *relate* | | | - |
| **13** | *state* | What are | Unix Shell/Unix Kernel/ Process | 6 |
| **14** | *recall* | What is | Unix Shell/Unix Kernel/ Process | 4 |
| **15** | *select* | | | - |
| **16** | *repeat* | | | - |
| **17** | *recognize* | | | - |
| **18** | *reproduce* | | | - |
| **19** | *measure* | | | - |
| **20** | *Memorize* | | | - |

**Analysis on Demonstration Portrayal:**

Experimental respondents (Users) were allowed to use their own expressions to search for document on "description of user/kernel mode of operation" .

**Table 2.0** Responses on 'Demonstration'

| S.No | Portrayal words | Concept link words | Domain words | Number of respondents attempted |
|---|---|---|---|---|
| 1 | *Demonstrate* | the working of | user and kernel modes | 3 |
| 2 | *Summarize* | operation of | user and kernel modes | - |
| 3 | *Change* | different types of | modes | - |
| 4 | *Illustrate* | the working of | user and kernel modes | 1 |
| 5 | *Contrast* | different types of | modes | - |
| 6 | *Distinguish* | different types of | modes | 3 |
| 7 | *Identify* | the working of | user and kernel modes | - |
| 8 | *Describe* | the working of | user and kernel modes | 8 |
| 9 | *Show* | the working of | user and kernel modes | 1 |
| 10 | *Classify* | different types of | modes | 3 |
| 11 | *Discuss* | the working of | user and kernel modes | 2 |
| 12 | *Compare* | different types of | modes | 6 |
| 13 | *Translate* | different types of | modes | - |
| 14 | *Differentiate* | different types of | modes | 4 |
| 15 | *Explain* | the working of | user and kernel modes | 7 |

## IV RESULTS AND DISCUSSIONS

### *A. Analysis on Term frequency:*

Term frequency classifier is a technique that extracts words from a document. This method indicates how much important a word is to a document. The importance of a concept word to a document is determined by knowing the relationship of occurrences with total words in it. Number of times the concept word exists in a document is proportional to its importance (Arun K.Pujari, 2001). It is mathematically represented as:

i = Number of times the concept word is appearing in 'n' worded document.

The term frequency is tf = i/n. 'i' for Activation e-content = 4 (same e-content used for 'Demonstration' also). This document is displayed in Fig. 2.0. tf for 'Activation' is 0.043 and for 'Demonstration' is 0.0226.

By definition, if there are a total 'N' documents and the concept word is appearing 'K' times, the inverse document frequency is:

$$IDF = \log(N/K) * tf.$$

In the experiment, there are four total number of documents (2 for the actual e-c0ntents for displaying 'ACTIVATION' and 'DEMONSTRATION' on 'User Shell and Kernel modes of Operation', while two documents are accompanying these e-contents as either collaborative textual or audio documents. Hence N = 4. The number of times the concept words appearing is also 4.

**Table 3.0** Comparison on Portrayals with respect to Term frequencies.

| Portrayal | Activation | Demonstration |
|---|---|---|
| No. of Words in documents | 93 | 177 |
| File size in storage | 12.00KB | 12.00KB |
| File size in memory | 10.90KB | 10.40KB |
| No. of Portrayal | 21 | 34 |
| No. of Concept words used by respondents | 7 | 10 |
| Tf / IDF value of Concept words as Key words used by respondents | 4 | 4 |

It is observed clearly from Table 3.0 that the term frequency even though is small and insignificant, the number of concept words appearing both in the 'Activation' stage as well as in the 'Demonstration' stage is also not present per-se in the e-contents although the four words shown in Table 3.0 are not in any portrayal form; but are purely domain dependent and not portrayal dependent. But the correct extraction of documents, when provided with different responses (short concept queries) by all the 38 respondents, demonstrates clearly that when portrayal words are tagged with each portrayal based e-content the concept extraction would be very effective.

## V.CONCLUSIONS

A. Portrayals of the First Principles of Instruction would be effective in designing independent e-contents based on each portrayal of problem centric subject contents like 'Operating System'.

B. It is demonstrated that portrayal based concept words when tagged with selected e-content documents would facilitate in effectively extracting the document, irrespective of the words present in the main e-content or not.

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