

A Framework for Formative Knowledge Assessment System



Engineering

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ABSTRACT

Formative Knowledge Assessment (FKA) is becoming a very important and need of the hour in the teaching and learning process especially in e-learning and mobile learning (m-learning). In today's competitive world, Higher Education Institutions are forced to be highly knowledge centric and would have tremendous value when develop initiatives to provide quality learning environment. FKA is a very familiar and effective way to assess the knowledge acquired by the learner and has its advantages over summative assessment which is used only at the end of the course. Concept Map (CM) is a visual knowledge representation technique which represents the knowledge schematically. This paper; (i) describes a FKA process using CM in a web based environment, (ii) proposes a framework called Online Assessment Management System (OAMS) and (iii) discusses on two assessment approaches defined.

1. INTRODUCTION

Learning Assessment is known a very important process in the education. Assessment gives an insight of what the learner learned. Advents of new technologies especially, information and communication technologies (ICT) enable educators of today to keep their students active even after the class hours. FKA is a type of assessment, which is generally used to assess the knowledge acquired by the learners periodically. This helps the educator to understand the level of learning done by their students and accordingly adjust their lesson plan if needed. FKA also helps teachers to give useful feedback about the learning. FA can be practiced through various approaches like quiz, slip test, oral presentation and question-answer. FKA can be conducted either as a class room activity or computer based (i.e. web based).

This work is to explore the possibilities of having a framework, Online Assessment Management System (OAMS) using CM for the users of HEI (i.e. the staff and student community of the institution). This paper is organized as follows; section 2 gives a brief introduction about Formative Assessment (FA), Concept Map(CM) and related works. Section 3 argues the necessity of having a framework. Section 4 talks about the proposed conceptual framework for a web based formative knowledge assessment and Section 5 concludes the paper.

2. BACKGROUND

2.1 Formative Assessment

Assessment is the process of documenting, usually measurable terms like knowledge, skills, attitudes, and beliefs. Knowledge Assessment can focus on the individual student or the learning community that include students of a class or workshop or other organized group of learners. According to a Wikipedia web article that quotes The Academic Exchange Quarterly [1] in which assessment defined as follows:

“Studies of a theoretical or empirical nature (including case studies, portfolio studies, exploratory, or experimental work) addressing the assessment of learner aptitude and preparation, motivation and learning styles, learning outcomes in achievement and satisfaction in different educational contexts are all welcome, as are studies addressing issues of measurable standards and benchmarks”.

Assessment is mostly used as an integral part of instruction, as it determines whether the goals of education are being met or not. Assessment is used to take decisions about grades or scores, advancement, lesson plan and instructional needs and curriculum design. When assessment works better in an educational setup, it achieves the following;

- Helps educators to define standards

- Evaluates progress of students
- Helps the students and teachers in self-evaluation

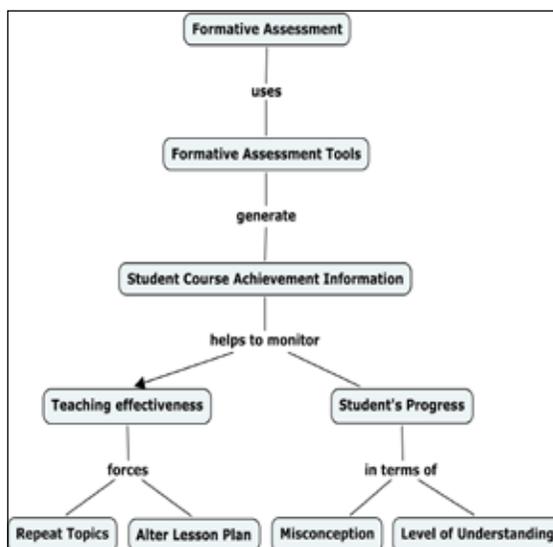


Figure 1. A Concept Map about Formative Assessment

In general there are different types of assessments that are being used across the world [4], like (i). Standardized assessment is provided in the form of tests which is often criticized as teacher centric. (ii). Authentic assessment which is used to measure students' understanding of a topic or lesson. (iii). Summative and (iv). Formative assessment are being used by the educators in order to gauge the understanding of the students in the class room and fields. The summative is being carried out at the end of the course which is often fails to improve the quality of learning obtained. More effective learning takes place only when the knowledge acquired is measured periodically (in stages) during the course being taught in a student centric approach. This is possible when formative assessment used in the learning environment. A CM about the FA is presented above in figure.1.

2.2 Concept Maps

Concept Map (CM) is one of the Knowledge Representation techniques first proposed by John D Novak (2006) [2] in 1970s. A CM is a way of representing relations between ideas, images or words. A concept is normally referred to a theme/ event / object /process. Novak [2] says that a “concept is a perceived regularity of any object or event”. A map consists of collection of concepts and the relationships among them, is called a Concept Map. CMs are described as graphs consisting of nodes with

connecting arcs, representing relationships between nodes. The nodes labeled with descriptive text, representing the “concept”, and the arcs are labeled with a relationship.

CMs help us to map the new knowledge with previous knowledge and hence support meaningful learning of the concepts rather than memorizing concepts. They are more flexible and simple. Novak [2] used CMs to assess the understanding level of school students belonging to primary classes. From then, CMs have been used as a teaching-learning tool at various levels of educational institutions to give better understanding of the relationships between concepts.

Recent literature survey by Kumar et al.[3] reported that CM has been widely used in e-learning and m-learning. It is evident that CM plays various roles such as teaching tool, learning tool and assessment tool. This paper focuses and investigative the use of CMs as an assessment tool for measuring the student knowledge.

3. NEED FOR A FRAMEWORK

A framework is a real or conceptual structure intended to serve as a support or guide or prototype or model for the building of something that expands the structure into something useful. A framework is used to solve complex issues, usually a set of tools, materials or components. Frameworks can be classified into two categories namely, the descriptive and prescriptive frameworks. The descriptive framework’s role is to characterize the nature of processes and the prescriptive framework prescribes methods to follow in implementing processes. Numerous researchers have proposed several approaches and frameworks that have been used for different assessment processes.

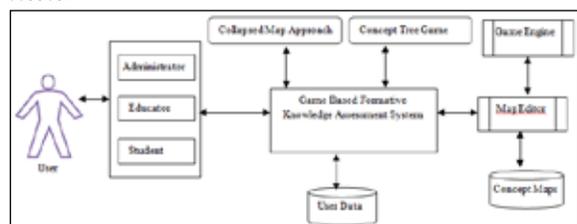


Figure. 2: Framework of OAMS

A framework is very important for the institutions that intend to implement online assessment system in their institution. It will become as the guideline in order to avoid failures and gain other benefits in terms of effective learning, time and effort. The implementation of such assessment framework remains a challenging task. As the FA getting the momentum in educational setup, the important challenges are to build systematic practices for implementing formative assessment tools for assessing the students learning dynamically so as to enable them the effective learning. Therefore, it is appropriate that a framework be developed to guide institutions before the actual implementation takes place to ensure the success of their educational endeavors. The issue here is to provide directions on constructing a FA implementation framework.

However the rapid growth of emerging and cutting edge technologies coupled with e-learning systems have led to the increased adoption of new applications that includes ranking of the students based on many measures like topics chosen, time spent, feedback, number of assessments taken and related information on assessments, assessing the programs and courses and performance of the students. The integration of the above mentioned applications enable the sharing of knowledge that is necessary for any educational institution. The following may be the benefits of having a well defined framework;

- Provide a more holistic view on how students learn a course
- Facilitates both formal and informal assessment of Knowledge
- Helps to determine the lacking students and to improve learning
- Facilitates online assessment using different techniques

The further step in designing the framework is identifying the core competencies of the assessment processes. This will help the teachers to be apparent in their teaching process, so that the learning will be very easier and effective. Then the next step is the identification of the knowledge needs of the students in the teaching learning and other associated areas which will help them to identify and define the knowledge manipulation processes.

4 PROPOSED FRAMEWORK

A framework for online assessment would serve as a guideline and hence all the components are to be well addressed. A conceptual framework is proposed (see fig. 1) for FA. The framework is designed after carefully analyzing the teaching learning process which helps the staff and students to manage their teaching and learning processes. The following sections describe the elements involved in the framework.

The feedback system is another important module of the system which is needed to be intelligent. The system should be included with feedback for perceived level of understanding. The authors of this paper are of an opinion that developing a framework for FA should be one of the prioritized steps of any initiative towards improving the quality of the education. Today the teachers and students hardly find time to discuss or interact on doubts or clarifications beyond the class hours. Hence, this kind of web based formative assessment will certainly help the teachers to assess the understanding of the students periodically.

4.1 Design of OAMS

OAMS has been designed as a web based application that allows the educator and students to make use of it for an effective assessment of knowledge on selected topics. The following sections describe the users and their roles briefly. The following roles have been considered as the members or users of OAMS;

Users

The probable users of the proposed system will be the administrator, educator and student.

Administrator roles;

- Responsible for the entire system maintenance
- User account creation and management

Educator (teacher or professor) can perform the following;

- Adds concept maps for the topics
- Posts assessment(s)
- Announces the assessment(s)
- Generate Reports

Student is the another human entity interacting with the system with the following roles;

- Registers for a course
- Takes the assessment
- Views the feedback with scores
- Modify profile

4.2Cmap Editor

Cmap Editor is an important element of the system which has been integrated with OAMS with the basic functionalities needed for mapping like add node, add relationship, save and submit test.



Figure 3. Cmap Editor of OAMS

The CmapEditor is developed using Java and MySQL technologies. The editor is a simple CM editor that enables the user to create CM for desired topic. The nodes and relationship labels are stored into the database. The screenshot of the editor is presented in figure 3. In addition to the above OAMS has the basic functionalities like registration, login, add course, add students, add staff, logout and report generation.

4.1.3 Formative Knowledge Assessment Tasks using CM

The OAMS is proposed and designed to have two major assessment approaches namely; (i) Shuffled Concept Map and (ii) Concept Tree Game. CMs more flexible and hence, can be used to capture the knowledge structure of the learner using many forms according to the needs. Two new forms of CM based assessment have been defined as follows;

(i) Concept Tree Game: The students will be asked to construct a map for specific topic from course, which have been taught very recently (within 5 conduct classes). The student will be notified through email notifications. The student then will visit the OAMS and take the assessment. This is defined as a closed game approach. For this a restricted assessment approach based on extensive game theory has been defined with limited of number of nodes and relationships. The students have to play the game of constructing a concept tree using the allowed moves like addnode, addrelation. OAMS will act as opponent to the student player. Once the game is over, system will evaluate it and will give the feedback. Further, based on the analysis the professor will decide whether to proceed further or change the lesson plan and revise the same topic if more students reflect misconception.

(ii) Collapsed Concept Map Approach: The collapsed map approach is also a restricted approach in which the professor's map of a selected topic will be the source. The nodes and relationships from the map will be collapsed randomly and presented to the student who is taking the assessment. The student has to use his learning to reorder the collapsed nodes and relationships correctly. A ratio of valid nodes placed is initially used to provide the feedback instantly to the student. The following sections provide the basic algorithms defined for implementing the above approaches.

Process Description: Professor (Add Assessment)

Description: this function Provides professor the ability to insert, delete and update assignments.

Input: Click on insert assessment link from administrator main menu and fill Course number, description, instruction, start time , end time, motivation, type of work, is strict and update assessment

Output: Save the assessments and notification to the students via email.

Destination: Web server.

Require: Valid login and single click on assignments link (insert or update).

Pre-condition: Admin Home Page and fill all textboxes with valid data type.

Post-condition: Save assessment or update it.

Process Description: Student (View Assessment)

Description: By clicking the courses link from the main menu a new page will be displayed, containing assessment details.

Input: Clicking view assessment link from student main menu.

Source: The view assessment link from menu.

Output: Courses and details of related assessments.

Destination: web server.

Require: Valid log in and single click on view assessment link.

Pre-condition: Student Home Page and registered student courses.

Post-condition: details of assessments displayed.

Process Description: Collapsed Map Game

Description: By clicking the launch link from the assessment menu a new page will be displayed, containing assessment (collapsed map).

Input: Clicking launch assessment link from view assessment menu.

Source: The professors CM from maps table.

Output: Scores and feedback on assessment along with the correct map.

Destination: web server.

Require: Valid log in and single click on launch assessment link.

Pre-condition: Student Home Page and registered student courses.

Post-condition: score and feedback displayed.

5. CONCLUSION

The role of FKA is inevitable in today's modern educational set-ups. Assessing students' level of understanding in stages will definitely help the educators to plan for further proceedings towards achieving the educational goals and also enable them to provide students a platform for effective learning.

Design of a CM based formative knowledge assessment system (OAMS) has been presented in this paper. OAMS would serve as an effective tool to gauge the knowledge of the students in its initial phase. The approaches discussed here are already implemented and assessment processes have been carried out periodically and the data are recorded for further research.

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