

Assessment Model in an intelligent e-learning system for personalized holistic learning experience

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Abstract- Over the past few years, rapid technological innovation has facilitated a large increase in e-learning. Although e-learning reduces logistical difficulties, it has pedagogical limitations. It follows the one size fits all approach. In order to make learning environments more effective, researchers have been exploring the possibility of an automatic adaptation of the learning environment to the learner or the context. Assessing the learner during the learning activity is the most vital task as it measures the obtained knowledge, skills and competence level, which leads to personalizing the learning experience. .

Against this background, this paper discusses the role of assessments in intelligent e-learning systems. Further it explains the taxonomy for assessment questions suitable for the technical training in IT industry. It also suggests which learner's assessment results can be taken into consideration for personalizing the learning. An assessment model is also proposed for giving a personalized holistic learning experience.

Index Terms- E-learning, adaptive learning, Assessments, Assessment model, Intelligent tutoring,

I. INTRODUCTION

In the fast moving space of IT services, which is particularly characterized by rapid technological change and new technical advances, most successful IT companies are those that systematically and continuously enrich the workforce competency. For companies, training their employees on various technologies is a recurring activity. Training becomes more challenging due to various factors like diverse set of technologies used, variety in domains, geographical spread, crunched timelines and limited budget

In such situations, e-learning is the best approach that offers location independent and self paced learning. But lacks customization of learning approach based on the knowledge, skills, and expertise of the learner. An Intelligent e-learning system is an intelligent tutoring system that is available on the Web. It fills some lacks of the e-learning systems such as [1]

- It allows customization of course contents based on learner's profiles as opposed to standardization in e-learning.
- It exploits the learner's assessment results in changing the learning strategy and dynamically sequences the learning objects

Components of Intelligent Tutoring Systems(ITS)

Intelligent e-learning systems might often seem monolithic, but for the purpose of conceptualization and design it is divided into four independent components.

The major modules are [2] :

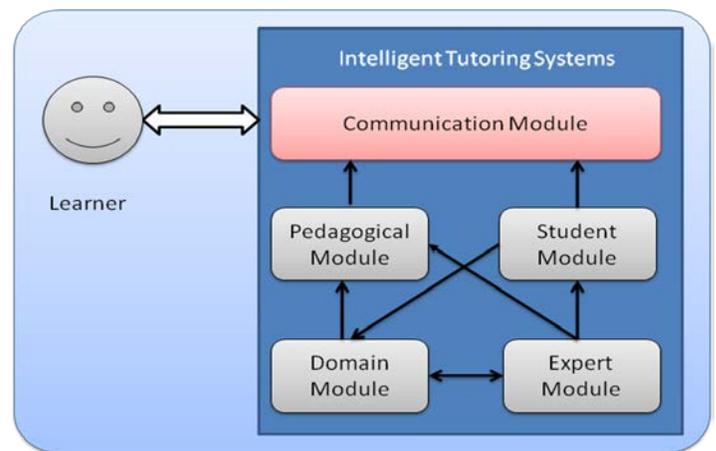


Figure 1: Basics components of Intelligent Tutoring systems

1. **Domain Module** contains the domain specific knowledge repository that should be presented to the learners.
2. **Expert Module** is same as domain model; it also contains the information repository being taught to the learner. The expert module compares and contrasts a learners' solution to that of the expert and elements of the learner's solution that require feedback [4].
3. **Student Module** dynamically maintains the cognitive state and affective state for individual learners. Its helps the adaptive systems "learn" about their learners and evolve their tutoring interactions based upon past interactions with the user. The tutoring module makes pedagogic decision based upon data in the student model.
4. **Communication module** is the communication model of the ITS and is an interface between the learner and assessment in intelligent e-learning computer system. In the context of the intelligent e-learning system it would comprise or a web based interface.
5. **Pedagogical Module** or also called as Tutor Module provides the model for instructional interactions including the feedback and the teaching strategy. This module uses the knowledge about the learner from the

student module and feedback data from the expert module to identify which pedagogical tasks to present. Adaptation of the content to the individual learner's needs makes the system very attractive.

II. ROLE OF ASSESSMENT IN E-LEARNING

For offering a personalized learning experience assessing the learner is a very vital activity in an ITS. The learner should not only be assessed on the skill level acquired, but also on the learner's goals, behavior and preferred learning styles. Good assessment serves multiple objectives: [4]

1. Improve student learning
2. Identify students' strengths and weaknesses
3. Review, assess, and improve the effectiveness of different teaching strategies
4. Review, assess, and improve the effectiveness of curricular programs

5. Improve tutoring effectiveness: content and assessment design strategies.
6. Provide useful administrative data that will expedite decision making

The Student Module and Expert Module in the ITS will have all the assessments. Student model would maintain the results for individual learners. These results further would be referred by the Pedagogical Module to decide the learning and the assessment strategy.

III. TAXONOMY FOR ASSESSMENT QUESTIONS

The table below categorizes the questions into different types based on the complexity it involves and how much constrained it is. The more constrained questions have to choose from a set of choices, where as in the less constrained ones the learner has to work on the problem in real environments to derive a solution.

	More Constrained → Least Constrained				
Less Complex	Multiple choice	Selection/ Identification	Reordering/ Rearrangement	Completion / Correction	Construction /presentation
	True/False	Multiple True/False	Complete the flow	Fill in the blank	Project or Case study
	True/False With reasoning	Yes/No with Explanation	Ranking and sequencing	Fill missing statements in the code	Concept Map
	Standard multiple choice	Multiple answer	Categorizing	Short-Answer & Sentence Completion	Implementation Demonstration, Discussion
More Complex	Multiple choice with media distracters	Given a scenario choose the options	Assembling Proof	Matrix Completion	Diagnosis, teaching

Table 1 : Taxonomy for assessment questions

IV. ASSESSMENT DESIGN

Designing an assessment for an intelligent e-learning is same as designing another e-assessment. But the delivery will offer a lot of advantages over the traditional assessments.



Figure 2: Assessment design process

The basic rule that should be followed while designing assessment questions is "Keep It Simple and Straightforward! ". A simple doable design is better than a complex, impossible design that is never completed! The following aspects should be very clear before designing the assessment:

- The learning goals and objective that should be assessed
- Scope of the assessment – the content through which it should span
- Type of assessment to be done
 - Formative or Summative
 - Ongoing or episodic
 - Diagnostics

Figure 2 depicts some of the important steps in designing an assessment

1. **Define the question:** the questions should be designed based on learning goals/objectives. Scope of the assessment should also be taken into consideration.
2. **Design the assessment** – the assessment on whole should have a right mix of questions, based on the complexity of the questions. E.g.: some simple, medium and complex questions. Complex questions should have more weight age (marks) than those of simple questions.
3. **Report and discuss the results:** Failure is a prerequisite to becoming an expert, so too is the ability to persevere and remain motivated through failure. Providing the feedback during the assessment will motivate the learner in the learning activity. Feedback of individual questions can be provided during the assessment or a cumulative feedback can be given even after the assessment.
4. **Identify Improvement Opportunities:** Feedback is an excellent way to identify the areas of improvement. An intelligent e-learning should readily provide some additional e-learning material.
5. **Make decisions based on results:** based on the improvement areas an intelligent e-learning system might as well redirect the learner to take up the modules where the skills are low.
6. **Gather and Analyze data:** Data management is crucial to the assessment process. Gathering data about all the learner's, assessment, learning objects etc can be used to great effect. It can be accessed by the instructional designers to revisit the learning module, to student for knowing their skill level, tutors for understanding the effectiveness for their content.

A good design of assessment tasks and processes is critical to ensuring that the eventual assessment is valid, reliable, flexible and fair. A web based tutoring system secure delivery of the assessment also plays a very important role.

V. ASSESSMENT MODEL

The assessment model suggested is depicted in figure 3. Here the assessments are classified based on the phase in which it is delivered to the learner during the learning process i.e pre-learning, learning phase and post-learning. For a successful learning experience, it is very critical to deliver an assessment at the right time, with appropriate complexity to the learner. Failing to do so might result in de motivation of the learner which might even lead to the learner quitting learning.

The classifications are:

1. **Pre-assessment:** This assessment is delivered in the pre-learning phase. Usually diagnostic assessments which would be of survey type and would occur at the beginning of the course or before each unit of study. This assessment plays a major role in personalizing the learning experience. This basically focuses on the following two aspects before starting the learning:

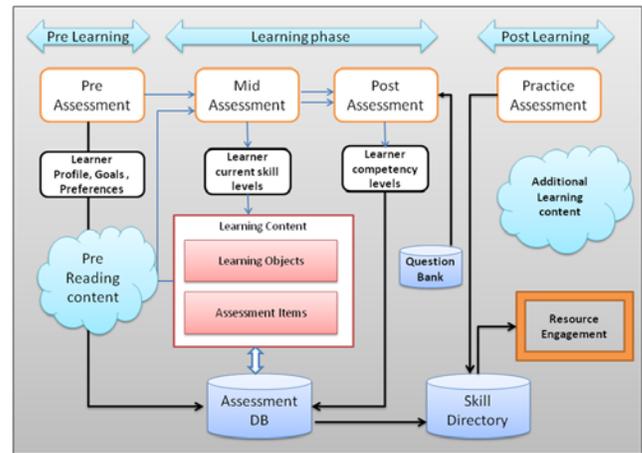


Figure 3: Assessment Model

- a. **Learning Pre-requisites:** If the skill level fails to satisfy the pre-requisites required for the learning, the learner is suggested to go through the pre- reading content then later attempt this learning.
- b. **Learner preference:** This aspect will help us giving a personalized learning experience to the learner. This survey would be a major contributing factor towards selection of the learning artifacts being disseminated to the learner. In this survey we check the
 - i. **Learner's profile:** The learners experience level, skill level, does he know other parallel technology? , what role does he perform? , would be understood.
 - ii. **Learner goals** should be checked, does he wants to be an expert or this learning is only an information gathering exercise? , Does he want to go through the full learning or only partial? Is this learning a pre-requisite for the next higher level learning?
 - iii. **Learning model** should be checked to understand the learner's preference on the frequency of interaction with the instructors. Learning model could be either *synchronous or asynchronous*. Synchronous learning models allows participants to have live interaction with instructors. On the other hand in an Asynchronous learning model the learner would complete the learning phase without interaction with the instructor. The later would be the ideal situation in the ITS. However if the learner prefers synchronous model it could be through online chats, discussion boards, frequent group discussion or even conducting contact session with the instructor.

- iv. **Learner Artifact Preferences:** In a web based learning, since ample of digital assets available for learning, the learner can choose the type which will increase his learning capability and hence the satisfaction. E.g.: A Business analysts preferred learning object might be case study scenario, where as programmer might be more interested in learning it through code samples. Assessments should also be based on the preferred learning style; this is one way to ensure dedicated and timely completion.

Below are the recommended weightages of the pre-assessment parameters that should be considered while shaping up the learning content and artifacts that would be disseminated to the learner an ITS.

Parameter	Weightage
Learners profile	50 %
Learners goals	20%
Learning model	10%
Artifact preferences	20%

Varying the % of these parameters will have an impact on the personalization of the learning experience.

- 2. **Mid-assessment:** This would be delivered during the learning phase. These are usually formative type of assessments which are not graded and would basically check the understanding of a particular skill acquired. Fixing the delivery interval of the mid assessment will have a direct effect on the confidence level of the learner. The assessment can be after each topic, if the topic is very lengthy it can be after every complex concept. Providing the feedback during the assessment will motivate the learner in the learning activity. Feedback can be provided for every question. Feedback like Good job, why don't you try again, I know you can do it..., can be provided based on the response of the learner. This would motivate the learner and he will approach the learning with a positive approach. Mid assessment will help identify the improvement areas. Based on the improvement areas an intelligent e-learning system might as well redirect the learner to take up the modules where the skills are low.
- 3. **Post-Assessment:** This is final assessments to assess the learning at the end of the course. Assessment will be dynamically created based on random questions picked up from the question bank. The rules engine will randomly pick up the questions based on the rules specified by the instructor. Questions are presented in sequence and the learner cannot quit the assessment half way. Results and overall feedback are shown at the end of the assessment. These results will also be stored in the assessment database. Assessment database would have the data of the learning activities in the

organization. Who has undergone learning, on what topics, what is the skill level etc. Based on this a skill directory is built which would store the employee skill data that is acquired from the learning. This skill directory would be a ready reference when engaging resources for the client project commitments.

- 4. **Practice Assessments:** After the learning exercise, retention of knowledge over a span is also required. If the knowledge gained is not utilized or refreshed the learning would be waste and after some period the learner has to start the learning process from scratch. Hence In addition to the assessments during the learning phase, post learning assessment also plays a vital role. The learner should be prompted to take practice test after a regular interval of time say one month and also given some additional learning material to read through. This would help retaining the knowledge and also keeping the learner up-to- date with the current trends.

At the end of the e-learning, we recommend taking a functionality feedback for the assessment – this should be based both on the assessment design and delivery. Below mentioned are some questions that can be asked in this feedback.

- 1. The suggestion provided from the online test based on the marks I obtained is very useful in my learning process
- 2. The correct answers provided for the questions I answered wrong in the online test are essential in learning online
- 3. The explanation of the correct answers tell me what I do not know and help me improve my understanding
- 4. Overall, the online test provided me with useful feedback

Ideally an overall e-learning feedback should be taken that includes the content, assessment, delivery and infrastructure aspect as well. This e-learning feedback will help us evaluate learners experience and improvise the system; we recommend it to be a continuous process.

VI. CONCLUSION AND FUTURE WORK

Assessment plays a vital role in personalizing the learning experience in the e-learning system. In this paper we have defined the important steps to design the assessment and the taxonomy to be followed. It further suggests assessment model that can be shadowed as a base framework when developing the assessment for e-learning.

The future work would focus on determining the usage of the assessments result in customizing pedagogical module to decide the learning path, artifacts to be presented and the assessment strategy. Further we are working on an architecture design to store the learning artifacts and an algorithm for faster retrieval of data.

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