A Content Proposer System (CPS) Based on Deficiencies of Confidence Based Learning (CBL)

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There has been a dramatic change in the Teaching and Learning System across the globe. The use of technology in learning arena has brought paradigm shift. This has led to a separate research domain known as Technology Enabled Learning (TEL). E-Learning is an important research area which not only improves the performance of the Learners but also provides flexible and efficient learning solutions. Confidence Based Learning (CBL) is a newer development in the field of e-Learning that is not only concerned to the development and dissemination of the Learning Content but also provides a comprehensive and holistic assessment approach using 2-dimensional assessment technique. This research work proposes a methodology that identifies the related learning content or competencies from the deficiencies identified during diagnose phase. Each learning chunk known as Learning Object (LO) is based on Instructional Objectives (IO). Each IO is further divided into a number of tasks. Each task is divided into several atomic competencies (ACs). An algorithm is proposed for the system that maps the AC from the deficiencies identified for a particular learner. The proposed system once implemented will handle prescription of customized learning content in an efficient manner. A case study has been used to illustrate the technique for an industrial application which shows state of the art diagnosis and prescription with analysis of results.

**Keywords:** e-Learning, CBL, Technology Enabled Learning (TEL), Dependency Structure Matrix (DSM), Industrial Training using CBL

**Introduction**

Technology Enabled Learning (TEL) is a newer methodology to enhance the overall performance of the learner as well as to develop a comprehensive roadmap for the improvement of the Teaching – Learning System\(^1\). Web based technology becomes an integral part of the e-Learning system for smooth organization of the various courses\(^2\). There are two significant modes of e-Learning, namely synchronous mode and asynchronous mode. The content should be designed carefully, and proper assessment methodology should be incorporated\(^3,4\). Confidence Based Learning (CBL)\(^5\) is a methodology used in e-Learning that identify the deficiencies of an individual learner and provides customized content to that particular learner based on the deficiencies identified during the process. CBL is divided into three phases namely diagnose, prescribe and learning. The diagnose phase, use the 2-D assessment technique\(^6\) and in the prescription phase, the learning content is prescribed. In the proposed research work, the authors propose a technique that automatically creates an intelligent content to the learner based on the deficiencies identified during diagnose phase.

**Proposed work**

In the proposed research work the content development is based on the Instructional Objectives (IO). The entire course curriculum is divided into various organizations. Each of these organizations consists of a number of aggregations and aggregations are further consists of Learning Objects (LO). This structure is in compliance with the SCORM\(^7\) standard proposed by Advance Distributed Learning (ADL) initiative. In this section, the authors have proposed a structural relationship between various sub components of an LO\(^8\). Each LO is based on some Instructional Objectives IO. The various subcomponents such as tasks within the LO are defined. Each task is further divided into AC given as follows.

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- Consider an Instructional Objectives IO, based on which the LO is developed.
- IO has a set of defined tasks $T = \{t_1, t_2, \ldots, t_n\}$, where $n$ is a finite number.
- Each of these tasks $T = \{t_1, t_2, \ldots, t_n\}$, have atomic competencies $AC_{11}, AC_{12}, \ldots, AC_{nn}$, where $AC_{11}, AC_{12}, \ldots, AC_{in}$ belongs to $t_1$, $AC_{21}, AC_{22}, \ldots, AC_{2n}$ belongs to $t_2$, $\ldots$, $AC_{n1}, AC_{n2}, \ldots, AC_{nn}$ belongs to $t_n$.
- Each of these AC can be divided into two categories; ACs dependent on other AC and ACs which has no dependencies on other AC.

The entire relationship is shown using a graph given in Figure 1. In the proposed technique, there are two types of dependencies of ACs that has been taken care off. In the first category ACs are moderately dependent and that of in the second category, they are highly dependent. The authors have proposed a Dependency Structure Matrix (DSM) that establishes dependencies of ACs. Figure 2 shows a typical DSM. The dependencies related to various ACs are given in the matrix. A ‘Φ’ symbol establishes that there is no dependencies between the corresponding ACs. A value ‘0’ shows that the ACs is moderately dependent whereas a value of ‘1’ indicate that the ACs are highly dependent. In this typical DSM, $AC_{12}$ is moderately dependent on $AC_{11}$. Similarly, $AC_{nn}$ is highly dependent on $AC_{n1}$.

The implementation of DSM is done using sparse matrix. In CBL, assessment plays a vital role. Unlike conventional e-Learning system, CBL uses 2-dimensional assessment system. This establishes knowledge as well as confidence level of a learner in that knowledge. The deficiency diagnosis is performed based on the 2-D assessment of the learner. The typical deficiency diagnosis will identify the tasks that are having deficiencies. A learner can be identified with typical tasks as having doubt, ignorant or having misconception. Based on the identification a detailed or superficial content will be provided to the learner. For each AC, a detailed as well as superficial content development is required.

Algorithm 1: SDM generation using AC based on tasks for an IO.
Begin:
For each IO in the given curriculum do
{
Identify the tasks \( T = \{ t_1, t_2, \ldots, t_n \} \) that has to perform for that particular IO;
For each task \( t_i \) \( \{ i=1 \) to \( n \} \)
{
Identify \( AC_{ij} \) \( \{ j=1 \) to \( m \} \);
Prepare the SDM for entire set of ACs related to IO;
}
End;
Algorithm 2: Prescription of Learning Content based on Deficiency Diagnosis (DD).

Begin:
For each IO in the given curriculum
{
For each task \( t_i \) in the set \( T \) obtain the status of \( t_i \) from the deficiency diagnosis;
if (status\( (t_i) = \) “doubt”)
{
Select \( AC_{ij} \), \( j^{th} \) AC of task \( t_i \);
}
else if (status\( (t_i) = \) “ignorant”)
{
Select \( AC_{ij} \), \( j^{th} \) AC of task \( t_i \);
Follow the SDM and include highly dependent \( AC_{ij} \), where AC may or may not belong to same task;
}
else if (status\( (t_i) = \) “misconception”)
{
Select \( AC_{ij} \), \( j^{th} \) AC of task \( t_i \);
Follow the SDM and include moderately as well as highly dependent \( AC_{ij} \), where AC may or may not belong to same task;
}
}
End;

Result analysis
Results are analyzed extensively, and considerable improvements of the performance are seen using SDM. The system takes care of the dependent ACs by using an SDM and more relevant content prescription is obtained. Table 1, shows the performance of

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Criteria</th>
<th>Existing System</th>
<th>Proposed System</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Performance of system</td>
<td>Based on tasks</td>
<td>Based on ACs</td>
<td>Better due to granularity</td>
</tr>
<tr>
<td>2</td>
<td>Time Complexity</td>
<td>Takes more time</td>
<td>Takes less time due to SDM</td>
<td>Optimizes the system in terms of time complexity</td>
</tr>
<tr>
<td>3</td>
<td>Space Complexity</td>
<td>Takes less space</td>
<td>Takes more space</td>
<td>Degrades performance due to memory use</td>
</tr>
</tbody>
</table>

Conclusion
In this paper, the performance improvement of the system is achieved for the CBL based on ACs in lieu of tasks. The SDM has been a very important fulcrum that provides a readily available dependency criterion making the system efficient for implementation. The dependent AC may be made available either from the same tasks or may be from different tasks. However, to implement the system, SDM must be provided to the system as a pre-requisite, which will become a computation overhead for the system to be implemented. Further to this it may also be noted that algorithm related to efficient computation of SDM may be a potential research area with future scope. The future scope of this research work will be real time base implementation of the proposal where specific values of time and space complexity may be analyzed.

References