CHAPTER 3

E-LEARNING SYSTEM

3.1 INTRODUCTION

Human resource crunch is one of the major issues the world over, especially in the areas where highly skilled and complex professional expertise is required. This results in a paucity of skilled trainers. Thus, more and more areas are shifting their attention on e-learning to address this problem. And continuous improvement through further research is underway to make e-learning performance surpass traditional training. In the case of E-learning in the sports domain, compared to other domains like science, Engineering, Technology and management, where the learners’ mental ability to grasp the subject is the prime requirement, whereas in sports, physiological variables are equally important and the success of learning depends on the physiological performance.

3.2 ARCHITECTURE OF THE KEYWORD BASED SPORTS E-LEARNING SYSTEM

The framework for Keyword based sports e-learning system has various components and functionalities are described in Figure 3.1. The actors of the system are the e-learners and instructors. The sports e-learning system provides information to the e-learner.
3.2.1 Interaction between the E-learning System and E-learners

In general, learning in the sports domain is effective when it is combined with physiological variables. It helps to choose the right sports or athletic events suitable for that e-learner and provides guidance to the e-learner; hence, the physiological parameters take a prominent place in sports e-learning.
The learner inputs the query through keywords. The system suggests to the e-learner the list of keywords present in the system. The e-learners inputs (same keyword, different keyword) to the system may be the correct keyword, relevant to the keyword list, or may be an incorrect keyword which is not in the keyword list.

The communication to the e-learning system is through keywords (say, what should be the heart rate, RRlow, EDmedium, 120-150HR) as it enhances fast search.

Even if the e-learner (Beginner (basic, middle, expert), Middle e-learner) is not aware of the exact keyword, the e-learning system assists the e-learner with the appropriate keyword so as to provide information.

When a correct (available) keyword related to physiological variable of the sports is given, the e-learning system matches it with the concept in the sports ontology and responds with the relevant information.

A few examples of the correct keywords are listed below

- RRlow – Resting Rate low
- BHRhigh – Breath Holding Rate high
- EDmedium - Endurance medium
- RPRnormal - Resting pulse rate normal
- What should be the heart rate
- Range between 120-150 BP
3.2.2 E-learner and Instructor Interaction Through E-learning System

On receiving the incorrect keyword the system redirects the query to the instructor, as it cannot match the keyword with the ontology concept.

A few examples of incorrect keywords

- Endurance
- Capacity
- Pulse
- 120-150

The limitations of the interaction between the e-learner and instructor are the availability of instructor, and his capacity to handle the query.

Availability of Instructor, in case the instructor is not available online, are alert is sent offline through mail and the interaction between the instructor and e-learner happens through mail in an asynchronous way.

The instructors’ grasping capacity of the physiological variables in the sports domain, and the exposure to the subject queried, also play a major role in the response of the e-learner. In case the instructor requires further information, it is taken from the e-learner in an interactive way, and the instructor responds to the query through Chat, Video conference, Email etc. In addition the result mainly depends on the correctness of the queries raised by the instructors, and the responses to them by the e-learner.

3.2.3 Maturity Model and Dimensions of E-learning System

A physiological variable plays an important role in the sports domain. The following physiological variables are considered. Heart Rate
Internal and External (HR(I) and HR(E)), Blood Pressure Systolic and Dialistic (BP(S) and BP(D)), Vital Capacity (VC), Breath Holding Rate (BHR), Respiratory Rate (RR), Endurance (ED) and physical activity such as Speed (SP), stamina or Power (SD), Resting Pulse Rate (RPR). Sports e-learners have different physiological variables. Learning these physiological variables improves the physical activity training for the sports e-learners. This work is focused towards building a learning system that enables to access the sports e-learners’ need through the web. Normally, an e-learner can be categorized into Beginners (basic, middle, expert levels), Middle e-learners and Expert e-learners.

Beginners need a systematic learning process which has become a bottleneck, to cater to the need of e-learners based on their skills. Particularly in the case of the sports e-learning system, which is different from other domains, where the requirement of two way interaction and support from a guide are important phenomena.

The system caters to various levels of maturity mentioned in Table 3.1 described below (Samantha et al (2009), Insung Jung (2010) and (Yong Zhou 2012).

<table>
<thead>
<tr>
<th>Category of E-learners</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner (basic, middle, expert e-learners)</td>
<td>The e-learners without sufficient knowledge about sports</td>
</tr>
<tr>
<td>Middle e-learners</td>
<td>Knowledge about the sports domain physiological variable, need guidance on planning and scheduling of sports training</td>
</tr>
<tr>
<td>Expert e-learners</td>
<td>Complete knowledge, but the e-learners uses the e-learning system for clarification purpose.</td>
</tr>
</tbody>
</table>
3.2.4 Performance Support System for the Sports Domain

The major dimensions considered for the evaluation of the performance of the e-learning system for sports domain, include system quality, information quality and user satisfaction.

In system quality, the following items are considered

- High Availability
- Easy to use
- User friendly
- Interactive features between e-learners and the system
- Personalized information presentation
- High speed information access

In Information quality, the following items are considered

- Information that is exactly what is needed
- Sufficient information
- Easy to understand
- Up-to-date information

In User satisfaction, the following item is considered

- Positive attitude and satisfaction with the e-learning system

Here, totally 11 items are considered under 3 dimensions for the evaluation of the performance of e-learning system for the sports domain.

With respect to the sports domain, the result framework of performance evaluation in Figure 3.2 is given below.
3.3 COMPONENTS AND FUNCTIONALITIES OF THE E-LEARNING SYSTEM

The core components of the e-learning system are Ontology, CSP, Planning and scheduling.
3.3.1 Role of Ontology in E-learning System

The physiological variable keyword is obtained, as the input of the e-learning system is matched with the sports ontology. In case the keyword is matched it refers to the ontology query template. The query template is used for the generation of a query, based on the keyword input after matching with the ontology. The query generated in the query template is used to retrieve the data from the CSP. The query template is used to search for the relevant information based on the e-learner’s context and the result is returned. The index based organization of the query template helps in retrieving the data. The ontology based e-learning system responds only when the correct keyword is input by the e-learner; otherwise, the query is forwarded to the instructor base E-learning system.

3.3.2 Constraint Satisfaction Problem (CSP)

The Constraint Satisfaction Problem takes the physiological variable from the ontological concept. In sports e-learning CSP, the physiological variables and values are defined, and the solution to the CSP is a combination of the physiological variables and values, and its complete assignment that satisfies all constraints. Limited search is used to find the complete assignment that satisfies the constraints.

The planning and scheduling is possible only when there is a solution from the CSP. The e-learner, while learning, should be aware of the possible constraints of physiological variables; the system helps the e-learner to know all possible constraints’ combination to facilitate planning and scheduling the training activity, in turn, can achieve the goal.
Unplanned sports activity may result in a reactive approach to control the physiological variables, whereas planned sports activity based on E-learning will help control the physiological variables through proper planning and scheduling, which maintains the physiological variables under control; in turn, interruptions are avoided.

The CSP solver maintains the information which is used for generating optimized result.

### 3.4 E-LEARNING SYSTEM PROCESS

- Learner Interface
- E-learning system module
- Instructor Interface

**E-learner Interface**

Figure 3.3 below depicts the e-learner interface, which is a web enabled User Interface, which initially validates the access rights through secured login, and in turn accesses the user type, e-learner history and provide the personalized interface for the e-learner to proceed with the session. The history captures the keyword, the information accessed by the e-learner and the number of entries in the system, which are used for dynamic home page selection as the e-learner logs on to the system.
E-learning System module

The e-learning system module takes the sports physiological variable inputs as the same (collaborative learning) or different inputs from the e-learner, and matches them with the ontology, to retrieve the parameters for the query template based on the CSP. Based on the constraints, the system indicates the resources required for the activity, which in turn, makes the e-learner to align the planning and scheduling in line with the physiological parameter as represented in Figure 3.4 below. The sports e-learning system provides the sports learning activity content to the e-learners.
Instructor Interface

The Instructor interface represented in Figure 3.5 is the trainer for the sports domain. The incorrect keywords of the e-learners are responded with a “not found” message for the e-learner to forward to the instructor for his response.

The instructor’s response is then forwarded to the e-learner as well as added to the keyword database.
3.5 BENEFITS OF USING THE E-LEARNING SYSTEM

The e-learner seeks support from the e-learning system; it guides, based on the specified events (say running, throwing or jumping) and the physiological parameter mentioned by the e-learner. This improves his understanding of the importance of the physiological variable. This, in turn, results in powerful physical activity training.

Using the web based e-learning system, the e-learner can easily access the system and educate oneself, in case of any injuries or any other ailment which affects the physiological variable, at a reduced cost.

Sports e-learning system provides athletic related teaching materials, such as physiological variables and exercise rules. Athletes spend much more time preparing for competition than actually competing. Hence, a key word based sports e-learning system is to support the improvement of
athlete performances through learning activities feedback from training practices.

Collaborative learning has been incorporated simultaneously, and the number of sports e-learners can collaboratively learn, which leads to a deeper understanding of sports physiological variable content for the training activity.

3.6 PARAMETERS OF PERFORMANCE MEASUREMENT

The performance measurement of a system is basically the correctness of a response, response time and access to vast knowledge base. It is very apparent that the e-learning system is capable of storing and retrieving a vast amount of the knowledge base and responding with precision. However, the response time varies, depending on the keyword and the implemented ontology, and query generated through the CSP. Table 3.2 below indicates the response time of different e-learners in various activities, for analyzing the performance of the e-learning system.
Table 3.2 Response time of the credential-based e-learning system

<table>
<thead>
<tr>
<th>E-Learners</th>
<th>Keyword</th>
<th>Response Time for Learning Activity (Sec)</th>
<th>System</th>
<th>Task Access Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>el1</td>
<td>Correct keyword HR(I)Low</td>
<td>3.456</td>
<td>e-learning system constraints are VC(high), RPR(Medium), BHR (Normal). During training activity do not take water</td>
<td>11</td>
</tr>
<tr>
<td>el2</td>
<td>Correct keyword BP(s)high</td>
<td>2.345</td>
<td>e-learning system (constraints are RRlow, SD Medium, SP Normal, Training to be started stress free condition)</td>
<td>9</td>
</tr>
<tr>
<td>el3</td>
<td>Incorrect keyword Heart</td>
<td>25.667</td>
<td>Instructor system Incase heart rate is high or low should not take water and food.</td>
<td>3</td>
</tr>
<tr>
<td>el4</td>
<td>Correct keyword EDhigh</td>
<td>3.246</td>
<td>e-Learning system (Constraints are RPRlow, VDMedium), HR(E) Normal, when the stamina is high then the activity can be quickened.</td>
<td>14</td>
</tr>
<tr>
<td>el5</td>
<td>Correct keyword BHRhigh</td>
<td>2.345</td>
<td>e-learning system (Constraints are RPR is low, VC is medium, HR(I) is normal, when the BHR is high the activity can be completed as a power will be sufficient.</td>
<td>8</td>
</tr>
</tbody>
</table>
Table 3.2 (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Correct keyword</th>
<th></th>
<th>e-learning system (Constraints are RPRlow, EDMedium), VCmedium, when the Heart rate is normal the activity can be quickened.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>el6</strong></td>
<td>HR(E)normal</td>
<td>3.287</td>
<td>e-learning system (Constraints are HR(E) high, RPRMedium, VCNormal) when the power is low the activity has to be differed.</td>
</tr>
</tbody>
</table>
| **el7** | Incorrect keyword ED     | 18.965 | Instructor system
The activity has to be quickened when the endurance is high or low |
| **el8** | Incorrect keyword        | 32.564 | Instructor system Pulse rate is high or low, do not continue the training activity |
|           | Resting pulse rate       |     |   |
| **el9** | Incorrect keyword RR     | 47.88 | Instructor system When the Respiratory Rate is high or low, reduce the speed and power. |
| **el10** | Correct keyword EDlow    | 8.765 | e-learning system (Constraints are HR(E) high, RPRMedium, VCNormal) when the power is low the activity has to be differed. |
The graph corresponding to the e-learner response time is given in Figure 3.6; the green color represents the response time of the system. The rose color represents the access count of the tasks the e-learner has completed.

![Performance Measurement Graph](image)

**Figure 3.6 Performance measurement of the e-learning system**

### 3.7 SUMMARY

The interaction between the e-learner and the e-learning system when implemented, is superior in performance in terms of the response time and the vast amount of data it can process and flexible to add new processes, and activity. The keyword search is based on matching the keyword in the ontology, which improves the performance, and the CSP helps in query building and retrieval of information to facilitate planning and scheduling the e-learners’ training activity.