3 DYNAMIC QUERY HANDLING (DQH) SYSTEM FOR E-LEARNING COMMUNICATIONS

3.1 INTRODUCTION

In this chapter, framework for dynamic query handling is proposed. The proposed model explores the best feasibility to connect a learner with an appropriate expert for knowledge transformation in an e-learning environment. E-learning or electronic learning platforms facilitate delivery of the knowledge spectrum to the learning community through information and communication technologies. The transfer of knowledge takes place from experts to learners, and externalization of the knowledge transfer is significant. In the e-learning environment, the learners seek subject expertise to clarify their subject queries, and a learner query can be routed to an expert for externalization of expert knowledge provided the learner knows the subject expert or the expertise group. However, learners who are new to e-learning systems are not aware of the expertise group to which the query should be sent, which results in time delays, non-response, inaccurate solutions and loss of knowledge capture. Several models have been proposed to resolve this task, but thus far, these efforts have focused completely on returning the most conversant people as experts on a particular topic to retrieve valuable knowledge. In this chapter an approach has been proposed to address this problem, which externalizes the tacit knowledge of a subject expert by creating a dynamic query handling system that automatically transfers a user query to the best subject expert.

3.2 REVIEW AND COMPARATIVE STUDY ON E-LEARNING COMMUNICATION TOOLS.

E-learning, or Internet-enabled learning uses Internet technologies to deliver a broad array of solutions that enhance knowledge and performance. The Internet has begun to reshape education approaches with many versions
of e-learning software, which are used extensively at various levels of education sectors like universities, high schools, vocational schools, or junior levels. E-learning provides multiple benefits beyond conventional classroom-based learning (Manongga et al. 2014).

The traditional context of learning is currently undergoing a drastic change. Many situations exist in which learner’s desire to study specific topics in which they are interested without the constraints of time and place. These need requirements in which learning be personalized, flexible, and available on-demand. In the corporate sector, a heavy focus is turned towards sharing of knowledge between experienced and inexperienced users or new employees. Institutions also focus to a greater extent on sharing of knowledge between experts and learners.

Advances in computer technology in the recent decades have significantly transformed modern teaching approaches. Systems providers have developed different types of e-learning tools that ease the learning process and improve outcomes. Higher education institutions are using the benefits of these e-learning tools to design and offer new opportunities for teaching and learning. To evaluate the success of one type of e-learning tool relative to another, one must understand whether a specific type of e-learning system can effectively support the learning process. Therefore, it is important to determine whether the tools can provide feedback and continuously refine the learning process which contain individual characteristics, needs, learning styles, and learning pace and deliver high-quality information through a suitable medium to create a sense of personal touch and support.

E-learning tools can be considered as a digital medium that facilitates information transfer between knowledge sources (instructors) and knowledge seekers (students). To evaluate the proposed work, the two leading e-learning systems, namely, Blackboard and Moodle have been examined in a comparison of communication an aspect provided for the knowledge seeker and knowledge provider and is shown in Table 3.1.
Table 3.1 Comparison between blackboard and moodle

<table>
<thead>
<tr>
<th>Communication Tools</th>
<th>Moodle System</th>
<th>Blackboard System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email</td>
<td>Using the instant messaging tool, one can send messages to offline users and they will read them once they log into their Moodle account. Messages will be emailed if the user is offline.</td>
<td>One can send email to all the students, or to those in a subset workgroup.</td>
</tr>
<tr>
<td>Chat</td>
<td>Using the instant messages, one can chat with online users. Messages will be emailed if the user is offline.</td>
<td>Using the instant messaging tool one can send message only if the other user is online.</td>
</tr>
<tr>
<td>Discussion Forum</td>
<td>Instructors can rate their students on what they post and let students rate their colleagues. When user post to the class Forum, that posting can be automatically emailed to the class participants. Since posting remains visible in the Forum, those not receiving emails can check for unread postings. User can create a Forum for each class workgroup, then handle each separately.</td>
<td>Discussion forums can be created in a thread or blog.</td>
</tr>
</tbody>
</table>

The comparison between Moodle and Blackboard shows that the current e-learning systems use instant messages, emails and discussion forums as a knowledge transfer medium between knowledge seeker and
knowledge provider. These communication systems just facilitate information transfer between knowledge seeker and knowledge provider. The communication modes used in Moodle and Blackboard have the provision to store the transferred knowledge but fail to quickly retrieve the required knowledge on demand by the knowledge seeker or knowledge provider.

In order to solve this issue in e-learning environment, the researchers have developed query management system for transferring knowledge between knowledge seeker and knowledge provider. The query management system has the capability to target experts and quickly retrieve the transferred knowledge on demand by the user or learner. The query routing mechanism is used in the query management system which contains clusters of expert groups on each topic or subject to which the query would be routed. The learners must select the appropriate expert group and route the query accordingly. The expert from the group must take charge of the assigned query and provide a solution to the query and in turn, the solution will be delivered to the user. This type of query routing mechanism fails if the user is new to the system and unaware of the query process, which may lead the user to receive an irrelevant or unworthy solution from the expert group because the expert who handled the query may be inexperienced or has less knowledge on the raised query topic, or the user may have routed the query to the wrong expert group due to human error.

To address these problems, a dynamic query handling system has been proposed which can receive the query from learners and automatically deliver it to the best subject expert available in the system. The user does not need to know the subject or expert group to which the query should be routed, and the experts in the dynamic query handling system are analyzed based on work performance and the solution delivery ratio that they uphold. The experts are ranked and re-ranked based on the performance that they maintain in the system, which retains the best performing expert as first priority on the topic or subject. The proposed dynamic query handling system leads to a method for ranking experts, capturing expert knowledge, ensuring
the best solutions for the query and providing a user-friendly environment to learners.

3.3 METHODOLOGY OF DQH SYSTEM

The externalization of tacit knowledge in an e-learning environment takes place using the mechanism of capturing and sharing of knowledge with the right person at the right time. An e-learning system consists of learning contents in terms of documents, Power Point slides, videos, and so on. A well-defined e-learning system provides communication between learners (knowledge seekers) and subject expertise (knowledge providers). The knowledge transferred between knowledge providers and knowledge seekers is considerably significant to maintain references for other learners. In addition, the significant queries raised by the knowledge seekers and directed to the knowledge providers will become key references for future learners.

Streamlining the process of knowledge transfer between knowledge seekers and knowledge providers requires a mechanism or knowledge management process for capturing, sharing and maintaining knowledge. E-learning is considered as an effective and well-utilized system that provides a well-defined and simple method of capturing the knowledge from experts and delivering to or sharing the captured knowledge with the relevant knowledge seekers. The query management systems used in an e-learning environment usually require categorized expert groups to facilitate the learners in posting queries to the relevant expertise group and receiving solutions. This process can be considered useful if the learner is highly familiar with the e-learning query management mechanism that routes their queries to the targeted expertise group.

The problem identified in this process is that the learner may not be able to find the targeted expertise group for the query if the learner is new to the e-learning query management system or unaware of the selection
process. The learner may receive a non-valuable solution to the raised query due to the incorrect routing of the query to the irrelevant expertise group or if the expert to whom the query has been assigned does not have updated knowledge of the particular topic. To address these issues, the proposed query management system known as the dynamic query handling system, which automatically takes the query from the learner to the targeted or relevant expertise and captures and shares the transferred knowledge among all learners.

A basic dynamic query handling system (DQH) is constructed for the creation of a framework to externalize the experts' knowledge in an e-learning environment. The DQH has the significance of taking a query from a user to an appropriate expert automatically, without the use of manual routing parameters such as subject expert IDs and expert group IDs. The mechanism here is to offer a path to reach a potential expert for the solution of a problem query and opportunity to collect valuable knowledge from the expert and store it in the knowledge repository.

In this approach, the knowledge seeker can raise a query to an expert; the user who raises the query does not require any type of prerequisite knowledge (i.e., the knowledge to which expert group or individual expert the query must be routed or transferred). The knowledge seeker only needs to post the query, the query goes into an automatic processing flow mechanism that processes and routes the query to the most relevant expert in the system. The queries which are raised by users also stored in the internal database and made searchable to other users. This enables the learners to easily get connected with relevant experts and get a solution for the query. The stored query database will act like a primary source of reference to the learners.

The diagram in Figure 3.1 shows the framework of the Dynamic Query Handling (DQH) System in an e-learning environment for automatic transfer of the query to the most relevant subject expertise rather than manual
selection of an expertise group for routing the query. This mechanism uses two different paths of entry points into the system for users:

- Knowledge provider or expert.
- Knowledge seeker or learner.

**Figure 3.1 Dynamic query handling system**

The knowledge provider enters into the system as a subject expertise by providing the specialized keywords as the specialized skill set. The subject expertise is grouped by the following keywords such as

- Expert
- Moderate
- Beginner
Each subject expert or knowledge provider contains a query bucket as a threshold for maximum query limit. This query bucket is checked by the system before passing the query to the expert. If the query bucket reached to its threshold, then the query will not be assigned to that particular expert, instead it will look the next level of expert on that particular domain for query assignment. The query is first routed to the expert level of subject expertise for query resolving. If all expert level subject experts are engaged with existing query and have the maximum level of query assignment, then the query will be auto redirected to the moderate level of subject experts and for the beginner level of subject experts on moderate levels of experts are fully occupied with a query.

The Dynamic Query Handling System uses the following components for query processes:

- Expert Classification Registry. (ECR)
- Expert Cluster based-on Domain Keywords. (ECDK)
- Query Handler. (QH)
- Query Processor. (QP)
- Query Mapper. (QM)
- Query Assigner. (QA)

The expert enters the dynamic query handling system using the ECR process. The ECR process asks the expert to provide their specialized keywords (considered as the specialized skill set in the appropriate domain). The ECR process also requires the expert to enter a skill level in the domain like, expert, moderately skilled expert and beginner. These expertise levels are used by the dynamic query handling system for query transfer to the best expert in the domain. This information is also used to map the most knowledgeable expert in the domain for user-raised queries. This process also asks the expert to provide a query threshold limit for query assignment.
Query Handler is the main component and is interlinked with other components in the dynamic query handling system. The raised query from the learner or user enters the query handler, and the query handler checks the query within the query database and if a pre-existing query with solution is not available in the database, it transfers the query to the query processor component. Thus, the query handler operates as a search mechanism and gives the results to the user or learner. Query Processor is a component that delivers the raised query to the natural language processing parser, where the query is filtered by removing the stop-words. As a result, the extracted words are obtained. These extracted words are transferred to the query mapper. Query Mapper takes extracted words into the process of word mapping and checks the higher feasibility of mapping the words with expertise keywords. Once a higher match is found, the query will be mapped to the concerned expertise group to route or transfer the query to the particular expert.

Query Assigner checks the meta-data generated from the query database and validates it based on the number of queries handled by the expert and the number of users who accepted the query solution provided by the expert. Next, the processed validation data is used by the ranking algorithm to re-rank the experts based on the performance in the system. The query assigner uses the result of the re-ranked expert list and finds the high performing expert for the particular query, and the user query is transferred to that particular expert. On the other hand, the query assigner component also checks the query bucket threshold limit before assigning the query to the target expert, and if the particular expert query bucket has reached the threshold limit, the query will go to the next best expert in that particular domain. The dynamic query handling system frequently assesses the performance of the experts using the number of queries handled by the expert, the number of solutions accepted by the user and the user ratings for the expert. These constraints are applied to auto re-rank the experts in their subject domains.
The algorithm generated for the query transformation is described below:

**Step1:** User raise query.

**Step2:** Query to be processed by using NLP parser. Which remove stop-words and yield informative words or extracted words.

**Step3:** The extracted words (EW) compared with experts stored keyword (MT)

**Step4:** Once a match of extracted words with expert’s keywords found. Then the user query is mapped with the expert and expert domain.

**Step5:** Once a query is mapped with expert i,

\[ i = 1 \ldots n, \]
\[ j = 1 \ldots n, \]

If (query \( \rightarrow \) expert)

\{ 
  for (i=1;i<=n;i++);
  
  \{ 
    If (expert (i) query bucket capacity count < bucket threshold (i)) then 
    Query moved to expert (i)
  \}
  
  else
  for (j=1;j<=n;j++);
\}
If(expert j query count< expert j+1 query count)
move query to j
else
move query to j+1
}

**Step6:** If (query<> experts (keywords) then
Move query to dispatcher.

The algorithm generated for query transformation indicates that user queries is passed through the NLP parser for removing stop words and obtain extracted words. Which in turn compared with expertise stored keywords for mapping processes and the mapped expert’s query bucket threshold limit is checked before transmitting the query to the concern expert. If the expert’s query bucket is full or reached the threshold, then the query will be redirected to the next expert. If the query is not matched with any of the expert keywords, then the query will be moved to the dispatcher. The dispatcher is an administrator, who will divert the query to expert by finding expert manually or hold query to forward concern knowledge management team to take care of the issue and resolve it.

The DQH process eradicates time delays, non-response, inaccurate solutions and loss of knowledge capture. However the proposed system has attained the accomplishment of automatic transfer of a user query from the knowledge seeker to the knowledge provider using self classification and document based relevance that may be prejudiced, biased Information available in the local system for expert ranking that cannot cross verify the experts’ expertise level globally. There is a need to cross verify the experts’ expertise level from data available on the Internet to maintain an unbiased expert ranking system.
3.4 IMPLEMENTATION OF DQH SYSTEM

The Dynamic Query Handling System is implemented through the combinations of the following processes:

- Expert Enrolment.
- Expert Segregation.
- User Query Mapping.

Expert enrollment is carried out as an input process for DQHS to collect the information from the expert and store it in the database. As a self classification model the experts’ data are collected as and when the data are entered by the expert. The screenshot of the expert registry is shown in Figure 3.2.

![Figure 3.2 Screenshot of expert registry](image-url)
The expert registry shows the expert enrolled information stored in the internal database. This registry contains unique information, including the expert user ID, expertise level (i.e., expert in topic, moderate in topic, and beginner in the topic), expert email ID, and so on. These enrolled data are used at the time of query transfer confirmation.

![Expert domain directory screenshot](image)

**Figure 3.3 Expert domain directory screenshot**

The expert domain directory (Figure 3.3) contains the expert ids, expert domains or expertise keyword, expert rating and expert bucket threshold limit. The expert id field in the database is used for unique identity of the expert, the expert domains or expertise keyword field are used to conclude the expert specialization domain or subject area. The expert rating field is the value for expert level of specialization such as (expert on subject...
topic, moderate on subject topic and beginner on subject topic). These field values are used by the dynamic query handling system to take the decision on transferring a query to the expert. While transferring a query to an expert the dynamic query handling system check the field of expert domains or expertise keyword for finding expert on particular domain. The system also checks the expert rating field to pick a best expert for the query assignment. The expert bucket field value is checked by the system before query assignment to an expert. If the query bucket of an expert is full or reached the threshold limit then the system will check for the next best expert for the query assignment.

**Figure 3.4 Question directory screenshot**

The Question Directory screen shot (Figure 3.4) shows the user raised questions are updated with date time and studid who has raised the question. The answer flag field shows the number of answers given by the experts and also staffid to whom the questions are mapped and assigned.
The query transformation is done using The mathematical measurements shown in Equation 3.1.

\[
QT = ((KY \cap ED) \rightarrow XP((ER>\text{OXP}) \text{ AND } (BC<\text{TH}))) \tag{3.1}
\]

The query (QT) is transferred to the expert (XP), and the keywords (KY) extracted from the query using the NLP parser are used to map or match with the expert domain list (ED), that is, the intersection of the keywords and expert domain list (ED) contains a common word. The resultant expert’s rating (ER) must be greater than those of other experts (OXP), and the query bucket (BC) must be less than the threshold limits (TH).

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**Figure 3.5 User query posting screenshot**
The user query posting screen shot (Figure 3.5) shows that, the system presents a user-friendly GUI for ease of use. So that posters can send the query to the expert without checking expert lists or expert groups to which the query is more suitable for transfer.

### 3.5 FUNCTIONALITY AUDIT AND RESULT ANALYSIS

The sample functionality audit of the system is been done by having 100 users in the system. Three subjects are considered namely Operating system, Java and Networks for testing the functionality of the dynamic query handling system. All the query routes carried out by the system are found optimally matching the user query with the related expert skill set as shown in Figure 3.6.

The DQH model has given satisfactory results by successful transferring of a query to the best or suitable expert available in the system.

![Figure 3.6 Total queries with query relevance](image)

**Figure 3.6 Total queries with query relevance**
The results indicate that the total number of queries raised by 100 users is 348 for which 95% of solutions were provided by the experts were accepted by the users as worthy, and 5% solutions were rejected or unaccepted by users. The Java-related queries raised by users were 132, the total number of queries for the operating system was 95 and that of networks was 121. The results show that all queries are assigned properly to the experts out of which 5% queries are marked unworthy.
3.6 CONCLUSION

The externalization of expert’s knowledge in an e-learning environment takes place using the mechanism of capturing and sharing of knowledge with the right person at the right time. The framework of a dynamic query handling system has the significance of taking a query from a user to an appropriate expert automatically, without the use of manual routing parameters such as subject expert IDs, expert group IDs. The DQH system has successfully implemented to automatically transfer a user query to the best subject expert available in the system.

The results reveal that the queries raised by users are transferred to the appropriate experts automatically using expertization keyword entries provided by the expert. The system also checks the expert query bucket threshold before placing a query in the expert queue to maintain the correct expert workload. These mechanisms offer a path to reaching a potential expert for solution of a problem and the opportunity to collect valuable knowledge from the expert and store it in the knowledge repository. The stored knowledge in the knowledge repository is searchable by users to find relevant answers for the issue or problem before querying an expert.

It can be claimed that this approach can satisfy most of the needs of knowledge seekers by directly connecting to domain expertise for collection of tacit knowledge and transforming it into externalized knowledge. The proposed query management system can be limited to query mapping with experts based on keyword matching or can be improvised to handle queries by extracting the meaning of the query and subsequently mapping it to the appropriate expert based on the query meaning.

The DQH system has attained the accomplishment of automatic transfer of a user query from the knowledge seeker to the knowledge provider using self classification and document based relevance that may be prejudiced, biased Information available in the local system for expert ranking
that cannot cross verify the experts’ expertise level globally. There is a need to cross verify the expert expertise level from data available in Internet to maintain an unbiased expert ranking system. The proposed mechanism and system development are discussed in the next chapter.