CHAPTER 5

CONTEXT DETECTION AND DESCRIPTION MECHANISM

**Objective:** This chapter discusses the basic elements of context-aware e-learning and diversity in device context. It also discusses the context detection and description mechanism which is an essential constituent in context-aware adaptive e-learning system.

5.1 Introduction

The role that communication and interaction plays in the learning process becomes a critical success factor. In this context e-learning (electronic learning) and m-learning (mobile learning) can and should contribute to the quality of education because of the rich communication and interaction environment it provides (Brown, 2003, June). But the existing learning resources are mainly developed for computer based e-learning. To make the mobile learning useful and successful there is a need to develop context aware personalized e-learning applications. This issue can be solved through detecting characteristics and constraints of learning device and delivering suitable learning content. In the context of context aware e-learning, not only the learning device but also the learning activity of e-learner may be completely different in each moment the learner tries to learn from the corresponding web-based e-learning system.
The increasing use of mobile devices has led to the development of new applications to carry out daily activities anywhere and anytime. In education, teachers are trying to integrate mobile applications into learning tasks and activities in order to enhance the students’ learning experiences (Gómez & Fabregat, 2010). The advances of mobile communication technologies and rapid adoption of mobile devices with internet capabilities make learners access the e-learning content “anywhere anytime” with mobile devices (Zhao et al., 2008). The drastic development in the computational capability of mobile devices has shown the way to take its lead from traditional desktop e-learning systems to mobile based e-learning. Learning via mobiles can be seen as a “first-aid” knowledge acquisition while the learner is facing a real-life situation and is interested in getting urgent information about a specific topic of interest. M-Learning meets the learning objectives efficiently if it is context-aware and allowing the learner to get fine-tuned knowledge adapted to the learning environment, this requires a system that is capable of detecting the context and reacting to any change (Alzaabi, 2010).

The presentation capabilities of most of the existing learning contents (such as standard documents, image, audio, and video) are restricted to personal computers and they may not be supported by mobile devices (Zhao et al., 2008). And again within the mobile devices there is diversity in their capabilities; hence the context-aware adaptive learning approach is required to provide device-independent e-learning services, through recognizing various characteristics of the device. The meaning of “context-aware” as stated by Abowd et al., (1999) is: the system is considered as context-aware if it provides relevant information to the user based on user’s task. And almost similar definition is given by Cheverst and Byun (2004): a system is considered as context-aware if it is able to interpret, extract and use contextual information and adapt its behavior and functionalities to the current context of use.
5.2 Elements of Context-aware E-Learning

The learning context strategies such as device capabilities, learning style and domain specific preferences of e-learner have been considered as the key components for modeling an integrated context ontological model to support for context aware adaptive e-learning system. So, the system is able to deliver the most suitable learning material based on the learner’s specific situation. A commonly used definition of context in computer science is: “any information that can be used to characterize the situation of an entity”, where the term “entity” is defined as anything relevant that is participating in the interaction between a user and a system, and the term “information” is defined as any particular element or detailed piece of data that allows for the description of any condition or state of the participating entities (Dey Anind K, 2001). Baldauf et al., (2007) and Schmidt (2005) have stated that in the field of e-learning domain there are number of approaches to describe the context elements and to model the learner context. Context aware e-learning aims to deliver the right information to the learner, within the right context in response to the request.

Context is a multifaceted concept that has been studied in multiple disciplines. Each discipline tends to take its own idiosyncratic view that is somewhat different from other disciplines and is more specific than the standard generic dictionary definition. The dictionary definition of context is: “conditions or circumstances which affect something (Webster, N., 1980)”. In e-learning environment the context is basically concerned about the learner and the learning environment. The traditional e-learning systems provide adaptation based on only user preferences. To improve performance, it is required to incorporate learning environmental context information such as the device and network context to determine the appropriate presentation method along with the user preferences.
The contextual information describing the learner context can be divided roughly into technical aspects and facets of learning (Bomsdorf, 2005). It is possible to categorize the context in various ways by considering different characteristics of the context. The classified contextual information is useful for context modeling, context management, application development and required to define some specifics of adaptation process, that helps learner to get highly customized learning content. In e-learning domain the key components are: Learner, Learning Device and Learning Resources. All the information about the learner situation, concerned with these three basic components is referred to as the learning context. So, the contextual factors that influence learner’s learning approach are considered as following three basic categories:

Device context:
In context aware adaptation the device context refers to the presentation of learning resources according to the characteristics of display device and is the set of device features that supports accessing, processing and presentation of the contents.

Domain specific learner context:
The domain specific user characteristics are the preferences of the learner concerned to the topic that are conceptually similar to current learning topic such as applications, sub topics, related concepts, prior concept, etc.

Domain independent learner context:
It is concerned with the way in which the learner prefers to learn (such as orientation, media type, etc.). The adaptive user model is based on several kinds of information such as learning style, orientation, etc. (Paredes & Rodriguez, 2004). Based on the learning style the relevant version of learning concept can be delivered to the learner.
The existing literature has covered various diversity problems in these components, such as: different learners may prefer to read different types of learning material (definitions, exercises, case studies, etc.), due to technical and communication advancements there are various types of learning devices (PC, Cell Phone, PDA, etc.) and learning resources are available in different forms and characteristics (reports, books, web sites, videos, interactive files, etc.).

To facilitate development of context-aware applications it is necessary to gather, manage and classify context information. And finally, it needs to model the contextual information so as to acquire the relationships among context elements. In pervasive computing, context aware adaptation is a key concept to meet the varying requirements of different clients. In order to enable context-aware adaptation, context information must be gathered and eventually presented to the application performing the adaptation (Razzaque et al., 2005).

In computer science domain the term context awareness indicates the circumstances under which particular system operates and can react accordingly. Razzaque et al., (2007) has stated that the classification of the context information will be helpful for the context aware application designers and developers and helps in selecting the best possible context source.

Dourish (2004) introduced taxonomy of context, according to which contexts can be classified into the representational and the interactional views. In the representational view, context is defined as a predefined set of observable attributes, which does not change significantly over time. In other words, the representational view assumes that the contextual attributes are identifiable and hence, can be captured and used within the context-aware applications. In
contrast, the interactional view assumes that the user behavior is induced by an underlying context, but that the context itself is not necessarily observable.

Because of the diversity and the heterogeneity of context information, it is suggested to classify them in order to facilitate the context manipulation. Classification of context varies considerably across different types of applications. The conceptual categorization of context in terms of the actors and its diversity as mentioned in Table 5.1 will significantly influence the quality of context aware e-learning applications.

<table>
<thead>
<tr>
<th>Context Category</th>
<th>Semantics</th>
<th>Examples of diversity</th>
<th>Purpose in Adaptation</th>
</tr>
</thead>
</table>
| Device context            | What type of learning device is used? | Devices Type: Mobile, Laptop, Smart phone, etc.  
Hardware: Screen size, memory, etc.  
Software: Supported media type, Mobile browser. | The main mechanism of device context adaptation is to change the presentation properties of the content or to select suitable version of content as per the device capabilities before sending to the targeted device. |
| Domain specific learner context | What type of learner he is?  
What is his preferred area? | Learning Concept: Domain, Topic, Subject area, etc.  
Orientation of learning: such as Application, Practical, Theoretical, Examples, etc. | The domain specific preferences makes learner to choose preferred concept and area as he intended to learn and orientation improves the understanding level of learner. |
| Domain independent learner context | Who is the learner?  
What are the learner preferences?  
What type of content is to deliver? | Personal: Identification, Language, Standard, Level of learning, etc.  
Media Preferences: Learning time, File format such as Text, Animation, Audio/video, etc. | Learner personal details and preferences identify the learner type and learning style so as to deliver suitable content. |
5.3 The Need of Device Context and Mobile Learning

One of the key benefits of m-learning is its potential for increasing productivity by making learning available anywhere and anytime, allowing learners to participate in educational activities without the restrictions of time and place. Mobile technologies have the power to make learning even more widely available and accessible than existing e-learning environments (Brown, 2003, June). So mobile devices are recognized as an emerging technology with the potential to facilitate teaching and learning strategies that exploit individual learners’ context; this has led to an increased interest on context-aware adaptive and personalized mobile learning systems that aim to provide learning experiences delivered via mobile devices and tailored to the educational needs (Sampson & Zervas, 2013).

Gómez and Fabregat (2010) stated the advantage of mobile learning as: M-learning is not only about including mobile technologies in traditional learning activities but it is about how the students take advantage of mobile technologies to enhance their learning process like: doing the learning activities anytime and anywhere, and allowing them to achieve the learning objectives defined in a core course curriculum. Mobile learning is uniquely suited to support context-specific and immediate learning, and this is a major opportunity for distance learning since mobile technologies can situate learners and connect learners (Traxler, 2009). Owing to the recent mobile revolution almost every student is using mobile device to browse different file types of learning content.

To understand students’ opinion about using mobile devices in e-learning environment, the researcher conducted survey in his university. More than 80% of students who participated in the survey are having mobile devices with internet access capability and around 60% of them are willing to use mobile
devices for e-learning purpose. As part of the survey, when questioned about what category of file types they are willing to browse in traditional PC and mobile based learning, the following could be identified and the results are plotted as shown in Figure 5.1, from which we can conclude that:

- Most of the students preferred to read concise materials such as PPTs irrespective of their learning device.
- Users of laptops preferred to read large size text files.
- For audio based learning contents, students are willing to use mobile devices.

![Figure 5.1 File accessing preferences in PC and mobile learning](image)

India is the second-largest mobile phone user\(^\text{31}\) with over 900 million users in the world and five-year forecast statistics (Appendix 1) of Ambient Insight Research Report\(^\text{32}\) showing that India will reach the second largest mobile learning country. Though awareness about m-learning and research in the subject
is at a very nascent stage, there have been some humble beginnings. IGNOU\(^{33}\) (Indira Gandhi National Open University) which focuses on Distance Learning has initiated its basic mobile enabled services for all its students spread across the country (Dey S, 2009).

### 5.4 Device Independent E-learning

Through customized device independent course based e-learning applications the students can review their class materials and can refer extra help in topics that are hard to them. Morar et al., (2010) has stated that converging of the computer based e-learning and mobile based m-learning allows students to stay connected with the learning environment, learning resources and teachers no matter where they are. Thus the learning process is no longer tied to a certain location and depends only on the willingness of the learner in accessing the learning resources. The communication technology geared the traditional computer based e-learning to increase their change to m-learning. With the release of Wireless Application Protocol (WAP) version 2.0, the wireless world got closer to the internet access and with that the mobile technology (such as smart phones) has influenced the students to embark upon mobile based accessing of learning material.

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\(^{31}\) [http://pib.nic.in/newsite/PrintRelease.aspx](http://pib.nic.in/newsite/PrintRelease.aspx)


\(^{33}\) [IGNOU: http://www.ignou.ac.in/](http://www.ignou.ac.in/)
The mobile usage statistics comparing 2006 and 2011, released by “Speak Up 2012 National Report” survey (Project tomorrow, 2012) shown in Figure 5.2 states that the Smartphone and Tablet PC usage is increasing exponentially. The students’ mobile usage (which has internet access capability) growth initiated the traditional PC based e-learning applications to consider mobile context while developing and delivering learning resources.

Figure 5.2 The change in students’ mobile usage

5.5 Diversity in Device Context

In web based e-learning applications, to provide suitable content to different client devices, it requires to describe the technical capabilities of the client device (known as the device context). Different learning devices usually differ in hardware, software, and browsing capabilities. Before adapting learning content to devices, the technical details of learning device are obtained to negotiate between the adaptation system and the learning device. Table 5.2 represents the different stages in content adaptation based on device context and relevant device properties which may vary based on device type and model.
Table 5.2 Different stages and forms of content adaptation

<table>
<thead>
<tr>
<th>Stages of Content Adaptation</th>
<th>Device Properties</th>
<th>Forms of Content Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content presentation</td>
<td>Browsers type</td>
<td>Appearance adaptation through changing content’s layout reposition (Yang &amp; Shao, 2007).</td>
</tr>
<tr>
<td></td>
<td>Screen sizes</td>
<td>Encapsulation adaptation concerned to the extraction of most important part of the content (Yang et al., 2007).</td>
</tr>
<tr>
<td></td>
<td>Accessing mode</td>
<td></td>
</tr>
<tr>
<td>Content processing</td>
<td>Processing capability</td>
<td>Size adaptation by resizing the dimensions of media to reduce its storage size (Chen et al., 2003).</td>
</tr>
<tr>
<td></td>
<td>Storage capability</td>
<td>Format adaptation by changing the media format so as to make it suitable for relevant device (e.g. image format from bitmap to jpeg) (Chen et al., 2003).</td>
</tr>
<tr>
<td></td>
<td>Supporting format</td>
<td></td>
</tr>
<tr>
<td>Content accessing</td>
<td>Protocol</td>
<td>Characteristics adaptation by varying the content’s qualities (such as bits, color scheme, etc.) (Lum &amp; Lau, 2003).</td>
</tr>
<tr>
<td></td>
<td>Bandwidth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HTML,WML, OS</td>
<td></td>
</tr>
</tbody>
</table>

If the learning content is in the form of simple web pages, it is easily adapted to various types of devices, by automated re-authoring through proxy server or server-side techniques such as Common Gateway Interface (CGI), Servlet, transformation-style sheets such as EXtensible Style sheet Language Transformations (XSLT) or Cascading Style Sheets (CSS) techniques (Goh & Kinshuk, 2008).

In e-learning environment the learning content is in the form of simple webpage or some other format such as word document, PDF, PPT, etc. (which are
compatible for PC based environments). But many mobile devices do not support these wide varieties of file formats that support in PC based learning. Thus, to deliver the existing learning material to mobile devices (such as cell phones, smart phones, etc.) the solution is twofold: through transcoding approach (dynamic conversion of file formats) and maintaining multiple versions of contents that are compatible for various learning devices.

5.6 Context Detection Mechanism

In e-learning domain the context aware content adaptation is based on information such as device capabilities and learner preferences. In this section, the researcher would like to give the relevant technical pattern for context detection mechanism. Millions of digital educational resources are mainly designed to get access and to deliver through desktop computers, but mobile learning solutions have become an essential part due to mobile technologies evolution and that they have become indispensable to modern society. The existing educational resources are not directly accessible by mobile devices as they are not attuned based on the characteristics such as format, size, network-speed, etc. This is an important issue to solve in context aware adaptive e-learning applications. Here, a pragmatic approach to get the device profile and learner preference is presented.

5.6.1 Device Context Detection

To describe the delivery context there are mainly two standard approaches for detecting the type of device and its technical capabilities: Composite Capabilities/Preferences Profile created by the W3C and User Agent Profile created by the WAP Forum. CC/PP profile - Composite capabilities/Preferences profile (CC/PP, 2007): CC/PP profile describes the capabilities of learner device and preferences and is used to guide adaptation of
content presented to the device. User Agent Profile Version 20-Oct-2001 (UAProf, 2001): The UAProf specification is based on the CC/PP specification with RDF (Resource Description Framework) as schema and stored in a server called the profile repository. It is an XML document that contains information about the device capabilities and user agent type. It provides a mechanism for describing the capabilities of client devices to an application server (WAP 2.0, 2002).

A CC/PP profile is a two-level hierarchy, where the profile contains one or more components, and each component contains at least one attribute. A component refers to a capability or preference category, and an attribute describes the specific capability or preference of a specific client. Figure 5.3 provides a graph illustrating an example CC/PP profile of “Network Session” and the generic structure of CC/PP profile is as shown in Appendix 2.

Currently there is a huge number of mobile device categories, the technical details (device profile) of these devices are being maintained in the servers of relevant device manufacturers. ScientiaMobile Inc. has focused on this problem and presented an open source XML configuration file called Wireless Universal Resource FiLe (WURFL), which contains information about capabilities and features of various mobile devices, typically WAP Devices such as Mobile phone, PDA, smart phone, iPod, etc. It also provides a simple API to programmatically query the capability database so that there are a growing number of ASP.NET implementations on WURFL.

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34 CC/PP profile: http://www.w3.org/TR/NOTE-CCPP/
35 ScientiaMobile: http://www.scientiamobile.com/
36 WURFL: http://wurfl.sourceforge.net
WURFL is a Device Description Repository (DDR) in XML format. It defines characteristics of mobile device such as markup language, format of images, size of screen, etc., based on matching the user agent string that is identified from the http request object. WURFL is today more popular than pure UAProf or CC/PP solutions (Zhao et al., 2008). It supports the inheritance of properties from other devices so that they can be categorized according to families and subfamilies. To access the repository of WURFL XML files, ScientiaMobile, has provided API for Java, Perl, MS. Net, Ruby, and Python platforms. The API
has functions like: it can return a WURFL device ID for a given User Agent string and a capability value for a given capability name. The following subheadings discuss the practical approach for obtaining device and learner profile.

### 5.6.2 Approach for Obtaining Device Profile

Here, the device context detection mechanism is explained in three different steps through using some coding part in VC#.Net syntax, to support the explanation, as the proposed prototype is to be implemented in Microsoft VisualStudio.Net platform.

**Step 1: Check if the type of device is computer or mobile device.**

Different client devices send different User-Agent headers to the server to identify themselves to the server. `Request.Browser ["IsMobileDevice"]` is used to determine whether the request type is from a mobile device or not and redirects to the relevant version of web pages accordingly. An appropriate and relevant example code is given below:

```csharp
public static bool IsMobileBrowser()
{
    HttpContext context = HttpContext.Current;
    if (context.Request.Browser.IsMobileDevice)
    {
        Response.Redirect("MobileDefault.aspx");
    } else
    {
        Response.Redirect("DesktopDefault.aspx");
    }
}
```
**Step 2:** If device type is not mobile device, then the default is computer.

If the device is not mobile type, the default device context is considered as personal computer; most of learning contents are designed for desktop platforms so that the contents from default content database can be delivered based on preferences and activity context of e-learner.

![Figure 5.4 Approach of detecting device type](image)

Step 3: Obtain device profile if device type is mobile device.

When client device requests a service from web-server the “HTTP request header field” is sent from a client device to a server. Use the “User Agent” Property from the “HttpRequest Class” to identify the relevant client device model (type) and browser type. But through examining the User Agent header and performing adaptation, will be exclusively based on device/browser identity and not on particular device capabilities. So the characteristics of the device model can be obtained using WURFL repository
to create the device profile of learner concerned. The diagram shown in Figure 5.4 represents the approach to know the device type through HTTP request header and using WURFL repository.

5.6.3 Obtaining Learner Preference Profile

The non-technical aspects such as learning style and selection of learning resource services strongly influence the process of learning (Bomsdorf, 2005). The learning context consists of domain-specific information and domain-independent information (Esichaikul et al., 2011). The domain specific requirements and the learning style of e-learner are the two essential categories of learning context information for assessing the learning resource content.

The proposed context aware adaptive approach incorporates the adaptive theory based on integrated context model through combining the device context and learner context. Here, we are using static approach for collecting learner context information where the learner needs to enter the preferred style and orientation of learning. Based on the learner’s style-profile an appropriate material will be delivered to the learner.

Various steps in the process of obtaining learner context information are:

- Learner needs to specify the domain of their interest or subject area in learner profile during registration process.

- Before starting to learn, the learner has to specify his style of learning from different sets of learning style parameters such as:

  A. The format of learning material such as Audio, Video, PPT, etc.
  B. The orientation of learning such as application oriented, case-study, example oriented, etc.
The learner context information related to device context and learner context such as content type (format) and orientation of learning are stored in context database under appropriate learner Context-ID.

Based on the context information related to learning device, style of learning and learner’s personal profile, the adaptation mechanism provides a list of concepts concerned with the domain of interest of the learner.

During the time of learning, the learner is able to change his style of learning through user interface, which will be recognized by activity detection module and will get updated in context database.

The approaches for acquiring the contextual information in this proposed system can be summarized as shown in Table 5.3.

<table>
<thead>
<tr>
<th>Context Type</th>
<th>Acquisition Approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device context</td>
<td>Device context is automatically obtained by means of using User Agent profile and WURFL Device Description Repository.</td>
</tr>
<tr>
<td>Domain specific learner context</td>
<td>Learner needs to select the preferred domain specific preferences such as sub topics, related topics, etc. from presentation model using user interface.</td>
</tr>
<tr>
<td>Domain independent learner context</td>
<td>It includes the content format (such as Audio, Video, etc.) and learning style entered by learner through filling a form before starting to learn. Learner can change his preferences during the time of learning.</td>
</tr>
</tbody>
</table>
During the time of learning the device context cannot be changed so that it is considered as static context and whereas learner context is dynamic type because it can be changed as per learner needs during the moment of learning.

5.7 Context Description

To enrich the learning efficiency and interests of e-learner, the contextual information in the context aware e-learning environment can be used to analyze the student situation and needs. The semantic technology and ontological approach are emerging as promising approaches to leverage the retrieval and presentation of dynamic context (Roy et al., 2010). The ontological representation of learner context model in e-learning domain enhances the accessibility and the reusability of the learning material.

To model the real-world applications it needs complex rules. So, the meaning captured into ontology for the problem domain becomes very helpful for rule extractions when building complex systems (Shih & Tseng, 2009). The ontological approach is a suitable means for representing learner contextual information. Based on learner context ontology the production rules are derived and stored in knowledge base.

Here, the contextual entities of learning environment are described using an ontological approach from which the relevant adaptation logic is derived. The purpose of the ontology based context model is to formalize the structured contextual entities by making use of the ontological methodology to define the concepts and relationships of the context elements (Qin et al., 2007). The formal context model combines First Order Predicate Logic (FOPL) and Web Ontology Language (OWL), to provide a common understanding of
contextual information to facilitate context modeling and reasoning and to enable context knowledge sharing and reuse.

The set of contextual elements in learning environment can be divided into two classes as device context and learner context. Again the learner context has two parts, namely, the domain independent and domain specific. The domain independent part defines characteristics of learner such as learning style and preferences. The domain specific part reflects the characteristics of the learner for a particular domain and refers to the concepts from the respective domain model. The ontology-based context model uses predefined metadata of the learning contents, learner profile, learner activity, learning device characteristics, etc. for retrieving the context aware personalized learning contents. The learner context model can be formally represented as follows:

Device Context (Device features) and Learner Context (Learner’s Preferences) are the two sets of parameters that are considered to obtain context aware adaptive functionality.

Learner Device Context (DC) = {Concerned to the device details such as: Type, Hardware, Software, etc.}

Learner Preferences Context (PC) = {Concerned to the domain specific and domain independent details such as: Language preference, Content Type preference, Content Format preference, etc.}

Then the Context Profile is denoted as a 3-tuple:

Context Profile (CP) = <I, DC, PC > Where

I: denotes the learner’s context identity;

DC: denotes the receiving device context;

PC: denotes the learner context
The context aware adaptation mechanism takes two context dimensions DC and PC as arguments and delivers the matching learning resource to the learner. The formal description of integrated learner context ontology can be defined as shown in Table 5.4. The semantic-based description of learner context information is being described based on conceptual relations (Domain, Range and Relation) of three different contextual dimensions as shown in Table 5.5.
Table 5.5 Context categories and semantic relations

<table>
<thead>
<tr>
<th>Context Category</th>
<th>Domain</th>
<th>Relation</th>
<th>Range</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Context</td>
<td>Student</td>
<td>hasDevice</td>
<td>Device</td>
<td></td>
</tr>
<tr>
<td>Device Context</td>
<td>Device</td>
<td>ofType</td>
<td>Device-Type</td>
<td>Mobile</td>
</tr>
<tr>
<td>Device Context</td>
<td>Device</td>
<td>hasBrowser</td>
<td>Browser-Type</td>
<td>Firefox</td>
</tr>
<tr>
<td>Device Context</td>
<td>Device</td>
<td>hasScreenSize</td>
<td>ScreenSize</td>
<td>Size</td>
</tr>
<tr>
<td>Domain Specific Learner Context</td>
<td>Student</td>
<td>isCoursing</td>
<td>Course</td>
<td>Computer Science</td>
</tr>
<tr>
<td>Domain Specific Learner Context</td>
<td>Course</td>
<td>hasTopic</td>
<td>Topic</td>
<td>Data Structures</td>
</tr>
<tr>
<td>Domain Specific Learner Context</td>
<td>Preference</td>
<td>OfLearningOrientation</td>
<td>Learning-Orientaion</td>
<td>Case Study</td>
</tr>
<tr>
<td>Domain Independent Learner Context</td>
<td>Student</td>
<td>hasPreference</td>
<td>Preference</td>
<td></td>
</tr>
<tr>
<td>Domain Independent Learner Context</td>
<td>Preference</td>
<td>ofMediaType</td>
<td>Media-Type</td>
<td>Video</td>
</tr>
<tr>
<td>Domain Independent Learner Context</td>
<td>Preference</td>
<td>ofLanguage</td>
<td>Language</td>
<td>English</td>
</tr>
</tbody>
</table>

5.8 Context aware E-learning System Scheme

The adaptation mechanism in the proposed adaptive e-learning system scheme is mainly based on contextual information that is obtained from various sources. As shown in Figure 5.5, the device context and learner context details, mainly consist of two categories of information based on how they are acquired.

Static information:

It is mainly collected from device context detection mechanism and learner personal profile which does not change during learning process.
Dynamic information:
It is collected by learner activity monitoring system from user interface. This data may get changed depending on the student learning-progress and learning style.

![Adaptive e-learning system scheme](image-url)

Figure 5.5 Adaptive e-learning system scheme
The adaptation mainly works, based on adaptive rules which are derived from context model. The learning contents are managed by adaptation-oriented resource model so that the adaptation mechanism delivers suitable learning content based on device, domain and learning-style contextual information. As the ontologies expression ability is insufficient to provide efficient adaptive delivery of learning material, the researcher has used the semantic knowledge based rules that are derived from an ontological learner context model to enhance the efficiency in adaption process.

5.9 Summary

Most of the current e-learning applications and their learning contents are not suitable for mobile devices due to computational and technical barriers that can impede access to existing online learning resources. In this chapter, basic elements of context-aware e-learning and diversity in device context were discussed first and then the device context and learner context detection and description approaches were addressed so as to deliver suitable content based on contextual information.