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Adaptive Content Creation for Personalized e-Learning Using Web Services

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Abstract: A challenging topic in computer based education is to provide personalization support for learners when e-learning takes place in an open and dynamic environment. By selecting and combining appropriate learning assets into a learning object a learner's needs and preferences may be accounted for. Also by implementing web service in an adaptive learning environment the reusability of the learning content can be ensured. This paper addresses the problems of automatically selecting and integrating appropriate learning materials for a learner using web services based on the learners initial knowledge, goals, preferences etc. A system is described that provides learning content to multimedia industries and institutions those who are working in Adobe Flash. Instead of providing a learner with static data, the approach is based on fulfilling learning objectives based on a dynamic supply of services. Furthermore, the approach is based on reusable learning objects describing a learning process as a composition of learning goals. Based on the learning goals as well as web services, services appropriate to achieve a specific learning goal can be selected, composed and invoked dynamically.

Key words: adaptive, e-learning, webservices, standards, personalization, learning Object

INTRODUCTION

The rapid progressions of information and communication technologies create numerous new opportunities for the improvement of quality of education. It is generally agreed that, the education has not yet realized the full prospective of information and communication technology. Personalized learning is widely considered as one promising direction towards the full exploitation of the potential of the information society in education. Personalized learning ensures that it is the learning content that should be adapted to the individual learner as opposed to the traditional learning system, where it is the learner's responsibility to adapt to the learning context in order to maximize the learning outcome.

Learning contents delivered online gives learners a self controlled learning experience via a computer terminal. But the information available in the Internet is generally unstructured because it is not feasible to describe the conditions that determine which part of the educational material is appropriate for different learners' characteristics. Also due to limitations of the currently available searching technologies educational applications retrieve the same material for all learners without taking into account the varied needs of each individual learner e.g.-previous knowledge, background, skills etc. Due to such *e*-learning offerings, it has witnessed high drop out rates as learners become increasingly dissatisfied with courses that do not engage them.

Also learners in colleges and universities are provoked differently, but also spend considerable effort searching for information to gain knowledge and skills. In all cases, information on the web is often not effectively organized and learners spend considerable time in futile interactions and may not properly integrate information to address their immediate learning need. A more flexible approach is needed that is sensitive to each learner's unique needs and context, but also provides focused and structured learning.

A possible remedy for this dissatisfaction is to produce an adaptive e-Learning system that will tailor itself to different learner needs. Adaptive content refers to learning materials that can be adapted to the requirements of different learners. Intelligent Tutoring Systems (ITS) [5] and Adaptive Hypermedia (AH) [13] solutions have been used as possible approaches to address this dissatisfaction by attempting to personalize the learning experience for the learner. Such systems may tailor the educational offerings to the learner's objectives, prior knowledge, learning style, experience and many more characteristics of the learner. However, such systems have continually been criticized for believing that this embedding of expert knowledge is sufficient for effective learning to occur. In reality, these early systems constrained the learner and limited the opportunities for the learner to investigate topics that deemed to be of little relevance.

Also limited appropriateness, dynamic adaptability to actual learning contexts, limited reusability across different learning contexts, high development costs etc.

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can be considered while delivering the learning content in an adaptive elearning environment. For instance, a package suiting the needs of a learner with specific preferences – e. g. his previous experience or technological platform - can suit only this specific requirements and cannot be reused across different learning contexts.

The challenge is, therefore, to provide a more supple architecture for adaptive systems which can incorporate greater suppleness in dynamically selecting the learning material based on up-to-date knowledge of the learner thus satisfying the learner by using web services. The changes which are made on behalf of the learner may be adaptable or adaptive changes. Adaptable changes are those which originate from user and are also controlled by the user. Adaptive changes originate from the system and are controlled by the system. The system adaptivity may be hidden entirely from the user so that the user is unaware of changes made by the system on their behalf.

Personalization is a key premise for an improved learning experience. Personalization is closely associated with e-learning and refers to the following issues:

- Interface personalization can range from presenting some items on user's display in accordance with user's options, up to more complex processes that include establishing the user emotional profile and adapting the interface according to the result.
- Content personalization involves authoring adaptable learning materials, constant evaluation of student's knowledge level and adaptation of learning materials accordingly.

The main objective of the system is to implement the adaptive learning system where the requirements of the learner can be accounted for by suitably selecting the contents based on user profile. Also the learning contents can be delivered to the learner by using web service to ensure reusability. Instead of providing a learner with static data, the approach is based on fulfilling learning objectives based on a dynamic supply of services. The system is based both in the area of e-learning and in the area of Web services. The realization in a distributed fashion leads to a number of challenges including the maintenance of content and services, but has, on the other hand, potentials like direct integration of e-learning services into business applications or the access of learning services by different devices if there is an appropriate client for that device.

Personalized E-Learning: Personalized Learning is a unique, blended educational model that is tailored to the needs and interests of each individual learner. Personalized Learning is dedicated to developing individualized learning programs for each learner whose intent is to engage each learner in the learning process in the most productive and meaningful way to optimize each learner's learning potential and success.

Because education research confirms beyond any resemblance of doubt that not all learners are able to learn successfully at the same pace, with the same approach, in the same environment, on the same path and in the same style and manner. Research confirms that every individual assimilates information according to their own unique learning style, need and interest. Learning styles vary depending on the individual learner. Some people are visual learners, some are auditory learner, others kinesthetic learner. Some people learn at a faster pace, others need more time. Motivation, interests and passion to learn varies significantly from learner to learner.

Also by considering the impact of emotions and intentions, educators can better understand how and why individuals learn differently. For example, some learners are happiest learning in collaborative, facilitated environments with learning tasks accomplished in a structured or linear fashion. Other learners succeed in competitive learning environments that focus on specific details, tasks and projects. Some learners are passionate about exploring new challenges and taking risks and they enjoy using learning to achieve long-term personal goals. Finally, some learners are formally or situationally resistant to any kind of learning that appears to have little value or benefit to them.

Therefore it is indiscriminate that a one size fits all model can no longer effectively serve the needs of individual learners. Rather than trying to force-fit every learner into one model, the answer is to provide, in addition to the traditional model, an alternative model that offers flexibility to fit the needs of the learner. The Personalized Learning model is such a model to serve the growing percentage of learners who are yearning for an alternative to the traditional approach.

Thus the Personalized learning approach embodies a unique combination of key components that embodies flexibility, innovation and individualized learning, It offers an active learning strategy which empowers the learner to be in control of the context, pace and scope of their learning experience. It supports the learner by providing mechanisms through which they can personalize their learning experience. This learner empowerment can help to improve learner satisfaction with the learning experience which is gained during the learning session.

Persistent Problem: Content creation for an individual learner in a distributed environment is one of the main problems for e-learning systems. Professors find it difficult to develop learning modules according to e-learning standards. Particular problems are the structuring and the organization of learning materials in conceptual units and the addition of metadata definitions.

Current approaches to support a learning objective are fundamentally based on providing a learner with appropriate learning content – the so called learning objects. E-learning platforms and their functionalities resemble one another to a large extent. Recent standardization efforts in e-learning concentrate on the reuse of learning material, but not on the reuse of application functionalities. This means, a new learning content package has to be developed for every different learning scenario or individual needs of specific learners. For instance, a package suiting the needs of a learner with specific preferences – e. g. his native language or technological platform - can suit only this specific requirements and cannot be reused across different learning contexts.

For providing knowledge-based, intelligent tutoring systems, adaptive learning tools are used for the development of learner models. These tools track learner's activity and the learner's interactions with learning materials, analyze the answers and texts written by the learner, identifies needs or interest and evaluate the psychological profile and learning style. One important component of the student model is the knowledge level: what knowledge he has, what knowledge he does not have and what knowledge he has wrongly. These facts are derived from answers to different questions, from the analysis of tests written by students, from students' interactions. The most important is the domain ontology that includes the basic concepts and relationships in the domain taken into account. In addition, ontology for pedagogy is used for the generation of flexible, personalized learning processes.

Adaptive systems need to gauge the level of prior knowledge of the learner. The rate and manner in which a learner assimilates knowledge is dependent on the learner's previous knowledge of the subject matter. The system must then monitor the learner's mastery of concepts and build upon the knowledge acquired by the learner as they progress through the course. Direct feedback or test results may be used to infer the knowledge of the learner at the start of the course.

Thus the open problems in the context of personalization are:

- How to provide personalization capabilities making use of distributed yet connected repositories.
- How to support learner identification and profiles in such a distributed environment.
- How to integrate personalization capabilities with other functionalities needed to provide support for learners.
- How to provide reusable learning content in an adaptive e-learning environment.

Background Research: Personalized learning experience is accomplished through personalizing the learning material according to the pedagogical and contextual parameters of the learners. Pedagogical parameters comprise the learning styles, habitual properties and general aptitude of the learners. The aspects like cultural background, place of study, collaboration, timeliness and hour of study are some of the contextual parameters.

Adaptive educational Hypermedia systems[1] need to allow for different cognitive styles and attempt to nurture a more analytic cognitive style in learners who adopt surface processing of the content. The learning style of a particular learner changes depending on the time, context and mood of the learner. The factors which may affect learning style include the learner's physiological and psychological state, the prevalent cognitive style of the learner and their prior experience of Hypermedia in general and the course content in particular.

As for adaptivity, adaptive learning experience is accomplished by adapting the learning paths to the knowledge level and the acquired competencies of the learner. Learning paths are portions of the concept domain ontologies. These ontologies essentially represent the curriculum constructs. In addition, adaptivity will also have to take into account the learners previous experience outside the iClass so as to reflect to their iClass[2] experience. In order to achieve this adaptivity, appropriate assessment techniques are continuously employed by iClass. Hence, the knowledge representation of the learner is continuously updated throughout his/her iClass experience.

E-learning with dynamically adapted digital content is therefore an effective medium for personalized learning. Personalized learning advocates that the learning should not be restricted by time, place or any other barriers and should be tailored to the continuously modified individual learner's requirements, abilities, preferences, background knowledge, interests, skills etc.[3].

iWeaver[4] is a multidisciplinary research project, which draws upon prior work in 'multimedia learning theory', 'cognitive load theory', 'adaptive hypermedia environments' and 'learning styles research'. It implements a combination of adaptive navigation and adaptive content presentation techniques. Adaptive link ordering is used to improve selection time and to reduce cognitive overhead and also to guide the learners to their best-suited media experience. Adaptive link hiding is implemented by hiding links to experiences that are unlikely to be chosen. These experiences are still accessible via an expand-button, similar to the 'smart menus', in Microsoft Office and Windows.

Weaver uses the Dunn & Dunn learning styles model. The Dunn and Dunn Learning Styles Model is

the most widely used and researched learning-styles model in the history of education in North America. According to learning-style theory, learners' cognitive, affective and physiological patterns determine their academic outcomes. These patterns are relatively stable indicators of how individuals perceive, interact with and respond to their instructional environment. Understanding the multi-dimensional aspects of learning has been proven by research conducted over more than three decades to be one of the few known ways of helping learners improve their capacity to concentrate, process information, remember new and difficult academic information.

This model is based on 30 years of research and is used internationally. A number of learning strategies have been derived from this model and were successfully implemented in traditional classroom scenarios. In the iWeaver project, a selection of these strategies was transferred into an e-learning environment by using multimedia representations and specifically developed learning tools.

The computer can be used as a cognitive tool to develop higher order thinking skills. Learners who learn by associating and linking different ideas and information will be more effective at learning in a Hypermedia based system. Such learners think, perceive and solve problems in an active, exploratory manner[5]. They exercise strategic analysis of the meaning of the subject matter. Active learners who are confident in their learning strategies regardless of the subject matter are called field independent learners.

A feature of the knowledge-based content creation, management and delivery system OntAWare[6] is the ability to turn an ontology concept hierarchy into a collection of meaningful slides – a lesson – for the learner. An Ontology is a specification of a conceptualization. That is, an Ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents. This definition is consistent with the usage of ontology as set-of-concept-definitions, but more general. And it is certainly a different sense of the word than its use in philosophy. Also Ontologies are knowledge representation frameworks that allow us to express knowledge in an explicit and expressive way using well-defined semantics. They can be described as a method of structuring knowledge in a machine-processable manner. Similar to how sentences are created by combining words together to give meaning, ontologies can provide this functionality by linking concepts together using relationships which can in turn be processed to produce meaningful data. An advanced feature of OntAWare is its approach to navigation, adaptivity and interoperability.

The key factor for supporting large scale interoperability, portability and reusability is to create effective, open and scalable e-learning systems that are required to acquire, store and share knowledge under the form of learning objects (LO)[8].

The European IST project knowledge-on-demand (KOD)[7] aims to address needs for the effective and efficient distribution of electronically published learning material and the provision of personalized learning services in order to favor life-long-learning and knowledge transfer experiences through the web. The idea behind KOD system is the generation of personal learning paths referred to as knowledge routes on the published educational material, generated and updated according to the learner's characteristics (background, interests, skills etc.) which are constantly monitored and profiled.

Sugiyama[9] describes about content personalization and link personalization. This scheme involves selecting the links that are more relevant to the user and changing the original navigation space by reducing or improving the relationships between Web pages. E-commerce applications use link personalization to recommend items based on the buying history of clients or some categorization of clients based on ratings and opinions. Users who give similar ratings to similar objects are presumed to have similar preferences, so when a user seeks recommendations about a certain product, the site suggests those recommendations that are most popular for his/her class or those that best correlate with the given product for that class.

The research on e-learning and Web-based educational systems (WBES)[11] traditionally combines research interests and efforts from various fields. A quality aspect of this move is the attention the application needs to pay to the specific individual user in order to tailor the growing amount of information, coming from various distributed and local sources, to the needs, goals, roles and tasks of the individual users. In an effort to serve better the needs of the education community WBES attempt to employ Semantic Web technologies in order to achieve improved adaptation and flexibility for single and group users (e.g. instructors, courseware authors and learners) and new methods and types of courseware compliant with the Semantic Web vision. Nikos Manouselis and Demitrios Sampson[12] referred to the knowledge as the recommended sequence of educational material and activities, tailored to individual learner's needs and activities. Personalized learning using distributed information in dynamic and heterogeneous learning environments is still an unsolved problem in e-Learning research. Dynamic assembly of learning objects[14] focuses on the problem of how to automatically assemble learning objects into simple, short, focused, Web-based "custom courses". This process includes the

process of connecting relevant search results into a learning path, sequencing the selected learning objects on the path and linking the selected learning objects into an organized structure. Dynamic Assembly is based upon parameters that are available only when a learning session starts, such as the learner's keyword query, desired level of detail and the amount of time they have available to learn. The query is typically based upon a task focus, professional development opportunity, or specific interest.

Overview and Architecture:

The proposed architecture: The educational scenario can be defined by the variables such as knowledge of the learner, background of the learner etc. that will be considered to adjust the learning design. Users can define whatever properties they want. The adaptivity will take into consideration the personalization properties such as educational background, initial knowledge etc. and learner requirement to show specific learning activities. The learner can be categorized as beginner or experienced.

The system developed will identify the user requirements from the registration form submitted by them. The Learner model will be created based on the information provided by the user. Based on the Learner model the system conducts objective type test for each topic/pagelet of the subject. Depending on the test score it searches the XML structure provided by the web services and integrates the materials according to the need of the user.

The steps for the learning scenario are as follows:

- The user log on through a standard web browser.
- A learner session is initiated that stores all relevant data about the learner i.e. Learner's requirement, learner's previous knowledge etc.

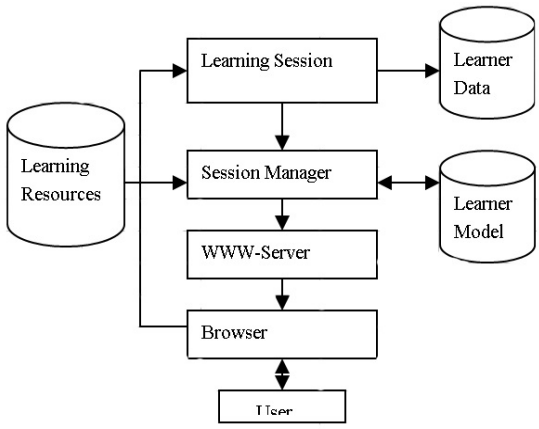

Fig. 1: System Architecture

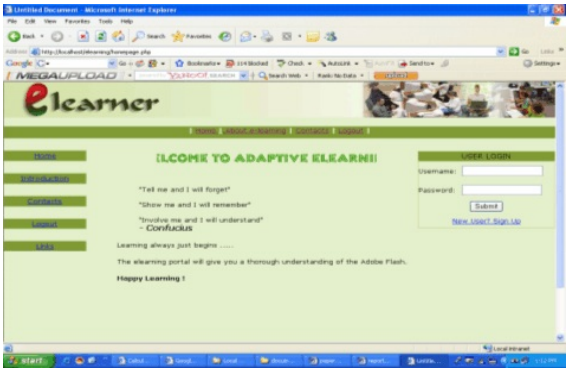

Fig. 2: Learner's Web browser

- The session manager is a server process that gathers updated data about the learner from learning session and retrieves data from web resources.
- The learner model is refined according to the need of the user i.e. in which portion of the subject the learner is interested.
- This combination is then send to the learner's web browser

The learner model: Before the system can create a personalized course for a learner it must have some appropriate information about that learner. This information is obtained from the registration form filled up by the learner prior to learning that determines their prior knowledge regarding the domain.

A learner model contains explicitly modeled assumptions that represent the characteristics of the learner which are pertinent to the system. The system can consult the learner model in order to adapt the performance of the system to each learner's characteristics. Learner modeling allows the system to personalize the interaction between the learner and the content

There are many properties and characteristics of the learner that the designer of an adaptive educational system may utilize to produce a personalized learning experience. The objective or goal of the learner is a description of what they are trying to achieve through a learning experience. This may be inferred by the context of the content and include learning goals and personal objectives.

In this paper the leaner model has been developed to identify the previous experience of the learner in Adobe Flash. The learner model is basically of two types as beginner or experienced.

Adaptive Content Creation: Adaptive Content Creation and Presentation is the customization of course content to match learning characteristics specified by the learner

Fig. 3: Learning Content for Beginner

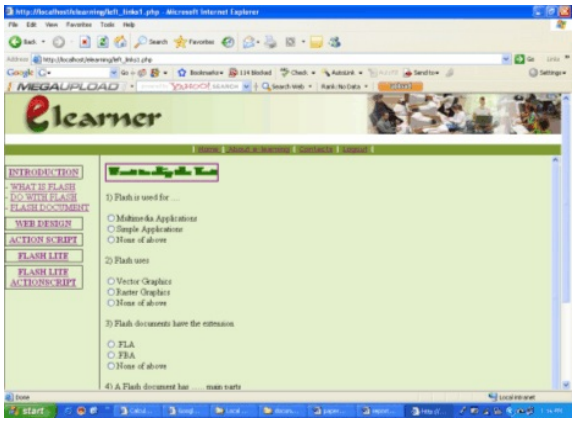

Fig. 4: Test for Experienced learner

model. The granularity may vary from word replacement to the substitution of pages or the application of different media. Content may be customized to contain additional information, prerequisite information or comparative explanations.

This form of adaptivity may be implemented by fragmenting the constituent content components into pagelets or paragraphs. These components, or pagelets, constitute a discrete unit of information about a concept. The pagelet is displayed if the learner model conforms to required conditions for the display of that pagelet. For example, if a learner has not covered a prerequisite concept for a given page the relevant pagelet may be included. The adaptive learning system will be created for a specific domain such as Adobe Flash. When a learner wants to enter into a learning session the steps for learning activities are:

If the learner is a beginner he will be supplied all the materials starting from introduction.

If the learner is experienced he may opt for the specific module for which he is interested. The experienced learner needs to appear for a test to fulfill the prerequisite condition for a specific module. If the prerequisite condition is not satisfied the learner need to go through the materials which are explicitly needed before proceeding through the specific module.

After going through the elaborate observation of the of the course material the student need to appear the final knowledge test. If he scores less than the minimum pass percentage then it is needed to go through the course material again. If he scores greater than the minimum pass percentage, some additional support will be provided to complete the course.

Webservices: A web service is a software application, which is identified by a URL like ordinary websites, but can be accessed remotely by another application. The difference between web services and websites that makes web services unique is, in fact, the type of interaction that they can provide. Web service describes a standardized way of integrating web applications using XML, SOAP, WSDL and UDDI. XML is used to tag the data, SOAP to transfer the data and exchanging information between computers, WSDL used for describing the services available and finally UDDI for listing what web services are available for a customer to use or buy. Web services transportation can be done over simple protocols (HTTP, SMTP, FTP, etc.); HTTP is currently the most commonly used web service protocol.

Web services provide a solution to a major problem in the computer world i.e. interoperability. Interoperability is provided by allowing different applications from different sources to communicate with each other without time-consuming customized coding. Since all communications are in XML, the services are not tied to any specific operating system or programming language. Therefore, C++ communicates with Perl, Java with PHP and Mac with Unix or Windows. The power of web services resides in the fact that each web service implements a capability that is available to each other, or to other applications, via standards, networks and protocols.

Services are components wrapped in a service layer. A service tends to aggregate multiple components into a single interface. The consumer of the service does not know the location or the interface of the service until runtime. The consumer finds the location of the service at runtime by looking it up in a registry, which also contains a pointer to the service contract.

The service contract is discovered dynamically at runtime, bound to and executed. This feature allows the consumer to perform real-time contract negotiation with several services in a dynamic way. Service-based development has solved the interoperability problem by adopting Web-based interoperability standards. Web Services use the HTTP protocol to transfer data and XML for the data format. Web services may use protocols such as for SMTP and FTP for transport.

WSDL: The adaptive e-learning web service based system proposed is based on WSDL architecture. WSDL is an XML document that conforms to a specification. All the services metadata is contained somewhere in this file, structured in such a way that will make it easy to understand what the data means. In addition to a WSDL file being human readable, all that a programmer has to do to generate the code necessary to connect physically to services is to use an XML parser to extract data into local variables. This automatic code generation is one of the outstanding features of web services.

A WSDL document[10] defines services as collections of network endpoints, or ports. In WSDL, the abstract definition of endpoints and messages is separated from their concrete network deployment or data format bindings. This allows the reuse of abstract definitions. A WSDL document uses the following elements in the definition of network services: Types, a container for data type definitions using some type system (such as XSD); Message, an abstract, typed definition of the data being communicated; Operation, an abstract description of an action supported by the service; Port Type, an abstract set of operations supported by one or more endpoints; Binding, a concrete protocol and data format specification for a particular port type; Port, a single endpoint defined as a combination of a binding and a network address; and finally a Service is a collection of related endpoints.
WSDL is a cornerstone in the web services architecture because it provides a common language to describe such services plus it provides a platform for integrating those services.

SOAP: SOAP, which historically used to refer to, Simple Object Access Protocol, is a lightweight protocol for exchange of information in a decentralized, distributed environment.

SOAP is an XML-based protocol for exchanging information between computers. Its job is to encode messages in a common XML format so that message can be understood at each end (client and server). It is a high level of abstraction, so that any operating system and programming language combination can be used to create a SOAP-compliant program. Web services use SOAP as a logical transport mechanism for moving messages between services described by WSDL interface

SOAP[10] can be defined as a "specification for a ubiquitous XML-based distributed computing infrastructure". It is a stream of characters that are carefully created so that the programs on both sides of the transmission can understand exactly what the other side is saying. Those characters are XML documents that are embedded in the transport's request and response messages.

A SOAP message is composed of three parts, two of which are mandatory and a third which is optional. The mandatory parts are: SOAP envelope <SOAP-ENV: envelope> that defines a framework for describing what is in a message and how to process it and SOAP body <SOAP-ENV: body>; The optional part includes SOAP header <SOAP-ENV: Header>.

Learning Content as Web Service: In order to deliver the learning content as web service the following stages are required in this process,

- Create the service to be called by the client.
- create WSDL service description of that system
- deploy service onto a server
- register new service via UDDI

Implementation: The system is implemented entirely in PHP and runs on Apache web application servers. Web pages are created using PHP and HTML. Learning contents are delivered to the learner using PHP web service.

The learning contents are then cleaved into chapters and subchapters and stored in MySQL database. Foreign key concept is implemented in the tables to avoid insertion, updation and deletion anomalies. The webservice is created using PHP based on the chapter and subchapter ID. The NuSOAP library in PHP will generate WSDL documents automatically. The WSDL file is a document that describes a Web Service. It can tell a client how to interact with the Web Service and what interfaces that Web Service provides.

The contents of WSDL file are:

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
- <definitions xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:SOAP-ENC= "http://schemas.xmlsoap.org/soap/encoding/" xmlns:tns="urn:chapter" xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/" xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/" xmlns="http://schemas.xmlsoap.org/wsdl/" targetNamespace="urn:chapter">
- <types>
- <xsd:schema targetNamespace="urn:chapter">
  <xsd:import namespace="http://schemas.xmlsoap.org/soap/encoding/" />
<xsd:import namespace="http://schemas.xmlsoap.org/wsdl/" />
</xsd:schema>
</types>
- <message name="getchapterRequest">
 <part name="ch" type="xsd:interger" />
 <part name="sub" type="xsd:integer" />
 </message>
- <message name="getchapterResponse">
 <part name="return" type="xsd:string" />
```

```
 </message>
- <portType name="chapterserverPortType">
- <operation name="getchapter">
 <input message="tns:getchapterRequest" />
 <output message="tns:getchapterResponse" />
 </operation>
 </portType>
- <binding name="chapterserverBinding" type=
"tns:chapterserverPortType">
  <soap:binding style="rpc" transport=
"http://schemas.xmlsoap.org/soap/http" />
- <operation name="getchapter">
  <soap:operation soapAction="http://localhost/
elearning_web/chapterserver.php/getchapter"
style="rpc"/>
- <input>
    <soap:body use="encoded" namespace=""
encodingStyle="http://schemas.xmlsoap.org/soap/encod
ing/" />
 </input>
- <output>
 <soap:body use="encoded" namespace="" encoding
Style="http://schemas.xmlsoap.org/soap/encoding/" />
 </output>
 </operation>
 </binding>
- <service name="chapterserver">
- <port name="chapterserverPort" binding=
"tns:chapterserverBinding">
   <soap:address location=
"http://localhost/elearning_web/chapterserver.php" />
 </port>
 </service>
 </definitions>
```

For each subchapter one client program is created to call the web service. When the user clicks on the sub chapter the service will be called and the contents will be displayed.

Conclusion: This innovative approach proposed the runtime reconciliation of discrete elements of adaptivity to produce extensible personalized e-learning resources. The adaptive e-learning system for the domain is implemented which improves the performance of the learner by reducing the browsing time and providing more time for learning thus reducing the cognitive load of the learner. Also the "create once, use often" concept is implemented by delivering the learning content as web service as opposed to the traditional system of e-learning where the learning content can be created and used only once. By moving towards a web service based system the aim to lay the foundation for a middleware service that will offer an open application program interface for e-learning system designers. Also the reusability of the learning contents can be ensured, which will then give them access to many other e-learning systems. This work, along with additional research on the usability of the system, will aim to simplify creation and re-use of learning materials, thereby encouraging their use in Education and bringing the benefits of a personal educational experience to more learners.

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