Design and Aggregation of Computer Science Syllabus using XML-based Learning Repository

Mona G Dave, P V Virparia

Abstract: This paper presents an approach to create a XML-based Syllabus repository for Computer Science subjects. It facilitates educators and experts to create, store, update and publish a syllabus for a particular subject. The objective of the research is to contribute to automate the Computer Science syllabus creation process allowing use, reuse and repurpose of the learning objects from the repository. The Syllabus learning objects like topic and subtopic are stored in a hierarchical XML structure which are combined and aggregated to create a customized syllabus for a particular subject. This paper discussing the Structuring, Navigating and Parsing of XML data done by using XML Schema Definitions (XSD), XPath and SimpleXML respective XML technologies. The steps to process the XML data and transform the data to produce the output is also discussed. We have tried to solve the issues associated with the traditional method of creating a syllabus which uses MS-Word or PDF data format.

Keywords: SimpleXML, Syllabus Repository, XML, XML Schema, XML Parser, XPath

I. INTRODUCTION

Well-designed syllabus plays an important role in the Education Field. A syllabus can be beheld as a group of meta-data for a particular course. A comprehensive syllabus normally comprises of the Subject ID, Subject name, a short description of the subject, the learning purposes of the subject, a list of the topics, subtopics, references such as text books, and other related online reference links [12][13]. The various learning objects that are included in a subject syllabus offering are created based on the syllabus definition, and the difficulty level. We understand that the content should be in a standard compliant format that can be exchanged and re-used. Metadata structure is used to customize the creation process of the syllabus from the Learning Object Repository (LOR). LOR has influence on web based retrieval and storage of contents. Syllabus repository stores XML documents in a hierarchical structure. The specific learning objects like

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topics and subtopics are combined and aggregated to create a customized subject syllabus for the experts and educators.

II. RESEARCH OBJECTIVE

The objective of the paper is to suggest an XML-based Computer Science Syllabus Learning Object Repository (CsSyllabusLOR) which stores Computer Science syllabus data. The syllabus repository has collected the primary and secondary data from the Universities of Gujarat offering Computer Science subjects for Bachelor of Computer Applications (BCA) course. This paper proposes an efficient method to create, reuse, repurpose the syllabus objects from the XML data in the repository. The repository also has search facility that finds existing syllabus for any subject. The subject expert who designs the syllabus manually uses MS-Word or PDF format for editing the syllabus. This work will help to automate the syllabus creation for the experts instead of working manually with MS-Word or PDF format files. Accessibility to a syllabus repository shall unlock many opportunities for many state-of-the-art applications. The easy access of Computer Science syllabus learning objects repository can open a new resourceful means in the future [12][13].

III. EXPLORATION OF XML IN SYLLABUS REPOSITORY

A. XML and Data

XML is a mark-up language for documents containing structured information. The XML domain is made up of distinct sub-standards describing various aspects of document use and reuse. XML is a meta-language, which can be used to define the logical structure of documents and data, using element and attribute names [12][13]. XML permits users to term their own tags. This assists to build the structure of the data according to the content of the document along with the format criteria of header, body text, etc. Following are the advantages of using XML database for the repository [6].

- XML is popular for single source publishing due to its reusable content.
- XML standards provide interoperability and flexibility to software
- XML processing tools are widely used and inexpensive.
- XML is good compared to other database for data interchange.
- XML support powerful platform to manage complex and demanding content applications.

- Supports volatile schema in XML (schema modification is simpler).
- XML is most suitable for Hierarchical Data.
- Updating component-owner data is easy.

Figure-1 shows our Syllabus XML document and Figure-2 illustrates its tree-structured representation [9].

```
<?xml version="1.0"?>
<Learningobject
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="cssyllabus.xsd">
     <Area id="A1">
          <Aname>Programming</Aname>
          <Subject Level="1" id="S1">
               <Sname>Programming Using C</Sname>
                    <Topic id="T11">
                         <Tname>Problem Solving</Tname>
                         <Subtopics id="St11">
                              <Subtopic>Algorithms</Subto
                              pic>
                              <Subtopic>Flowcharts</Subto
                              pic>
                         </Subtopics>
                    </Topic>
                    <Topic id="T12">
                         <Tname>Basics Of C</Tname>
                         <Subtopics id="St12">
                              <Subtopic>History</Subtopic>
                              <Subtopic>Structure Of
                              C</Subtopic>
                         </Subtopics>
```
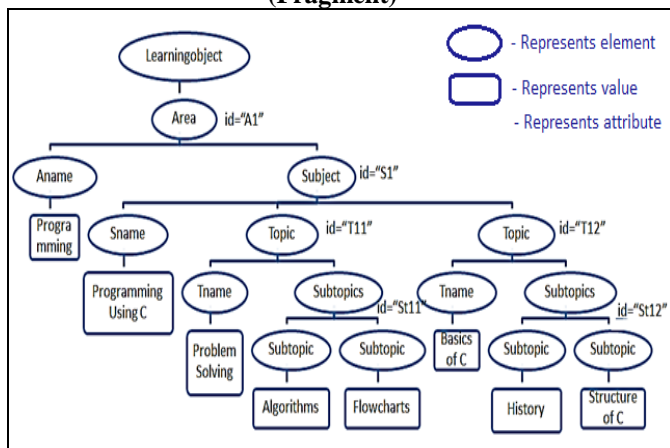
Fig-1: An Example of Syllabus XML Document (Fragment)

Fig-2: Tree representation for Syllabus XML Document

B. Structuring of XML

There should be a consent on the use of all the element names and their hierarchical relations when XML documents are used in data exchange. Therefore, the constraints must to be declared on XML documents for clarity on the usage of elements and attributes. A schema is an intellectual collection of metadata, consisting of a set of schema components like elements and attribute declarations, complex and simple type definitions, etc. Different standards like Document Type Definition (DTD), XML Data Reduced (XDR) and XML Schema Definitions (XSD) are defined to validate elements, elements structure and data types of an XML document. DTD and XSD are developed by World Wide Web Consortium (W3C). XDR has been defined by Organization for the Advancement of Structured Information Standards (OASIS) [2][6].

The schema can be used as XML data binding. The schema helps to generate code allowing the contents of XML documents to be treated as objects within the programming environment. XSD is used to precise a set of rules for an XML document to be considered "valid" according to the schema [2]. The features offered by XSD and not available in DTD and XDR are integrated namespace, built-in and user-defined types, local element names and powerful key and referential constraints.
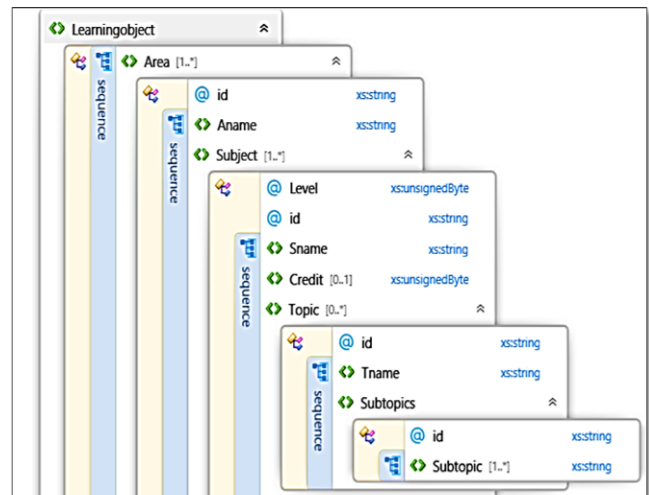

Fig-3: Content View of the Syllabus XSD Document (Fragment)

C. Navigating XML Document

XPath is a formal method of navigating the XML hierarchy using XSLT and XQuery. The different kinds of nodes in the XPath data model of a document are text, element, attribute, root, namespace, processing instruction, and comment nodes [18][19]. XPath operates on the logical structure of an XML document. XPath query returns the values from the tree of nodes stored in the XML document [6].

Following are the sample XPath expressions used to query XML documents:

- /Area/Subject/Topic
  Selects all Topic elements that are children of the element Area
- //Subject
  Selects all Subject elements in the document
- /Area/Subject[Sname = 'Programming in C']
  Selects all elements that are children of the Subject whose name is 'Programming in C'
- //Area[@id="'.$id.'"]//Subject
  Selects all Subject elements according to the id attribute of Area element
- //*[name()='Subject']
  Selects all elements that are named "Subject"

D. Parsing of XML Data

XML parser reads and interprets XML data [20]. Syllabus repository uses a tree-based simpleXML API (Application Programming Interface), a standard XML parser with PHP 5. SimpleXML turns an XML document into a data structure to repetitive access the collection of arrays and objects. An object represent the syllabus xml document using PHP simplexml_load_file() function as shown in the sample code.

$xml variable has captivated all the 'Learningobject' object which can further read and manipulate the values of all the elements and its attributes [14][15].

Following is the sample code for captivating objects from XML document using SimpleXML API with PHP:

```php
<?php
$xml = simplexml_load_file('Syllabus.xml');
$area = $xml->Area;
for ($p = 0; $p < count($area); $p++)
    echo "<option value='".$area[$p]->attributes()->id."'>".
        $area[$p]->Aname. " </option>";
$subject = $xml->xpath('//Area[@id='".$id."']//Subject');
for ($i = 0; $i < count($subject); $i++)
    echo "<option value='". $subject[$i]->attributes()->id."'>".
        $subject[$i]->Sname."</option>";
?>
```

IV. PROCESSING OF XML DOCUMENT

An application program written in PHP technology, JavaScript, Cascading Style Sheet (CSS) along with different XML technologies are used to process the XML documents to generate the syllabus in the desired format [19]. These following steps used to process the XML document to create a syllabus of a particular subject are presented in the Fig-4.

1. Firstly, the XML document will be uploaded by the API connection.
2. The XML structure validation is checked based on the XSD file included in the XML file.
3. For the extraction of XML data XPath expression is used.
4. The XML parser explicitly builds an object model in the form of a tree structure.
5. PHP application program provides an interface for creating, parsing and manipulating XML documents using the standard tree-based SimpleXML API.
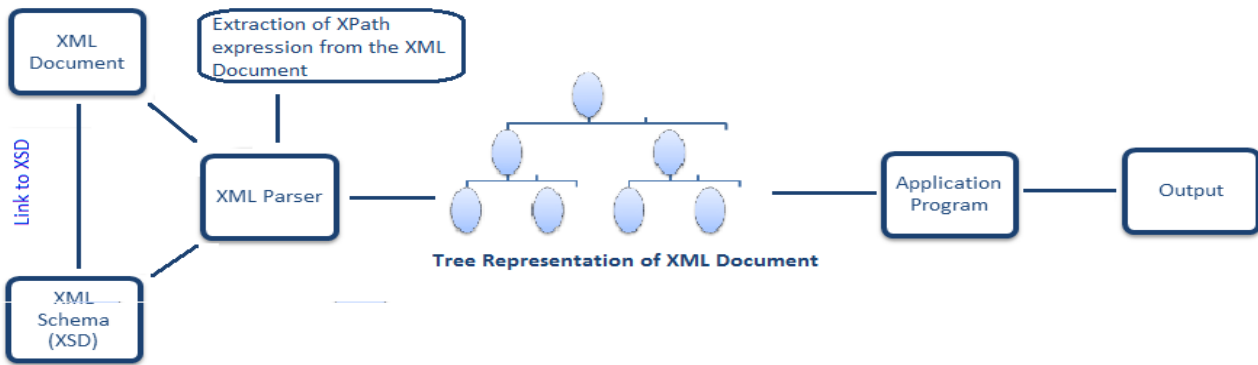6. The XML data will be transformed to generate output in the desired format.

Fig-4: Steps to generate Syllabus by Processing the XML Document

V. XML PARSER RESULTS

The Syllabus XML document has been processed using PHP and the XML technologies as per the above steps. According to the selected Area of Computer Science, aggregating the learning objects like Subject and Topic will transform to generate the output. Figure-5 and Figure-6 shows fragment of the syllabus creation process which involves the aggregation of learning objects to create a syllabus of 'Programming Using C' subject from the 'Programming' area of Computer Science repository.

Fig-5: Input screen for the syllabus creation

Fig 6: Output screen for the syllabus creation

VI. CONCLUSION AND FUTURE DIRECTIONS

Computer Science field is changing rapidly. So updation in the syllabus is required frequently as compared to other fields.

The universities request the computer science experts and the educators to update the syllabus frequently helps to reduce the gap between industry and academic.

This paper presents the work to effectively create, update and publish the objects stored in the XML-based syllabus repository. It allows to manipulate the learning objects, use and reuse the knowledge rooted in the computer science syllabus repository. It also solves the issue of the inefficiency, time constraints associated with the manual or traditional way of preparing the syllabus. A simplified syllabus helps to clearly communicate the goals and expectations of the syllabus to the students and the educator. Several researcher has worked with Fuzzy logic in XML. In future we intend to use fuzzy XML for the development of Rule-based framework to create or search a syllabus according to the difficulty level of the topic selection for a syllabus.

REFERENCES

1. AbdelbassetRouabah, Samir Akhrouf, LarbiSelmani, YahiaBelayadi, "Dihya: an Intelligent Learning Object Repository", In the proceedings of International Conference on Interactive Mobile Communication Technologies and Learnings, 2015.
2. Aleksandar Bulajic, Nenad Filipovic, "Implementation of the Tree Structure in the XML and Relational Database", In the Proceedings of Informing Science & IT Education Conference (InSITE), 2012
3. Ali H. Alharbi; Health Informatics e-Learning Object Repository HiLOR, In the proceedings of International Conference on Informatics, Health & Technology, 2017.
4. Andy Ju An Wang and Ken Yetsko, "Building Reusable Information Security Courseware", http://dl.acm.org/citation.cfm? id=1107642, 2005.
5. Daniela Leal Musa, José Palazzo Moreira de Oliveira, "Sharing Learner Information through a Web Services-based Learning Architecture", In the proceedings of Conference on Advanced Information Systems Engineering, Riga, Vol. 1, pp. 122, 2004.
6. Dare Obasanjo, "An Exploration of Xml in Database Management Systems", http://www.25hoursaday.com/storingandqueryingxml. html, accessed on 11/25/2019.
7. Hazem M. El-Bakry, Nikos Mastorakis, "Advanced Technology for E-Learning Development", Recent Advances In Applied Mathematics And Computational And Information Sciences, Vol. II, pp. 501, 2009.
8. Ignacio Gutiérrez, Víctor Álvarez , M. Puerto Paule, Juan Ramón Pérez-Pérez and Sara de Freitas; Adaptation in E-Learning Content Specifications with Dynamic Sharable Objects, Systems, Vol. 4, Issue 2, pp. 24, 2016.
9. Igor Tatarinov, Zachary G. Ives, Alon Y. Halevy, Daniel S. Weld, "Updating XML", ACM SIGMOD, May 21-24,2001. "
10. Ismar Frango Silveira, Nizam Omar and Pollyana Notargiacomo Mustaro, "The Architecture of Learning Object Repositories", http://proceedings.informingscience.org/ InSITE2005 /P117 Silveira.pdf, 2005.
11. Ken Abernethy and Kevin Treu, George Piegari and Han Reichgelt, "A Learning Object Repository in Support of Introductory IT Courses", http://dl.acm.org/citation.cfm?id=1095766&dl=ACM&coll=DL&CFID= 755547096& CFTOKEN =95490784, 2005.
12. M'HAMMED ABDOUS, WU HE, "A Design Framework for Syllabus Generator", Journal of Interactive Learning Research, Vol. 19, Issue 4, 541-550, 2008.
13. ManasTungare, Xiaoyan Yu, William Cameron, GuoFangTeng, Manuel A. P´erezQui˜nones, Lillian Cassel, Weiguo Fan, Edward A. Fox, "Towards a Syllabus Repository for Computer Science Courses", In the Proceedings of the 38th SIGCSE technical symposium on Computer science education, USA, pp. 608, 2007.
14. Mohammad I. Santally, MahenGovinda, and Alain Senteni, "Reusable Learning Objects Aggregation for e-Learning Courseware Development at the University of Mauritius", In the Proceedings of International Journal of Instructional Technology & Distance Learning, Vol. 1, No. 7, 2004.
15. Mona G Dave, P V Virparia, "A Review on Learning Repositories and Fuzzy XML in Education Field", National Journal of Systems and Information Technology, Vol. 10, No. 2, 2017.
16. Mona G Dave, P V Virparia, "CsSyllabusLOR: Computer Science Syllabus Learning Object Repository", International Journal of Computer Sciences and Engineering (IJCSE), E-ISSN: 2347-2693, Vol.-7, Issue-1, 2018.
17. Pollyana Notargiacomo Mustaro and Ismar Frango Silveira, "Learning Objects: Adaptive Retrieval through Learning Styles", In the proceedings of Interdisciplinary Journal of Knowledge and Learning Objects, Vol. 2, 2015.
18. Raymond L. Plante, "Chapter 57: Advanced XML Technologies: Schema, Xpath, XQuery, and XSL", The National Virtual Observatory Book - ASP Conference Series, Vol. 382, 2008.
19. Somchai Chatvichienchai, "An XML-Based Syllabus Repository System for Inter-University Credit Exchange Systems", International Conference on Computer Technology and Development, 2009.
20. Vivek Koli, Anum Khan, Rajasi Pawaskar, Prof.Supriya Solaskar, "XML Parser for Email Resume System", International Research Journal of Engineering and Technology (IRJET), Vol. 03 Issue 4 , 2016.

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