On the Standards Testing System for Digital Music Learning Resource

Wu Di, Xu Jian, and Huang Jianxin

Abstract—**As one special type of digital learning resource, digital music learning resource provides strong support for music learning and education. To standardize the management and distribution of resource, we defined its standards framework and developed related standards testing system. This paper analyzes the characteristics of digital music learning resource, describes the standardization requirements of resource management and distribution, and introduces the design and implementation of the standards testing system.**

Index Terms—**Digital music learning resource, standards testing system**

I. Introduction

Digital music has penetrated to all areas such as music teaching, writing, researching and appreciating, and shows its unique technological advantages [1]. Coupled with the development of e-learning, remote music education has been viewed as an important way to promote the quality and enlarge the scale of music education. Currently the major form of digital music education is to render the content as a web site for distance learning students. Digital learning resources are important carriers for learning content. Therefore, a wealth of resource has been developed. However, due to the lack of uniform standards and specifications, it’s difficult for sharing and exchanging digital music learning resource among a variety of resource systems and learning platforms. To solve the problem, a digital music learning resource standards system should be defined based on the resource characteristics.

A. Characteristics of Digital Music

Digital music is recorded and stored in digital format and transmitted over the network. No matter how many times it has been downloaded, copied and broadcasted, the quality will not decrease [2].

Digital music has the following features: digital music abandons the physical carrier to break the tradition of digital music. It is stored in the database by digital signals. It is transferred in the network space at high speed which is incomparable by traditional transmission of music based on logistics [3]; today, with the great development of broadband technology, the speed advantage of digital music is more apparent; The traditional carrier of music such as tape, CD is inevitable when it is used several times, but the losses of sound quality of digital music will be avoided by the reserve of music quality. Without the physical form, the quality of digital music will not change no matter how many times it has been downloaded, copied and broadcasted [4].

B. Characteristics of Digital Learning Resource

The digital learning resource is the extension and promotion of learning resources with the development of information technology as prerequisite [5]. It includes the multimedia material that can be shared for both autonomic and cooperative learning, according to the learner characteristics. It has the following distinguishing characteristics: diversity, sharing, interactivity, scalability and regeneration.

The information content is manifested by different form integrate multimedia, hypertext structure and so on. The resource is shared in a network environment for free remote access. The bi-directional transfer of digital learning resources and feedback features make the interaction more convenient and efficient between learners, learners and content and teachers. It allows finish machining from various angles to meet the diverse learning needs of learners and the needs in different periods. Therefore, the knowledge integration and creation by the learners' active participation become available [6].

C. Characteristics of Digital Music Learning Resource

Digital music learning resource (DMLR) is a special type of learning resource which integrates the characteristics of digital music and digital learning resource, as shown in Fig. 1. DMLR extends the capacity of music learning resource and enriches the music learning tools to make music more open, with its features of audio - visual strategy, iconicity and high, information [7]. Therefore, both the characteristics of digital music and digital learning resource should be considered in the definition of DMLR standards.

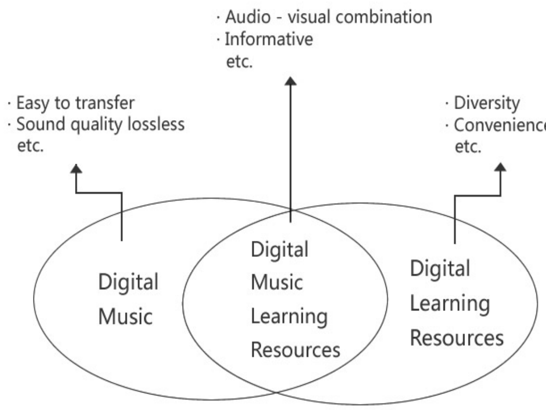

Fig. 1. Features of different type of resources

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Wu Di and Xu Jian is with the National Engineering Research Center for E-Learning, Central China Normal University, Wuhan, Hubei, China (e-mail: dr.wudi@ gmail.com, xujian207@gmail.com).

Huang Jianxin is with the Huazhong University of Science and Technology, Wuhan, Hubei, China (e-mail: hjxwww2008@gmail.com).

II. The Design of Standard Framework

A. The requirement of Standardization

The standards of DMLR mainly involve three parts of key elements: the learner, teacher and administrator. The learner mainly needs to find and retrieve the digital music resources, and about learning of music standard. The teacher mainly needs to supervise the register and control the process during the digital music teaching by implementing management series specifications. The administrator mainly needs to manage the learning and teaching process. Description of main factors in standard of DMLR is shown in Fig. 2.

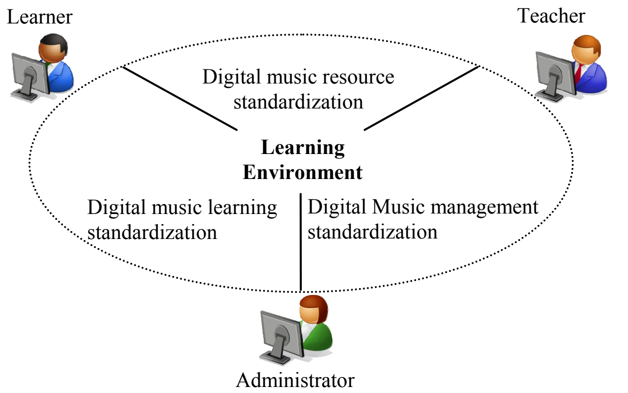

Fig. 2. Requirements analysis of DMLR standardization

B. The Standards Framework

Based on the requirements of DMLR standardization mentioned above, a standards framework is designed by us (see Fig. 3) which includes 3 types of standards:

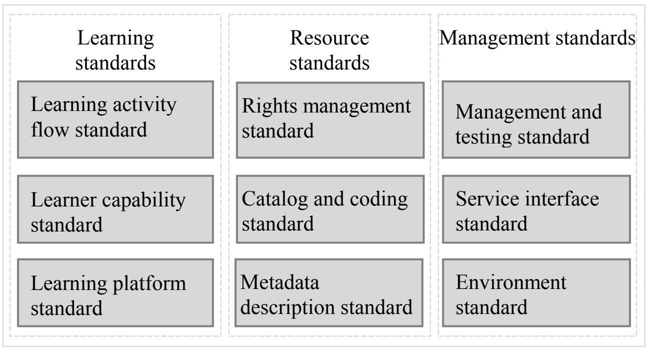

Fig. 3. Standards framework of DMLR

Learning standards – include all the standards related with digital music learning process, such as learning activity flow, learner capability and learning platform standards. The standards are mainly focusing on the digital music learning standardization requirements and commonly used by learners and administrators.

Resource standards – include all the standards related with digital music learning resource, such as resource rights management, resource catalog and resource metadata description standards. The standards are mainly focusing on the digital music resource requirements and commonly used by learners and teachers

Management standards – include all the standards related with digital music learning management, such as management and testing, service interface and learning environment standards. The standards are mainly focusing on the digital music management standards and commonly used by teachers and administrators.

C. The Metadata Standard of DMLR

The resource meta-data description standard of digital music learning mainly describes the basic information of music learning resource, includes the applied disciplines, resources producers, media formats and so on. As a special type of learning resource, there’re quite a few special elements included in DMLR metadata which aren’t included in any other type of learning resource metadata, such as lyrics writers and song composers. Metadata standard can make it more effectively in retrieve and reuse of learning resource more effectively.

Obviously, because DMLR metadata standard is most closely related with learning resource, it’s the most important standard in DMLR standards framework. To provide an effective way for developers, learners and teachers to use this standard, we designed a standard testing system to provide support for resource metadata validation.

III. The Standard Testing System of DMLR

The standard testing system of DMLR is a comprehensive platform for developers and managers. The standard testing system can help to generate compliant digital music learning resource which strictly obey the metadata description standard and can be directly import and export from any standardized digital music learning platform.

A. The using of XML Parsing Techniques

The standard testing system of DMLR is developed based on XML [8] to implement standardized test by XML parsing technology. PHP provides support for XML including XML parser, Simple XML, XML Reader, DOM [9] Document. Simple XML acts as parsing technology of XML in the testing system and supports XPath functions of PHP5 based on tree parser. It permits easily access to the XML tree, installs built-in authentication mechanism, supports for XML documents to improve the interoperability with DOM. It can apply simple XML parsing documents conveniently.

B. The Work Flow of Testing System

The work low of the testing system is designed with the schema validation technology and implemented based on PHP and DOM technology. As shown in Fig. 4, the entire testing process involves two XML documents. The target XML document which record the testing software uses a variety of media is the test object. The standard XML document which store data related to the information is the specification and basis of the testing work flow. The main task of the testing system is to implement the comparison between the target XML document and the standard XML document and validate the grammar and the content structure of the target XML document.

In order to implement the test process, there are three main steps which are included in the testing work flow.

First, the schema file which represents the standard should be parsed to achieve the information related with the testing.

When the traverse process is finished, the information to be tested about will be implemented as a DOM structure and stored into the memory.

Second, the target XML file provided by the user should be validated based on basic XML grammar. to check is it a valid XML file or not.

At last, the processed target XML document should be compared with the pre-defined specified data structure which is stored in the memory in the first step.

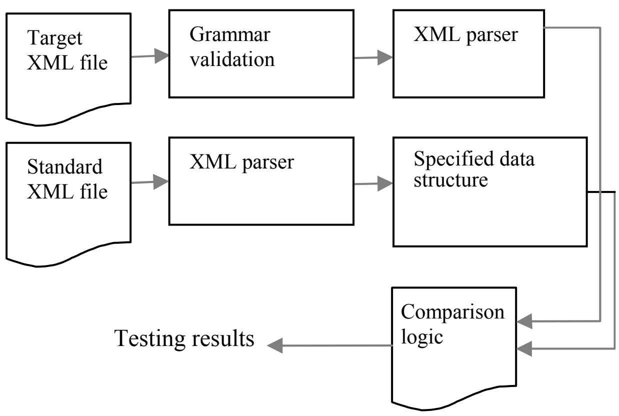

Fig. 4. The workflow of the standard testing system

C. The Implementation of the Testing System

The code fragment of comparison logic is implemented based on PHP technology (as shown in Table I).

TABLE I: CODE FRAGMENT OF COMPARISON

```
private function testNode($node,$path = ""){
   $node_name = $node->getName();
   $node_path = $path."/".$node_name;
   $occurInfo[$node_path] = $node_path;
   ……
     foreach($num_record as $url=>$num){
       if(isset($testInfo[$url][max])&&$testInfo[$url][max]!="unbound
ed")
       {
         $max = $testInfo[$url][max];
         if($num>$max){
          $error_str = $url . ": The occurrence number of the node
          under its parent element is wrong, it should appear no more
          than ".$max." time!";
         $errorInfo[] = $error_str;
         }
       }
   ……
   }else{
      $warn_str = $node_path.": Node and its sub-node aren't
presented in the standard!";
      $warnInfo[] = $warn_str;
   };
}
```

The testing system is developed based on browser/server structure. We have adopted a three-tier architecture [10] design of the system including presentation layer, business layer and data access layer. Presentation layer implemented with HTML mainly used for processing the interaction with users. The presentation layer accepts user requests, sends the request data to the business layer and returns the data displayed by business layer to the users. It is a service provided by Ajax with business layer. The business layer is mainly used for business functions. It accepts the user's data, processes the information and stores the result in the database. Data access layer is used to manipulate databases which provide support to the business layer.

A fragment of the standardized XML schema file of DMLR metadata description standard's XML-binding used to describe the DMLR metadata is shown in the Table II.

The root node of the schema is named information, and it has several child nodes named as "projectname", "principalname", "testtime", etc.

In the sample fragement shown in Table II, the XML schema file indicates that the child node named "projectname" should be a string, so does the "enterprisename" and some other child nodes, and the child node "testtime" should be "date-time" type.

TABLE II: A FRAGMENT OF THE XML SCHEMA FILE

```
<xs:element name="information">
  <xs:complexType>
    <xs:sequence>
       <xs:element name="projectname" type ="xs:string"/>
       <xs:element name="enterprisename" type="xs:string"/>
       ……
      <xs:element name="testtime" type="xs:data-time"/>
      <xs:element name="principal">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="principalname" type="xs:string"/>
            <xs:element
name="principaltelephone"type="xs:string"/>
            <xs:element name="principalemail" type="xs:string"/>
          </xs:sequence>
        </xs:complexType>
      </xs:element>
      ……
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

A sample case of resource description file is shown in Table III. We can figure out that the XML file has some deficiencies. First, the child node named "enterprisename" occurs twice, which not accordance with the schema file. Second, the value of the child node named test time is not a date-time type.

TABLE III: CODE FRAGMENT OF THE XML FILE

```
<information>
  <projectname>"DM"</projectname>
  <enterprisename>"eitec"</enterprisename>
  <enterprisename>"nercel"</enterprisename>
  ……
  <testtime>"2012-03-24"</testtime>
  <principal>
    <principalname>"wangwei"</principalname>
    <principaltelephone>"15072395478"</principaltelephone>
    <principalemail>"wangwei@126.com"</principalemail>
    ……
  </principal>
</information>
```

Therefore, the testing system tries to detect and validate the target XML document through the comparison with the standardized schema, the test result is shown as Fig. 5.

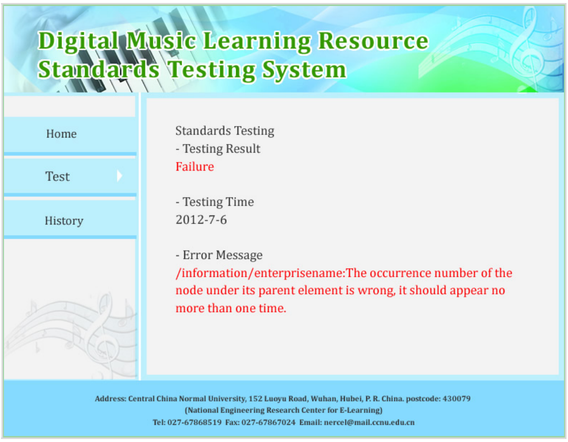

Fig. 5. Testing results shown in the testing platform

IV. Conclusions and Future Works

Digital music learning resource is an important type of learning resource and provides strong support for improving the quality and scale of music education. To manage and distribute digital music learning resource more effectively and conveniently, we defined a resource standards framework and developed a corresponding standards testing system.

In future works, we will keep promoting the quality of standards testing system and improving its application in distance music education.

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Wu Di was born in Hubei, China. He graduated from Huazhong University of Science and Technology in Computer Science, China, in 2000, and obtained his PhD in Communication and Information System at Huazhong University of Science and Technology, China, in 2006.

He is a researcher in National Engineering Research Center for E-Learning, Central China Normal University, Wuhan, Hubei, China. He has served as an Academic Visitor of Centre for Applied Research in Educational Technologies, University of Cambridge. Area of Interest: E-Learning technology and standards.

Dr. Wu has worked as Co-convener and project editor of ISO/IEC JTC1 SC36 WG6 - a standardization committee focuses on information technology about learning, education and training. Member of China E-Learning Technology Standardization Committee (CELTSC).

Xu Jian was born in Hebei, China. He graduated from Hebei Normal University of Science and Technology in Educational Technology, China, in 2008, and obtained his Master in Educational Technology at Huazhong University of Science and Technology, China, in 2011.

He is an Assistant researcher in National Engineering Research Center for E-Learning, Central China Normal University, Wuhan, Hubei, China. Area of Interest: E-learning technology.

Huang Jianxin was born in Hubei, China. He graduated from Wuhan Institute of Technology in Electronics and Information Engineering, China, in 2012, and obtained his Master in Communication Engineering at Huazhong University of Science and Technology, China, in 2012.