Proposed System for Automatic Evaluation of Learning Objects

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Abstract- The knowledge society is flourishing day by day and demanding new educational practices for imparting learning and education. Teachers or instructional designers comprising world of education are trying to develop new educational practices in the form of presentations, lectures, videos, animations etc. so as to impart education among the society in a better way. There is a need of a system to manage, store and organize these instructional materials that enables their applicability and reusability. Internet plays an important role in wide spread dissemination of these resources among the learning community. Repositories act as hosting areas for these instructional materials. Most searches in repositories return a vast number of materials without any assurance of value and quality, thus making it difficult for users to decide which of them best suits their requirements. Theorist and researchers have advocated a number of approaches for evaluating instructional material such as evaluation tools and metrics, but all these approaches are either unsupported by empirical evidence or based on peer review which provides qualitative results on which statistical analysis is very limited. The basic purpose of this paper is to discuss the current scenario of evaluation of instructional material by reviewing the literature, discuss their drawbacks and then propose a system that automatically evaluates the instructional material in terms of various parameters specified so as to give assurance regarding quality and value.

Index Terms- Learning Objects, Learning Object Repository, Quality Evaluation, Quality Metrics, Reusability Metrics, Ranking Metrics, LOQES, Learning Object Metadata.

I. Introduction

Learning Object (LO) is an instructional material that can be used as a basic unit of information and interchanged between e-learning applications. Learning Object has been defined by Institute of Electrical and Electronics Engineers' Learning Technology Standard Committee as, " any entity, digital or non digital that can be used, reused or referenced during technology supported learning" (IEEE, 2002) [1]. This definition is very broad and was therefore redefined by David Wiley as "any digital resource that can be reused to support learning". Different researchers have defined learning objects in different ways based on its characteristics such as interoperability, reusability, self contentedness, accessibility, durability, adaptability etc., still there is no consensus regarding its correct definition. To retrieve the learning objects from repository, each object is tagged with metadata which is defined as data about data. Metadata contains information about the Learning Object, its target group(s) and designer, date created and modified, size, type, usage etc. Both tagging and storing processes have standards to ensure interoperability, portability, reusability, durability and adaptability such as IEEE Learning Object Metadata (LOM), Sharable Content Object Reference Model (SCORM), Dublin Core, Can Core, Sing CORE etc. Learning Object Repositories provide a hosting environment for managing, sharing and organizing digital collections of educational materials, e.g. lectures, notes, presentations, assignments etc. The purpose of such repositories is to improve the sharing and reusability of learning objects to support learning. The challenge of developing effective evaluation systems is formidable because they must optimize on two opposing variables: the number of objects that can be evaluated versus the quality of the obtained evaluations.

II. Literature Review

The growth in the number of LOs, the multiplicity of authors, increasing diversity of design and availability of trained and untrained educators have generated interest in how to evaluate them and which criteria to use to make judgments about their quality and usefulness [3]. According to Williams (2000), evaluation is essential for every aspect of designing learning objects, including identifying learners and their needs, conceptualizing a design, developing prototypes, implementing and delivering instruction, and improving the evaluation itself. Theorist and researchers have proposed different studies for evaluating LOs in terms of reusability, standardization, design, use and learning outcomes. The major problems with these studies are that these are not supported by empirical evidence, covers limited number of objects and evaluate only the qualitative phenomenon. Researchers have followed two distinct paths for evaluating LOs – Summative and Formal. The summative approach deals with final evaluation of LOs (Kenny *et al.*, 1999; Van Zele *et al.*, 2003; Adams *et al.*, 2004; Bradley & Boyle, 2004; Jaakkola & Nurmi, 2004; Krauss & Ally, 2005; MacDonald *et al.*, 2005) based on informal interviews or surveys, frequency of use and learning outcome. The main goal of this approach has been to determine whether participants valued the use of LOs and whether their learning performance was altered. The formative assessment works during the

development phase of LOs where feedback is solicited from small groups at regular intervals [4].

Nesbit et al. (2002) outline a convergent evaluation model that involves multiple participants – learners, instructors, instructional designers and media developers. Each group offers feedback throughout the development of a LO. Finally a report is produced that represents multiple values and needs. The major drawback of convergent evaluation model is limited numbers. of participants and difference in opinions and beliefs [5].

Nesbit and Belfer (2004) designed an evaluation tool, 'Learning Object Review Instrument (LORI)' which includes nine items: content quality, learning goal alignment, feedback and adaptations, motivation, presentation design, interaction, accessibility, reusability and standards. This instrument has been tested on a limited basis (Krauss & Ally, 2005; Vargo et al., 2003) for a higher education population, but the impact of specific criteria on learning has not been examined [6].

Multimedia Education Research for Learning and Online Teaching (MERLOT) developed another evaluation model which focuses on quality of content, potential effectiveness as a teaching – learning tool, and ease of use. Howard – Rose & Harrigan (2003) tested the MERLOT model with 197 students from 10 different universities. The results were descriptive and did not distinguish the relative impact of individual model components. Coachrane (2005) tested a modified version of the MERLOT evaluation tool that looked at reusability, quality of interactivity, and potential for teaching, but only final scores are tallied, so the impact of separate components could not be determined. Finally, the reliability and validity of the MERLOT assessment tool has yet to be established [4].

Kay & Knaack (2005, 2007a) developed an evaluation tool based on a detailed review of research on instructional design. Specific assessment categories included organisation/ layout learner control over interface, animation, graphics, audio, clear instructions, help features interactivity, incorrect content/ errors, difficulty/ challenge, useful/ informative, assessment and theme/ motivation. The evaluation criteria was tested on a large secondary school population [7,8].

Based on above theories Kay & Knaack (2008) proposed a multi component model for assessing learning object, 'The Learning Object Evaluation Metric (LOEM)' which focused on five main criteria: interactivity, design, engagement, usability, and content. The model was tested on a large sample and the results revealed that four constructs such as interactivity, design, engagement and usability demonstrated good internal and inter rater reliability, significantly correlated with student and teacher perception of learning, quality, engagement and performance. But there is little finding as how each of these constructs contributes to the learning process [4].

All these evaluation tools are qualitative and are based on human review. Researchers feel that there is a need of such practices that automatically evaluates the LO and provides a rating based on various parameters specified. For this, various metrics have been proposed by different researchers for measuring different parameters of learning objects. Ochoa & Duval (2006) proposed various quality metrics that automatically assess the intrinsic characteristics of the metadata. The values obtained from the metrics are compared with the evaluations conducted by human reviewers to a sample of LOs from the real repository. Result of experiment reveals that one of the metric, 'Textual Information Content', is a good quality predictor and shows high correlation in metrics score and average quality value given by human reviewers, but the experiment is conducted on small scale [23].

Another set of metrics proposed by Ochoa & Duval (2008) is Ranking Metrics to estimate the topical, personal and situational relevance dimensions. These metrics are calculated mainly from the usage and contextual information extracted from repositories in which they are stored and do not require any explicit information from users. The evaluation of the metrics concludes that all the proposed basic metrics outperformed the ranking based on pure text-based approach [9].

Quality of metadata is just one parameter. Another parameter which is equally important is reusability. Rodriguez and Dodero (2011) in their research paper determine those aspects that influence reusability, defines set of metrics that measures those aspects using metadata and proposed different methods of aggregation in order to obtain single resulting value and evaluate the efficiency of model by analyzing LOs extracted from eLera and Merlot repository [10].

Munoz & Conde (2009) designed and developed a model HEODAR that automatically evaluates the LOs and produce a set of information that can be used to improve those LOs. The tool is implemented in the University of Salamanca framework and initially integrated with LMS called Moodle but the results are not yet tested [28].

Eguigure & Zapata (2011) proposed a model for Quality Evaluation of Learning Objects (MECOA) which defines six indicators: content, performance, competition, self-management, meaning and creativity to evaluate the quality of LOs from a pedagogical perspective. These indicators are evaluated by four actors: teachers, student, experts and pedagogues. The instrument was designed and incorporated into AGORA platform, a Learning Object Management System, but the results are not empirically tested [29].

III. Research Investigation

The literature review identified various gaps in the research which initiates researchers to undertake further investigation so as to fill these gaps.

- Theorist and researchers proposed different models and metrics for evaluation of LOs, but the empirical evaluation is done at small scale on individual basis. So Empirical evaluation on large federated LORs is still pending.
- How should the metrics calculating various parameters of LOs be adapted to environment in which only the top-k objects of each repository are known?
- How should the ranking made by different LORs be aggregated?

IV. Statement of the Problem

Literature Review discussed above highlights the need for research work that is widely used and is devoid of the limitations. Above literature review shows that all the existing learning

object evaluation tools are dependent on the expert review which is a costly and time consuming process. Furthermore, the reliability analysis of these explicit evaluations reveals there are a number of problems such as most expert evaluations are performed individually, which represents a limitation on their validity, lack of user training, potential subjectivity of tastes etc. Moreover, only a small number of users provide these evaluations and, as a result, their evaluations may not be representative of the opinions of all users as a whole (Kay & Knaack). Along similar lines, Akpinar performed a validation study on certain evaluation areas of the Learning Object Review Instrument (LORI). The study compared evaluations with student and lecturer surveys and concluded that LORI evaluations were not sufficient to predict the educational benefits that might be obtained from LOs. In addition, while there are various initiatives that allow a search to be performed across several repositories, it is observed that different repositories have different evaluation systems, thus making it difficult to sort the results returned for several repositories. In a similar way to the various metadata application profiles, it is crucial to develop strategies that allow different repository evaluation systems to be integrated. Metrics helps in automatic evaluation of LOs but all the proposed metrics are tested individually and on small scale. This clearly indicated that there is a need of an evaluation system that automatically and collectively assesses the performance of LOs in terms of various quality indicators defined.

V. Objective of the Study

The main objective of this research thus is to study the flaws in the current evaluation system and to develop a new system that would automatically assess the quality of LOs. Therefore, the major research objectives are:

- An in depth analysis of the current usage of learning object evaluation tools.
- Study the performance and impact of learning object evaluation tools on accessibility of LOs.
- Design and development of an automatic assessment system LOQES that evaluates the quality of LOs in terms of the defined parameters.
- Testing of open source system LOQES on various new LOs and then comparing its results with expert ratings for estimating the validity and reliability of tool.
- Draw conclusions and then providing the tool as open source software for the benefit of learning object community.

VI. Research Methodology

The methodology for the present study is to develop a system that automatically evaluates the learning object and gives assurance regarding quality and value of that object to the whole community. Previous approaches were qualitative and this approach is totally quantitative. The methodology comprises of various phases:

A. Development Phase

This phase employs development of LOs and the evaluation system for automatic assessment of these LOs.

A.1. Choice of subject for development of learning objects

The major taste of this research is based on the subject chosen (discipline of computer science). The learning object comprises of presentations, video lectures, assignments etc. as well as the metadata information for automatic assessment of quality of LOs.

A.2. Development of LOQES

The development of Learning Object Quality Evaluation System based on following:

- Selection of Parameters for evaluation of LOs such as reusability, quality of metadata, relevance ranking, cost, learning styles etc.
- Comparative analysis of the various metrics proposed by different researchers for evaluation of the above mentioned parameters, so as to select the best metrics in terms of performance.
- Design and Development of automatic assessment system after aggregating all the selected metrics that collectively evaluates the various defined parameters and give a quantitative value regarding overall rating of LOs.

B. Testing Phase

In testing phase, the validity and reliability of the proposed automatic assessment system LOQES is analyzed by comparing the results of LOQES with the expert ratings given on the LOs developed in Development phase. The reliability of the system is judged based on the correlation between the system rating and expert rating, and high correlation signifies better reliability. The last step is drawing conclusions on reliability and validity of the system and then making the system available as open source software for the benefit of the entire learning object community.

VII. Significance of the Study

The proposed study evaluates the LOs in terms of various defined parameters and provides automatic rating value that acts as a quality indicator for that particular learning object. This will provide help to contributors for making modifications in the LOs and to the users by providing them the assurance regarding quality and value. The benefits of the proposed study are:

1. Ratings and quantitative assessments aid individual users in searching and selecting objects.
2. Evaluations can provide guidance on how best to use an object.
3. Quality can be increased by evaluating the object before submitting it to any repository.
4. Evaluation standards can drive the practices of designers and developers.
5. Participation in evaluation activities can contribute to the professional development of those who work with LOs.
6. Evaluation activities can build and support communities of practice in relation to LOs.

7. Positive evaluations can promote social recognition of skilled designers and developers.
8. A trusted evaluation system may be an essential step toward the development of a workable business model for the economic exchange of LOs.

VIII. Conclusion

Review of literature shows that research on the evaluation of LOs in terms of quantitative factors is very limited, partially because of abundance of qualitative tools and dependency on expert review. The above study unveils the requirement of a quantitative automatic assessment system of evaluation of learning object in terms of defined parameters so as to get assurance about quality of LOs because of large dissemination of LOs. Expert system evaluates LOs efficiently but due to limited number of experts, difference in opinion and presence of biasness this system won't work and covers limited number of objects. The proposed system acts as a certification mechanism to certify the quality of LOs which will give reasonable assurance to users of learning object about quality and content.

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