ABSTRACT
Learning objects (LO) are modular digital learning resources enabling reuse in multiple contexts. It is based on the idea of building resources from existing materials rather than starting from scratch. Resources can be made reusable through Learning Object Repository (LOR). LOR stores resources along with their metadata. Metadata facilitates the search and retrieval of relevant resource from LOR. This paper explores background and controversies surrounding LO, degree to which it is reusable, factors affecting its reusability and discoverability. Finally, challenges in adopting LO to enhance learning experience are outlined.
1. INTRODUCTION

The term Learning Object coined by Wayne Hodgins [1] is fundamental unit of e-learning content. The notion of learning resources as small chunks of information has been appreciated by instructional designers [2]. In general practice, when instructional designers get educational materials, they break them into discrete parts and then assemble them in ways to attain intended learning goals [3]. It has the potential to provide flexibility as needed.

Learning objects are gaining importance in e-learning sector. They are fundamental elements for a new conceptual model for the creation on e-learning materials. As they are digital, educators can access them at any time and make use of them in their courses simultaneously. Its benefits have been also globally acknowledged [4]. Besides the advantage of reusability, it offers other benefits too. In the first instance, digital nature makes them easy to store, transfer and share. Secondly, it saves a lot of effort, time and cost of developing new materials. Thirdly, it can be also used in different contexts by different users.

1.1 SCOPE OF PRESENT SURVEY

It is essential for educators to embed LO in their courses. Design of effective e-learning courses rely on creation of good LO and sharing them globally. E-learning communities continue to explore the perennial questions how to search and discover relevant LO from LOR and how can LO be effectively used.

The main focus of the survey is to present the complete picture of LO concepts. It also aims to provide insight to researchers about the concerns that hinder the successful deployment of them. Also it highlights the key challenges surrounding this area of research. This survey is organized as sequence of sections. Section 2 reviews the background about LO, metadata and LOR. Section 3 focuses on reusable LO (RLO) particularly discussing how they can be reused and factors affecting its reusability. Section 4 reviews on how to find relevant LO from LOR and issues surrounding the search and discoverability of LO. Finally, we conclude by discussing challenges in realizing its full potential.

2 LITERATURE ON LEARNING OBJECT

The concept of LO evolved based on LEGOTM analogy to reshape the current form of learning. It is designed to combine any LO with any other LO thus elevating the digital connectivity to a new level [5]. In doing so, it is anticipated to use the available resources many times by different users. These resources can be delivered and accessed over the internet by educators that reduce to need their own one. This increases the opportunity to develop efficient courses in lesser time [6].

2.1 Definition of LO

Though the advantage of LO is highly realized and accepted by educators, there is dispute within E-learning Communities about what constitutes LO. There has been much debate and contradiction to define the term LO [7] and there are as many definitions as users [8]. According to IEEE Learning Technology committee (LTSC) defines LO as ‘any entity, digital or non-digital which can be used, reused or referenced during technology supported learning’ [9]. According to this, any digital content like multimedia, software tools and instructional content is considered as LO. However, this definition is broad as it includes any resource as LO. It includes ‘Learning Objectives, persons, organizations or events’ [9].

Others have proposed new definition varying generic to more specific. Wiley [10] defines LO as ‘any digital resource that can be used to support learning’. Shepherd [11] states LO as ‘small reusable digital components’..to meet individual; needs for learning or performance support’. These definitions excluded any non-digital resources and digital resources that are non-reusable.

Several definitions vary in their specification on size of the content, form and time. Though there is a little clarity on what is LO, most of these definition agree on the reusability and sharing. There has been a great emphasize on the way LO should be made available to other users.

2.2 Learning Object Metadata

Metadata provides ‘the ability to identify learning content so that we can find assemble and deliver the right learning content to a right person at the right time’ [12]. The goal of tagging LO with metadata is to enable search and discovery of LO. In addition, it also enables the user to decide the relevancy of discovered LO.

Several standards for metadata description are available. IEEE LOM [9] is commonly used standard. IEEE LOM categorizes data elements into nine groups namely General, Lifecycle, Metadata-metadata, Technical, Educational, Rights, Relation, Annotation and Classification.

Relevant LO can be retrieved only when they are tagged completely and properly. Different Learning
materials are required depending on one’s learning requirements. This could be made available by identifying the set of data elements from learning object that describes it.

There are practical difficulties in tagging metadata. Firstly, it is a labor intense activity. As there are nearly 90 attributes in LOM, tagging is very difficult to do by human [13]. Secondly, it is time consuming task. Thirdly, filling up the metadata with correct instances requires knowledge. Fourthly, it is prone to human error [14]. Many researchers have been focused on automatic tagging of LO [15, 16].

2.3 Learning Object Repository

LOR accommodates LO with their metadata. It can be seen as a digital library containing collection of modular, small units of learning resource solemnly for the purpose of retrieval and reuse. The main goal of LOR is the organization of learning object along with their metadata thus by enabling reuse and collaboration and to enhance learning opportunities [17]. The emergence of LOR is a major innovation in e-learning proving a rich environment to share knowledge. It eliminates duplication of resources that has been already created. LOR maximizes reusability potential of LO. However, this potential can be realized if it contains open access materials. This lead to the birth of Open Educational Resources (OER). OER are free educational resources that encourages user to access them without any barrier.

Some of the well-established LORs are: MERLOT [18], ARIADNE[19]. There LOR holds resources from different domains. There are also LORs related to specific domains, e.g., MACE [20] for architecture domain, KINOA [21] for civil engineers. LOR not also aims to share resources but also projects and domain specific problems [22].

3. REUSABILITY

Creating a high quality learning resource is expensive in terms of cost, effort and time. Hence it is crucial to ensure reuse of resources. LO is paves the way for reusing existing resources. The modular characteristics of LO provides means to easily assemble simple smaller units into larger complex units. LO intended for reuse should possess certain properties: 1. standalone and independent unit. 2. Each LO should have metadata wrapper that enables users and software agents to find the right material.

3.1 Characteristics of Reusable Learning Object

LO requires following characteristics to be reusable.

‘ Cohesion: Each LO should have one and only purpose. This implies that each LO should have a clear goal and be able to satisfy a single objective. This improves the reusability by making it easier to use in different learning situations.

‘ Loose Coupling: This is the most crucial characteristics for reusability. Each LO should have minimal binding with other LO. This implies that there should not be dependency with other Los. Each LO should be a standalone unit. This improves reusability by ensuring that each LO can be easily combined with other Los.

‘ Aggregation: Generally courses are made up of lessons which in turn made up of topics. Hence it is essential to have flexibility to combine relevant Los to make up larger units. This improves the reusability by providing opportunity to combine LOs in any possible way to create larger LO.

‘ Granularity: Granularity refers to size of LO. Downes [23] emphasizes the importance of size of LO. It is a process of breaking larger resources into smaller units called grain. These smaller units can then be assembled to create courses. A large unit minimizes the possibility of combining a unit with other units. Hence the granularity of LO is a crucial factor to aggregate units.

Granularity is the driving force that enables resource to be reused. Small granular units exploit reusability to its full potential as it provides flexibility to plug into other units. In this vision, researchers [23,24] assert that granularity enhances LO reuse. This arise a question of how to define and determine the granularity of LO. According to Media approach, the size of LO determines the granularity. Another approach suggests using context to determine granularity. Several factors influence the granularity including purpose, size and context of LO. Granularity of LO varies from raw content (e.g. a image) to complete courses. However, it can neither be very small that encumbers development nor big that hinders aggregation.

As granularity is seen as very important aspect of LO, standards on metadata embeds granularity as one of the data elements. It is inscribed in IEEE LOM specification as ‘Aggregation level’. According to this specification,

‘ Level 1 – A piece of raw data (e.g. Image).

‘ Level 2 – Collection of level1 objects (e.g. Lessons).

‘ Level 3 – Collection of level2 objects (e.g. Courses).
3.2 Issues with RLO
There are several factors that complicate reuse of LO.
Discover appropriate LO: User has to search and find the intended LO. Rising number of LO and LORS makes it more difficult to look for the intended LO. There is challenge to locate the resources. Even if users know where to find them, incomplete or inappropriate metadata may result in delaying the process.
Varying standards: There are several metadata standards available such as IEEE LOM, SCORM. The author would have followed the metadata standards of his choice. This forces the user to have knowledge about all metadata standards for efficient retrieval of LO.
Integration: Several Los are sequenced to create a course. These Los have been sequenced from simple to difficult, easy to hard. To design an effective courses

4 DISCOVERABILITY
Reusing involve retrieving appropriate LO from LOR. A big challenge for educators is to find suitable materials that fit their intended goal. In addition to that, there is uncertainty about the availability of the materials and where is it available.

4.1 Searching Mechanism in LOR
LO can be retrieved from LOR by means of metadata. Most of the LOR are integrated with both simple and advanced search tool. In simple search option, LO matching the user's search keyword will be returned. Advanced search option offers user an opportunity to specify more criteria to meet the requirements. However, researchers raise an issue about quality of search tool. They argue that these tools are still in embryonic stage and have not grabbed the advancement in the search technology [25]. Najjar [26] added that these tools add on the complexity to use. His survey confirmed user's dissatisfaction in using the tool.

4.2 Issues related to discoverability
As number of LO in LOR increases, the difficulty of finding the suitable LO increases. Some of the key issues are highlighted.
- Ranking Mechanism: LOR search tool has not incorporated good ranking mechanism. Rather than ranking the retrieved LO in relevance to user query, the list is based on author or title [26].
- Several Repositories: As there are several repositories, user has to do undergo separate searches for each repository. Moreover, each LOR vary in their search format [27].

Despite the major researches [28-30] to improve search tool including federated search [31, 32], tool still needs improvement on precisely and accuracy. In addition, there is also issue about measuring the quality of LO as it is subjective to certain degree.

5 DISCUSSION: CHALLENGES
Variety of definition: Drawback of LO starts with defining what is LO. LO remains as ill defined concept irrespective numerous efforts from LO community [33]. The degree of definition about LO left the user confused about what is LO. There are criticisms that certain resources had been excluded from what constitutes LO. Some researchers claim that LO is nothing but plain resources (34,35).
Separation of context from Learning: There lies a inverse relationship between granularity and reusability. The finer LO is, the more potential for reuse. That is, If LO is less specific, more it fits into any context. Conversely, coarse the LO is, less the potential for reuse. If LO is more specific it can fit only into fewer context [36]. To fulfill the reusability promise of LO, Instructional designer has to minimize the context of LO. This will lead to controversy as the educators emphasize need of context learning [37].
License and Digital rights: Many reputed education Institutions & universities has valuable resources and there is difficulty of find these resources through general search. There is no way of finding what materials are available in this institution. Certain materials are provided by commercial organization and require users to pay for them.
Time taken to create a course from existing LO takes only 14 hours where the time taken to get permissions for using materials takes 19 hrs (Elliot 2008). Privacy and license are major challenges needs to be addressed. They are also other issues like disappearing repositories and outdated resources.
Suitability and Quality: Searching through several repositories to find an appropriate LO is time consuming. Also there is major difficulty in discriminating suitable LO and those that are not suitable. Even if relevant LO is found, the quality of retrieved found remains questionable. In addition, there is also issue about
determining the quality of LO. Learning Object, like all new ideas and concepts underwent a lot of criticism from experts in several perspectives. However, the increasing literature and application on LO is the evidence for its growth. Researchers has taken attempt to describe LO as piece of digital instruction not as a mere digital information.

6 CONCLUSION:
In this paper, we have presented a survey exploring the background and contradictions of LO. First background literature on LO, metadata, LOR are presented. In addition to that, Reusable Learning Object & its characteristics and factors affecting reusability are also discussed. Next search mechanism and the practical difficulties associated with it are analyzed. Final section highlighted the issue which has implication on the use of LO.

REFERENCES

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