A Novel Approach to the design of E-learning System using Ontological Folksonomies

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ABSTRACT
With the emergence and growth of web2.0 paradigm, the theme of e-learning2.0 started to raise. E-learning2.0 is an ideal platform which supports learner centric approach. From the view of learners, the way people learn has changed from passive to active. This paper presents a novel approach to the design of e-learning system using web2.0 tools. The main focus of our approach is to create metadata using folksonomies and Dublin Core metadata standard for e-learning objects. Meanwhile, a learning repository is designed for storing learning objects and metadata. A query interface has been developed to retrieve the search item. To test the usefulness and ease of use of our prototype, we used the Technology Acceptance Model (TAM) to evaluate the system. Results are promising.

General Terms
Web 2.0, Metadata, Query Interface, Knowledge Management, Statistical Packages for Social Sciences(SPSS).

Keywords
E-learning 2.0, Dublin Core, Folksonomies, Learning repository, Technology Acceptance Model (TAM), Document Object Model (DOM).

1. INTRODUCTION
Web 2.0 paradigm has changed the roles of Internet users in dissemination of information resources online. It has made a strong impact on education and learning process. New technologies such as podcasts, RSS, scripting and XML enable Web 2.0 applications that are used and combined to create new services. Web 2.0 focuses on services rather than software. Web 2.0 transforms e-learning 1.0 into e-learning 2.0 that is depicted in Figure 1. The education must be supplemented by new applications, tools and paradigms that lead to what is called eLearning 2.0 [1]. E-learning 1.0 uses a broadcasting logic, which is mostly based on understanding of teaching as being transmissive. This is to say that information and materials are distributed, presented and made available to students. Learning in this view can be described using the metaphor of acquisition of learning contents. E-Learning 2.0 emphasizes the metaphor of participation – learning is perceived as an interlinked, social process in which Web 2.0 tools are used to develop learning results through collaboration and communication, compile one's own learning environment and comprehend the entire Internet as a learning resource. In e-learning 1.0 learning scenarios, the educator only act as an active constructor of learning materials and lack of interaction between educator and learner. E-learning 2.0 provides the new kind of learning platform with the help of social software [2]. The Social tools are used for a wide variety of purposes in education. Social tools play a vital role to improve the learner centric approach. Most of the teachers encourage their students to use social tools such as wikis and blogs [3].

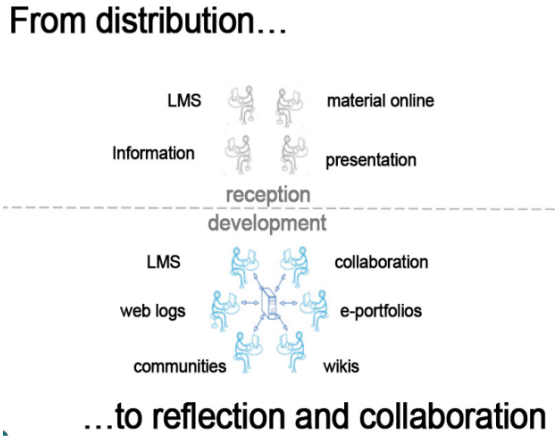

Fig 1: Change in the landscape of E-learning

Students take a more active role in all forms of learning process. Their interaction increases through interconnecting, cooperating, collaborating, creating and exchanging new knowledge. Educator's role has shifted from teacher to mentor that they encourage their students to create new knowledge [4]. E-learning 2.0 requires a unique framework.

Goal of this paper is to present the development framework of e-learning system where basic internet user who doesn't have programming experience can create new knowledge with the help of this system. The remainder of this paper is structured as follows. Section 2 deals with the background work carried for organizing this paper. In section 3, we narrate the design and methodology which are used for the development of e-learning 2.0. Then section 4 describes the implementation environments and results obtained in real time. Section 5 describes the evaluation of the system using TAM model. Finally, conclusions and future work will be given in section 6.

2. RELATED WORK
E-learning system can be developed using a framework based on ontology. Ontology plays a vital role that brings various knowledge items and processes together. It provides a richer and integrated view of knowledge domain to the learners. The processes required for establishing a web based knowledge management system for a learning frame work is as follows: knowledge creation, knowledge extraction, knowledge classification, knowledge retrieval, knowledge

sharing and use. Ontology enhances the value of KM in educational environment [5].
OWL is used to build the ontological relation between contents. These relations enable interchange of resources and the inference of knowledge by querying them. E-learning systems require content based data model that is more flexible and easy to search. It makes the learning contents share able by describing metadata and ontological relations [6].

Ontology is a formalization of the domain concepts in which the concepts are represented by classes. There is a relation between classes and class attributes. For example, the student dynamic model makes reference to course concepts, which are then used for making decisions about what contents should be displayed to the students. These concepts are organized in an ontology, which represents domain knowledge [7].

The system constructed through knowledge base ontologies consisting of meta knowledge, conceptual system, content knowledge, vocabulary and learner's knowledge. An ontology service holds one or several ontologies and can be asked to return a whole or part of it [8].

Another approach is to create e-learning system using web 2.0 tools. Folksonomy is one of the web 2.0 tools. Folksonomy can be considered as a collaborative classification of public digital content. The main characteristics of a Folksonomy are that it is always created bottom-up, public availability of tags, and meta data for each classified resource, and there is also social context. In e-learning folksonomies, social book marking can be used in a number of ways [4].

E-learning needs to be evolve and this evolution must consider the student centric approach. If the system does not consider the students as center of e-learning and new technological trends, it will be failed. To reach the student centric environment, the personalization of learning management system and its integration with web 2.0 tools and applications is required. Through this, a new way of teaching has implemented [9].

From the web 2.0 learning design perspective, learning designs can be conceptualized in terms of their content and type of pedagogy they apply. This requires educators to consider the types of content and pedagogy being applied as well as the types of modalities and degree of synchronicity that is appropriate for the predefined learning objective [10].

To conclude, each approach has their own advantages and disadvantages. In our opinion, web 2.0 approaches have a high potential for developing e-learning system and also for creating metadata. Our approach reuses few ideas from ontology based e-learning and integrates them in a web 2.0 based frame work to achieve effective e-learning system.

3. E-LEARNING SYSTEM DESIGN AND METHODOLOGY

The E-learning system is developed using the concept of web 2.0. The applications developed based on E-learning 2.0 mainly focus on making the learners as an active constructor of knowledge. This makes the learning process for a student both effective and efficient. The metadata plays crucially important role in the resource development framework for e-learning system. In order to develop the resource framework, not only the Learning objects but also the data about those LOs are important.

The Frame work for developing an e-learning system is shown in Figure 2. The framework is divided in to three main modules.

- Resource Development Framework
- Learning repository
- Interface design

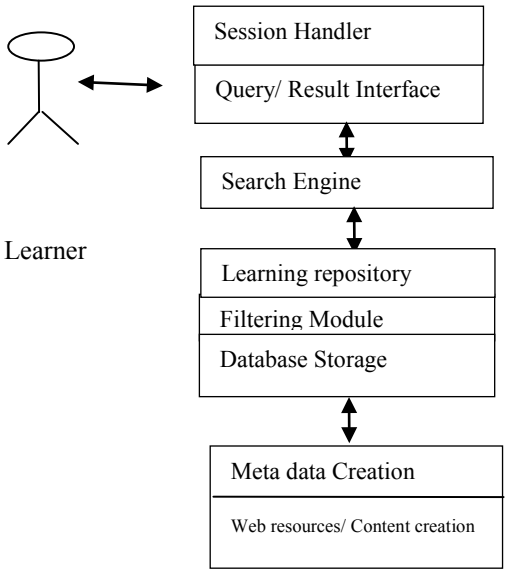

Fig 2: Abstract architectural framework of e-learning 2.0 systems

3.1 Resource Development Framework

The resource development framework has divided into two sections such as Learning Object creation and Metadata creation. The key idea behind the system is to motivating the learners to create the content and metadata.

3.1.1 Learning object creation

Learning object is defined as any digital resource that can be used to support learning [11]. Learning objects are created using the resources which are available on the web. The web puts a huge number of learning resources within reach of anyone with Internet access. However, many valuable resources are difficult to find in an efficient manner, because valuable resources are hidden in the closed and proprietary worlds of learning management systems.

3.1.2 Metadata creation

Metadata is defined as data about data or else it is known as machine understandable information [12]. The main task involved in this phase is the creation of metadata for each learning objects. Lot of techniques is available for creating metadata. The following are found to be most appropriate technique for metadata creation. The proposed approach for metadata creation is shown in the Figure 3. There are two approaches used for metadata creation. Authors use Dublin core for metadata creation where as learners use folksonomies.

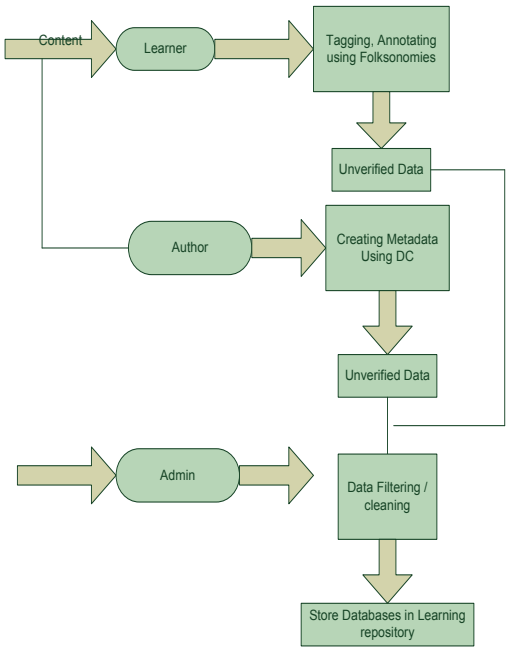

Fig 3: Metadata creation approach

3.1.2.1 Folksonomies

Folksonomy is a bottom-up social classification that was arising with the increasing popularization of web 2.0 services such as Flickr and del.ici.ous among others. Folksonomy can be considered an evolutionary product of social or collaborative classification of public digital content. The classification is performed by a group of people that may share common interest over certain topic by adding metadata to publish information. Folksonomies is a method of collaboratively creating and managing tags to annotate and categorize the content. It is an internet based information retrieval methodology that categorizes content such as web pages, on line photographs, and web links [4][13]. In e-learning there is a number of ways folksonomies can be used. Folksonomies have become widely popular in recent years because of their ease of use. The process commonly known as "tagging" has proven to be effective for creation of metadata.

3.1.2.2 Dublin Core

Dublin Core is perhaps the most well known metadata element set. The original objective of the Dublin Core was to define a set of elements that could be used by authors to describe their own Web resources. Dublin Core 1.0 consists of 15 elements: title, subject, description, source, language, relation, coverage, creator, publisher, contributor, rights, date, type, format, and identifier. Recently, the audience element was defined to support the broad needs of the educational and learning object communities. All Dublin Core elements are optional and all are repeatable. The elements may be presented in any order.

The Dublin Core was developed to provide simple and concise descriptions specifically to support the resource discovery of Web-based documents. However, in part because of its simplicity, the Dublin Core has been used with other types of materials and for applications demanding increased complexity. The desire to be able to specify more detail resulted in unqualified (or simple) Dublin Core versus qualified DC. In qualified Dublin Core, qualifiers are used to refine the meaning of an element or to specify the domain values or rules for representing an element. The element "Date", for example, can be used with the qualifier "created" to narrow the meaning of the element to the date the resource was created. A qualifier can also be used in the element "Date" to specify the ISO 8601 standard as the required format for representing date. There are perhaps thousands of projects worldwide that use the Dublin Core for cataloging or to collect data from the Internet [14]. An example of metadata record in DC is shown in Figure 4.

```
<meta name ="DC.title"
content="Metadata: What is it and How is it created?"/>

<meta name="DC.creator"
content="Chuttur, M Yasser"/>

<meta name="DC.data"
content="September 03, 2010"/>

<meta name="DC.description"
content="This paper review some common definitions of metadata and discusses different models of metadata creation"/>
```

Fig 4: Example of a metadata record

3.2 Learning Repository

Learning repository is a place that contains collections of relational databases which provides persistent storage for learning objects and metadata about those objects. The need for this kind of repositories is growing as more educators are eager to use digital educational contents and more of it is available. Most of the learning systems do not store actual learning objects. They just store metadata describing Learning Objects and including pointers to their locations on the Web and a search engine.

After the metadata creation, data pre-processing techniques are applied on the stored Learning Objects and metadata. Data pre-processing describes any type of processing performed on raw data to prepare it for another processing procedure. The pre-processing technique which is used in this phase is data cleaning and data reduction. After data pruning, all the databases are stored into learning repository.

3.2.1 Data cleaning

Data cleaning, also called *data cleansing* or *scrubbing*, deals with detecting and removing errors and inconsistencies from data in order to improve the quality of data. Data quality problems are present in single data collections, such as files and databases, e.g., due to misspellings during data entry, missing information or other invalid data. In order to provide access to accurate and consistent data, consolidation of different data representations and elimination of duplicate information become necessary. To detect which kinds of errors and inconsistencies are to be removed, a detailed data analysis is required. Errors and inconsistencies in the actual

data contents are not visible at the schema level. They are the primary focus of data cleaning. Data reduction can reduce the data size by aggregating, eliminating redundant features.

3.3 Interface Design

This module is divided into two sub process such as session handler and Query/Result interface.

3.3.1 Session Handler

Once a session has been established, the learner/author has the right to communicate with the system. In order to establish a session, an email id and password or any other credential may be required. For instance the authors/learners should login into the system using their email id and password to perform the actions. The session handler then will send the identity to the authentication module, which is responsible for authentication process. Ideally, authentication is performed only once for a series of interactions. A session is valid until it is destroyed. A session times out when no communication takes place during eg. 30 minutes. However, a session might be valid much longer than 30 minutes and sometimes might even require manual destruction.

3.3.2 Query/Result interface

Using this interface, authors and learners will manage collections of Learning Objects persisted in a repository. The interface integrates several tasks such as submission, browse, and comment/review of learning objects. It would also contain a search option for learners to quickly retrieve relevant resource material of interest in the context of their learning process. Based on the search query, the search engine retrieves not only the resource material that is directly related to the query but also other resources which are moreover related to the search item.

4. IMPLEMENTATION

The implementation of Learning Objects and metadata creation is made through Java Server Pages, Core Java and AJAX framework. The purpose of using AJAX framework is to exchange small amounts of data with a server, without reloading the entire page. The created metadata is to be displayed in XML format with the use of DOM parser. Then the learning repository is created using the mySQL databases which provides persistent storage for learning objects and metadata. Hibernate platform is used to retrieve/store the resources without database querying. The whole interface module is designed using Java Server Pages. In order to show how the system works, the functionalities of different modules are shown using real examples.

Before entering into a system, a learner/author registered their details with the system.

4.1 Learning Objects and Metadata creation

In this module, a learner and author can log into system and create a personalized space, where she/he can easily integrate, create, manage and sharing learning objects. Learning objects are available in different forms such as text, images, sounds and videos. The learner/author can upload all forms of learning objects from web or their own and also create metadata for it.

The Learning Objects created by author and learner are displayed in the interface area under the option resources that are visible to those who are accessing the system. An example of learning resources created by learners using Folksonomies are shown in Figure 5.

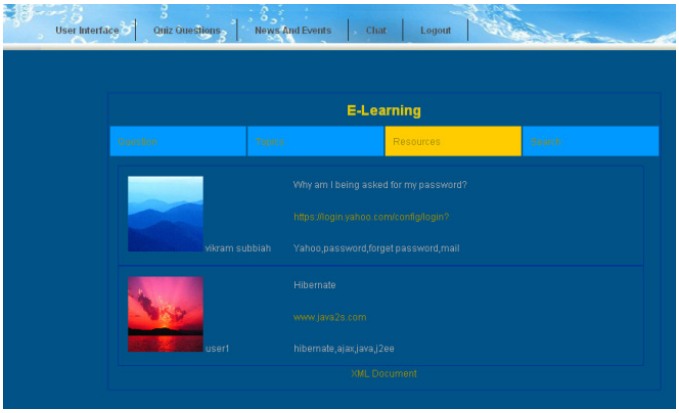

Fig 5: View of learning resources

If the user wants to know about the metadata of the resource in XML format, just he clicks the XML format option, the system display the information in XML. An example of created learning objects in XML format is shown in Figure 6.

```
<? XML version='1.0' encoding='UTF-8'?>
<topics>
 <domainname>Web application</domainname>
<title>E-learning2.0</title>
<subject>We are funded through direct
donations, grants and royalties</subject>
<description>E-learning comprises all forms of
electronically supported learning and
teaching</description>
<source type> Text</source type>
<source link> http://en.wikipedia.org </source
link>
```

Fig 6: Resources in XML format

4.2 Learning repository creation

Finally, these should be stored into different tables. It can be shared and reused by other learners. Now we applied pre-processing techniques such as data cleaning and reduction on stored data. At last, all the tables are put into learning repository.

4.3 Interface Design

This module provides course management facilities such as search, discussion forums, on line chat, news and events, online test and evaluation. Using these facilities, one can get help from anyone in the community and gain knowledge. For example, if you want the resources for "web 2.0" simply types the query, it would display the relevant resources, as well as moreover related resources. An example of query interface is shown in Figure 7.

Fig 7: Search interface

Using the online chat facility, the learner/author can communicate with anyone and discuss about the topic and able to clarify their doubts.

5. EVALUATION

5.1 TAM model

With the growing reliance on computerized systems and increasing rapidity of the introduction of new technologies, user acceptance of technology continues to be an important issue. In particular, the technology acceptance model (TAM), introduced by Davis has received considerable attention and has become established as a parsimonious yet powerful model for explaining and predicting usage intentions and acceptance behavior [15]. The present research extends the technology acceptance model by incorporating the motivation variables of self-efficacy, enjoyment, and learning goal orientation in order to predict the use of Web-based information systems. Using the Technology Acceptance Model (TAM) as a research framework, this research found perceived usefulness (PU) and perceived ease of use (PEU) of the prototype developed.

5.2 Hypotheses Development

This section presents the research hypotheses based on the Technology Acceptance Model. In the TAM , technology usage is determined by behavioral intentions to use a system that in turn is jointly determined by the user's attitude towards computer use and perceived usefulness. Attitude towards computer use is also jointly determined by perceived usefulness and perceived ease of use. Lastly, perceived usefulness is influenced by perceived ease of use and external variables such as system features, training, documentation and user support. Therefore, the three variables that are fundamental to the TAM are perceived usefulness, perceived ease of use and attitude towards computer use. It is important to note that the hypotheses in this research are to be considered in the context of e-learning for author- learners.

5.2.1 Hypothesis for perceived usefulness (PU) and perceived ease of use (PEU)

The definitions of perceived usefulness (PU) and perceived ease of use (PEU) are adapted from the original definitions proposed by Davis. In this research, PU is defined as the degree to which an author/learner believes that using e-learning 2.0 technologies will enhance his or her performance in learning and teaching level. PEU refers to the degree to which the author-learner believes that using this technology will be free from effort. While PU has a direct impact on attitude towards use, PEU influences attitude towards use indirectly through PU.
To evaluate the model's usefulness and ease of use, this paper presents two hypotheses:

H1: A developed e-learning model which categorizes the resources based on educational objective and intelligence of resources can deliver useful resources to Learners more efficiently and improve their attitude to use the system.

H2: A developed e-learning model enhances the interactivity level that will provide an easy-to-use sequence for learners and improved their perceived usefulness of the system.

5.3 Methodology

5.3.1 Sample

The E-learning 2.0 system is the target system of the evaluation. The major aim is to motivating the learners to create the learning objects. Authorization is restricted to learners who are registered in the site. Each learner is asked to fill out a single-page questionnaire indicating his / her agreement or disagreement. All the questionnaire items used an 11-point Likert type scale ranges from 0 to 10. Questionnaires were sent and collected through email.

We chose 20 people with IT and non IT background students to use the system and answer the questionnaire based on the TAM model. The questionnaire had 22 questions to evaluate the effect of them on ease of use, usefulness, behavioral intention, self efficacy, enjoyment and learning goal orientation. All the questionnaire items used an 11-point Likert type scale ranges from 0 to 10. Questionnaires were sent and collected through email. In total, 18 replies are collected, out of 20 learners.

5.3.2 Measures

The questionnaire consists of 4 constructs for the usefulness, 4 constructs for ease of use, 3 constructs for behavioral intention, 3 constructs for self efficacy, 3 constructs for enjoyment and 5 constructs for learning goal orientation.

Table 1: Construct Items

The Construct Items
Perceived Usefulness 1. Using E-learning 2.0 system would improve my performance 2. Using the E-learning 2.0 would increase productivity 3. Using the E-learning 2.0 would enhance my effectiveness 4. I find E-learning system would be useful
Ease of Use 1. Learning to use e-learning 2.0 system is easy for me 2. I find it easy to get e-learning 2.0 system to do what I want it to do 3. My interaction with e-learning 2.0 system is clear and understandable 4. I find the system easy to use
Behavioral intention 1. I intend to check the news events up-to-date in e-

learning 2.0 system
2. I intend to download files from e-learning 2.0 system
3. I intend to visit other web sites using this system frequently

Self efficacy

1. I believe I have the ability to download the file from e-learning 2.0 system to my pen drive
2. I believe I have the ability to chat with anyone in the community
3. I believe I have the ability to use favorite web site link on the e-learning 2.0 system

Enjoyment

1. I have fun using this system
2. Using this system is pleasant
3. I find using e-learning 2.0 system to be enjoyable

Learning goal Orientation

1. I am willing to select a challenging work assignment that I can learn from
2. I often look for opportunities to develop new skills and knowledge
3. I enjoy challenging and difficult tasks where I will learn new skills
4. For me, developing my work ability is important enough to take risks.
5. I prefer to work in situations that require a high level of ability and talent

5.3.3 Analysis

Reliability is the measurement scope of a test consistency, over repeated tests about the same subject under identical conditions. Reliability may be estimated through a variety of methods that could fall into two types: single administration and multiple administrations. Single administration methods include split half and internal consistency. The split half method treats the two halves of a measure as alternate forms. The most common internal consistency measure is Cronbach's Alpha or co-efficient alpha usually interpreted as the means of all possible split-half coefficients; this measure is a model internal consistency, based on the average inter-item correlation. This co-efficient varies from 0 to 1, and a value of 0.6 or less generally indicates unsatisfactory internal consistency reliability.

Table 2 : Internal Consistency

Cronbach's Alpha	Internal Consistency
$\alpha \geq .9$	Excellent
$.9 > \alpha \geq .8$	Good
$.8 > \alpha \geq .7$	Acceptable
$.7 > \alpha \geq .6$	Questionable
$.6 > \alpha \geq .5$	Poor
$.5 > \alpha$	Unacceptable

The collected data is first analyzed with SPSS(Statistical Packages for Social Sciences), and overall Cronbach's alpha is 0.7365. The table below illustrates the Cronbach's alpha for each factor, it can be seen that the entire values are above 0.6. It exceeded the recommended level of 0.70. Thus the result was reliable and has high internal consistency.

Table 3: Cronbach's alpha for each factor

Factors	Number Of Items	Cronbach's Alpha
Ease of Use	4	0.720
Usefulness	4	0.739
Behavioral Intention	3	0.779
Self efficacy	3	0.777
Enjoyment	3	0.638
Learning goal orientation	5	0.766

Hypotheses are tested by chi-square test method. The results are shown in Table 4.

Table 4: Chi-square test results

Hypothesis	p-value
H1	0.01<0.05
Objective	0.011<0.05
Intelligency	0.01<0.05
H2	0.015<0.05

P-values are less than the significant level (0.05), conclude that the prototype is easy to use. Furthermore, users are positive towards using it in the future. Clearly the result shows that the developed prototype can be easy to use and usefulness for authors and learners.

6. CONCLUSION AND FUTURE WORK

The explosion of the internet has been increased because of the web 2.0 model. A learning repository has accumulated over the World Wide Web. This abundance of information if tapped efficiently can act as a very good learning resource for an e-learning 2.0 system. This work is a step in the direction of bridging the gap between an e-learning and its learners. An e-learning 2.0 platform that enables users gather resources from the web. They can create their own resource by adding annotations to the resource retrieved from the Web. Users can form groups and create this resource together. This might improve the quality of the original document. This application is tested on web browsers Mozilla Firefox and Internet Explorer. The system design lets users tag all content they add to the system. The created resource will be of no use if it cannot be used by other users, that is, if it is shared.

A survey has made with the current metadata standards to create metadata. Two approaches are discussed to create metadata.

Architecture with a set of methodologies to develop e-learning 2.0 based systems has been proposed and developed. An e-learning 2.0 is successfully deployed in the real environment.

6.1 Future Work

The above conclusion represents a strong incentive for further implementation of E-learning 2.0 using the concept of other web 2.0 tools.

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