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The codification of linguistic learning objects for use in mobile, image-based contexts

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Abstract

There is a need for a convergence of learning media and materials, open networks, and individualisable tools in today's mobile learning methods. The Formal Learning Object Model (FLOM), which we have been using to formally characterize learning objects, their components, and their life path from conception to retirement, has been our primary emphasis. Execution, including defining responsibilities and workflows for everyone engaged in planning, training, interacting, testing, and revising. Emerging data exchange technologies and some approaches for retrieval and visualization of multimedia documents in mobile environments have been used to test the FLOM model on an image-based language learning application created for interpretation of Japanese kanji and Mayan glyphs.

1. Introduction

Learning items are connected to the growth of customized learning platforms and settings where users can build and manage their own digital learning content. (LOs). LOs are indivisible chunks of data that may be made accessible in various file types. (Pérez & Sánchez, 2011; Polsani, 2003) Linked resources can be merged to create new, more complicated components or resources and then shared via libraries. Recent literature on LOs has concentrated on topics like conceptualization (Ciaffaroni, 2006; Oldfield, 2008; Pérez- Lezama, 2012), creation (size, granularity, design tools), use (metadata for searching engines), and storage (management of LO repositories). But a) most tools are not based on formal pedagogical or instructional design models; b) they do not account for students' interests, skills, and knowledge; c) they do not encourage the development of learning communities engaged in the collaborative generation of LOs; d) there are no formal specifications on how to achieve interoperability between created networked repositories. As a result, we have suggested a formal model for the creation of LOs, in which students take on the role of LO creator by tailoring technologically-based, multimedia materials to their individual requirements and preferred methods of instruction. It was in 2010 that this FLOM model was first presented by (Pérez- Lezama & Sánchez). In this article, we examine FLOM's application to the
Situation of two image-based languages—Japanese characters and Mayan glyphs—chosen for the creation of a mobile learning environment.
Developing suitable learning distributed environments that may support users while they are on the move and working in informal situations is a difficult task in light of the convergence between new ideas about learning and new mobile technologies. As a result, we've developed an algorithmic method for handling multimedia documents on mobile devices, tailoring their user experiences to the needs of mobile language study. This is especially helpful for those interested in studying Mayan symbols and Japanese calligraphy on the go. Obviously, there is more to learning a language than memorizing symbols, but being able to create and administer LOs and services, as well as perform activities in accordance with a predefined behavioral model, gives users more agency in their own education and decision-making.

2. The formal learning object model (FLOM)

The primary goal of LO is to make it easier to share and adapt online learning materials. Granularity, longevity, portability, openness, accessibility, scaling, reuse, expansion, efficiency, and control are just some of the many LO characteristics that have been explored in the literature. Citation needed for citations: Ciaffaroni, 2006; Hernandez et

Applied Laser Technology
Vol. 30, No.2,April (2023), pp.01–05

al., 2008). Combining basic resources or the significance that a resource acquires in a particular situation can be used to make LOs. In order to determine how multimedia assets should be constructed, actual composition/content models lack the formalization of grouping levels or functional precision of Los. Table 1 summarizes notable research that has proposed formal models for LO construction.

Key Characteristics of Formal Models Table 1

Model	Main focus	LO composition	Formalization approach
3-level model (Bouzeghoub et al. 2006)	Three-level Model (domain, learner, LO) based on a semantic description of each LO	a) Web page, file or program b) Operator-node, LO-node, query-node; c) ILO	RDF implementation of the description model
Multi-facet model (Hernandez et al., 2008)	Multi-faced representation of documents using LOM/SCORM, educational theory thematic and learning design diagram	a) Assets; b) SCO; c) CA	UML. It uses IMS-LD to model sequencing activities allotted to each role to attain goal of course
3-part conceptual model (Knight et al., 2006)	3-part conceptual model introduces learning object content level between learning design and learning objects layers	a) LO b) LOC	3 ontologies: learning object content, learning design, connecting ontologies using OWL and Protege
ELO (Santacruz, 2005)	Assemblies and reuse of LO through ontologies	a) Information unit; b) Content unit; c) Didactic unit	OWL, XML Schemas for IU, CU and DU

The major problems with the given models are that (a) learners are not involved in making LOs; (b) actors' interactions during the creation of LOs are not formally specified; (c) suggested models are not rigorously validated; and (d) no development process is provided. The suggested formal paradigm, then, needs to describe needed features for digital materials to be recognized as learning objects, and what kind of relations should occur between players in the LO creation process. Although there are varying opinions on what makes up LO, we hold that the following features are necessary for its proper functioning: Content (the digital resources that make up LO); Practice (the tasks the learner must perform while interacting with LO); Evaluation (mechanisms designed to measure knowledge acquired by the learner); Learning Objectives (the educational goals that must be reached after using LO); Competencies/Skills (the abilities, attitudes, and values acquired after interacting with LO); Requisites (the knowledge or competencies the learner should have previously acquired in order to take advantage of LO); In order to explain the components of LO and the process by which these components can be combined to yield useful resources, we have created a modular framework with four levels (see Table 2).

FLOM, which is made up of composing and group models, now includes the newly introduced LO description. The composing model defines what goes into LO and how it must be put together. The composing process of LO (structure), the minimal content needed to comply LO (elements), and the information used to characterize LO can all be depicted using three models in UML notation. Using organizing charts, cooperation maps, and use case diagrams, the group model pinpoints the most crucial steps in creating LOs. We've built a software ecosystem that shows how FLOM functions from the perspectives of the three key participants (the student, the instructor, and the system controller; see Fig. 1). The LOs are organized into subjects in the training. The game's components are accessed in four

Admin (2 courses), Educator (3 modules), Student (3 modules), and Commons (1 lesson). Metadata, prerequisites, skill, and at least four IOs constructed from DOs are the bare minimum for developing a LO. Each DO is a collection of pixels, and the content can be anything from a still picture to a moving movie. This model therefore allows setting the parts engaged in LO creation and the tasks allocated to each role during the production of LOs, and it clearly specifies the components needed for making LOs.

Structured formal example of Los Angeles with

Applied Laser Technology
Vol. 30, No.2,April (2023), pp.01–05

Layer 4: Learning Collections (LCs)	LC is comprised of LOs. It includes associated knowledge, requirements necessary for its understanding, specific objectives, exercises or practices on the subject, and partial evaluations of such subjects. Examples of LCs are tutorials, sections, chapters, courses, units and topics.
Layer 3: Learning Objects (LOs)	LO represents knowledge acquired after understanding, applying, synthesizing and evaluating a specific subject. LO is formed by combination of at least four IOs: content or associated knowledge IO that has certain requirements for its comprehension, learning objective IO, exercises or practice IO that ensure understanding of subject and evaluation or feedback IO to measure acquired knowledge after interact with the object. Examples of LOs are demonstrations, principles, procedures and processes.
Layer 2: Information Objects (IOs)	IO is composed of various DOs assembled in template to ensure a sequence and a logical order. Since the IOs are compound entities, they may require a certain prior knowledge in order to be comprehended. Examples of IOs are definitions, examples, exercises, concepts and summaries.
Layer 1: Digital Object (DOs)	DO is a simple object that contains unique resource, possibly consisting of multimedia contents. DO by itself does not complete learning objective nor does it provide user with knowledge about specific subject. Examples of DOs include texts, videos, audios, images, graphs, tables, figures, and animation.

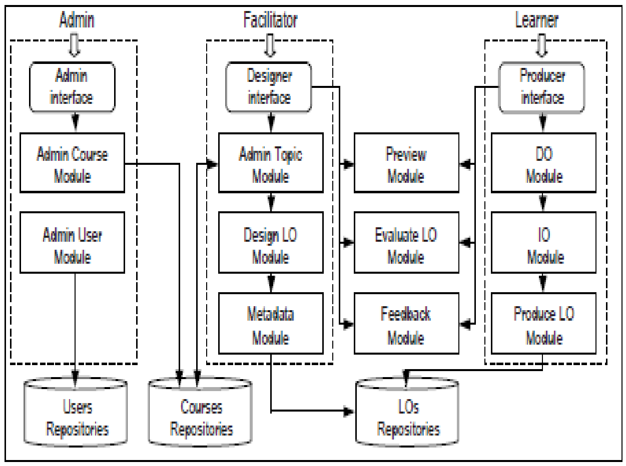

Figure 1. FLOM software architecture.

3. Designed system for image-based language learning

Using FLOM, we created a working prototype for mobile device-based image-based language acquisition (Japanese characters and Mayan symbols; see Fig. 2 for a block schematic of the system). Model View Controller was chosen as the execution strategy to best take advantage of movement and availability of data and services. Developing high-performance, dynamic, engaging user experiences while adhering to a server-thin-client architecture and giving clear descriptions of data structures. The server is built with a GCC compiler and the Blue Cove library on an Intel CPU design running Opens USE 11.2. The client runs on Sony Ericsson phones that support the Java ME platform version 8.3, have a screen size of 240x320 pixels, and adhere to the JSR-75, JSR-82, JSR-135, and JSR-234 standards for viewing JPEG files.

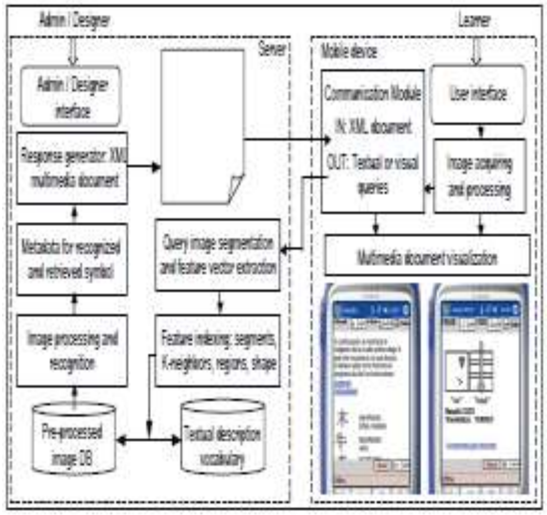

Figure 2: A system block schematic for reading Japanese characters and Mayan hieroglyphs.
K-nearest neighbor shape algorithms have been used for picture processing and categorization due to their fast processing speed and ease of application, allowing for real-time sign identification. A student who creates LO transmits a query to a library of pre-processed symbol images and a lexicon of textual descriptions, and gets back an XML document with all the multimedia data it needs to learn that character, along with all the associated details and references to other vocabularies. Interfaces for LO creation and administration have been tailored to take into account the limited resources, tiny displays, and constrained computing and networking powers of handheld devices in order to make language learning activities accessible on the go.

4. Experiments and discussion

Segmentation and identification are central processes in the planned system. Over 200 icons have been tested across six different training groups. Each grouping shares a structural similarity among its symbols, which manifests as a preponderance of either vertical, horizontal, diagonal, or spherical components. The segmentation performance and identification accuracy are displayed in Table 3.

Comparison of Kanji and Mayan character segmentation and identification algorithms

Total characters in the testing set	Correct kanji segmentation (%)	Correct Mayan glyph segmentation (%)	Precision of kanji recognition (%)	Precision of Mayan glyph recognition (%)
34	90	92%	84	85
35	89	94%	86	90
35	90	92%	85	88
32	89	89%	84	85
32	84	88%	82	86
33	86	91%	83	88
Total: 203	Average: 88%	Average: 91%	Average: 84%	Average: 87%

Segmentation accuracy for Mayan glyphs is around 91%, and identification accuracy is around 87%. Due to the close proximity of its component parts, Japanese calligraphy is less precise than Mayan symbols. Experiments validate the effectiveness of the suggested image processing method in retrieving properly identified pictures. (Starostenko & Alarcon-Aquino, 2010). How quickly various actions are responded to Image capture takes 0.2s, preparation takes 0.6s, segmentation takes 0.2s, and symbol extraction takes 0.5s, for a total identification time of 1.0s. It's fine to take 1.5 seconds per character. Delays in making contact are not factored into the mean recognizability time. User friendliness was a major factor in the positive assessment of the FLOM setting. Both the instructor and the students were successful in completing their duties. Students' engagement in LO creation and knowledge sharing with others in a mobile setting that fosters the development of joint learning groups led to positive user feedback.

5. Conclusion

This study's significance to the CSCL field lies in the fact that it outlines general methods for using technologies to encourage a shift in learner role in virtual settings, where students take on the role of creator of LOs, customizing multimedia materials based on their own preferences and requirements. As a result of the suggested formal paradigm, Los into pedagogical cornerstones and the necessary dialogue between key players in LO creation. One more perk is that students can form online study groups by exchanging LOs. When mobile devices are seamlessly integrated into a dispersed learning environment according to new technological standards and specs of cellular network technologies, students have easy access to the most up-to-date material data and instructional tools. As an instrument for accomplishing a job, aiding learning, helping a student create and arrange ideas, guiding the development of skills, etc., the intended software incorporated in portable devices can be thought of as educational agents for mobile learning. The suggested system's implementation of algorithmic methods for recalling ideas and occurrences can suggest new approaches to study and resource organization. And finally, the suggested method may be a viable option for creating mobile-assisted, image-based language learning systems.

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