

A Japanese Grammar Learning Support System using Teaching Method Ontology and Course-centered Ontology

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Abstract: This paper describes the framework of a customizable learning support system based on teaching method ontology and course-centered ontology. A partial teaching method ontology which focuses on Japanese grammar teaching and a course-centered ontology which consists of about 200 grammar points have been built to facilitate the personalization of learning support system.

Keywords: teaching method ontology, course-centered ontology, customizable learning objects, language learning support system

Introduction

In recent years, numerous industrial products have been developed based on different learning/content management systems (LMSs/CMSs). These products provide a platform for communication and collaboration among instructors and students. However, e-resources provided by these systems are simply an unorganized collection of some related materials. Without a reasonable classification, it is difficult for students to find the most suitable learning materials.

Recently, ontologies have been used in many research fields to facilitate information sharing and interaction, which are indispensable in e-learning systems. Examples of such facilitation in e-learning are the semantic annotation model developed by Faical et al. [1] using ontologies of three level (pedagogy, domain and document) and the semantic system developed by Kasai et al using ontologies of the fundamental academic ability and of IT education goal [2]. However, these systems cannot completely satisfy the dynamic needs of users, especially with regard to differences in learning abilities. Best-effort minimization of learning curve is another critical issue in system design.

From the educators' perspective, course design must match learning capabilities of learners. It would be of great benefit to learners if teachers could adjust their teaching methods and organize different course materials to reflect of learners' knowledge structures, learning objectives and preferences. In response, a customizable learning support system by integrating traditional education methodologies with advanced e-learning systems is developed in this research.

1. System framework design

To provide the personalized e-learning services to learners, a system framework as shown in

Figure 1 which combines teaching method ontology with course-centered ontology is proposed.

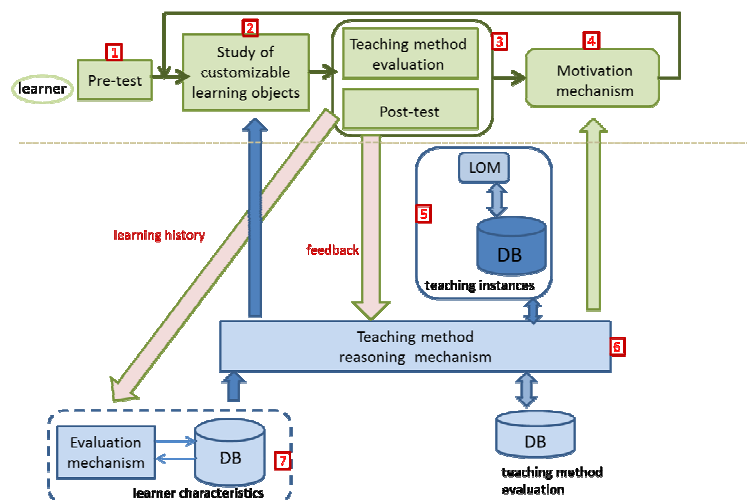


Figure 1. The framework of personalized learning Support System

To decide the customizable learning objects from the database of teaching instances (Item 5, Figure 1), the teaching method reasoning mechanism (Item 6, Figure 1) integrates learner characteristics (Item 7, Figure 1), teaching method ontology, and learner knowledge structures identified by a course-centered ontology. For the reusability and interoperability, the metadata description of the learning objects (Item 5, Figure 1) is in compliance with Learning Object Metadata (LOM) [6] standard and conforms to these two ontologies. On the other hand, feedback of the teaching method evaluation by learners and the result of tests are given to the teaching method reasoning mechanism.

1.1 The ontology of teaching method

The concepts of teaching method and their relations are the foundations for generating a personalized teaching method from the learning processes. The framework shown in Figure1 could be suitable for any education fields, but this research just focuses on Japanese grammar teaching. According to the Language Interface Model [3], grammar teaching method could be generally divided into exposure with explanation and practice. Although the ontology of Japanese grammar teaching method might have numerous concepts, this paper only discusses the process shown in Figure 2.

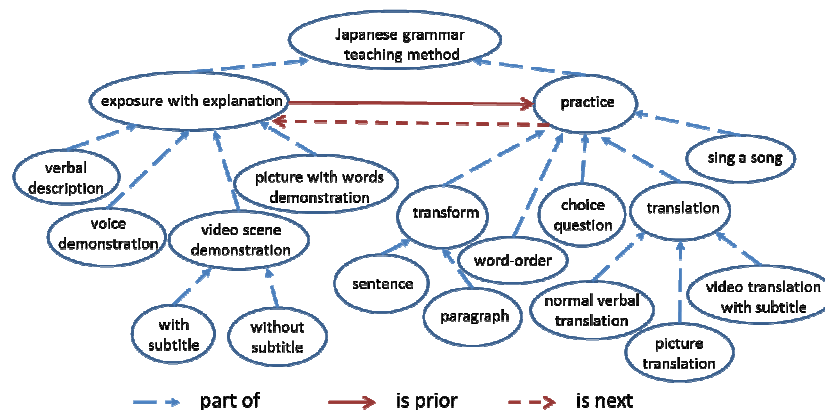


Figure 2. A partial structure of Japanese grammar teaching method

The exposure with explanation which has 4 kinds of demonstration, and the subsequent practice which has 5 exercise forms to guarantee the expansion of the learner competence. Based on the analysis of characteristics of both learners and courses, an effective teaching solution will be offered.

1.2 The ontology of a specific Japanese grammar course

In order to organize various learning materials based on knowledge structures of learners, a course-centered ontology is presented. To some extent, the course-centered ontology in Figure 1 generated from the course design and teaching strategy is a type of task-specific ontology [4]. The concepts are the knowledge points (rather than chapters/sections), and the relations include the concept dependences, similarities and contrasts.

The design of the course-centered ontology in this paper is based on a Japanese grammar book [5] which has been extensively used by Chinese learners of Japanese for years. Assume all the course-centered ontology as O , all the knowledge points of this book as G , all the attribute of the knowledge points as A , and the relations among G as R , then

$$O = \langle G, A, R \rangle.$$

A are consists of two types: the static attribute (SA) which describe the datatype property of concepts and the dynamic attribute (DA) which describes the relations between two concepts. G approximately contains 200 grammar points which can be generalized into 22 top-level concepts, such as Nominal Predicate Sentences, Existential Sentences, Adjectival Predicate Sentences, and Verbal Predicate Sentences. Figure 3 describes a part of the course-centered ontology model of Japanese grammar (Level 3) while the SA is implied in the figure, in which 3 top-level concepts (Causative Expression, Giving and Receiving Expressions, and The Expressions of Request) are included.

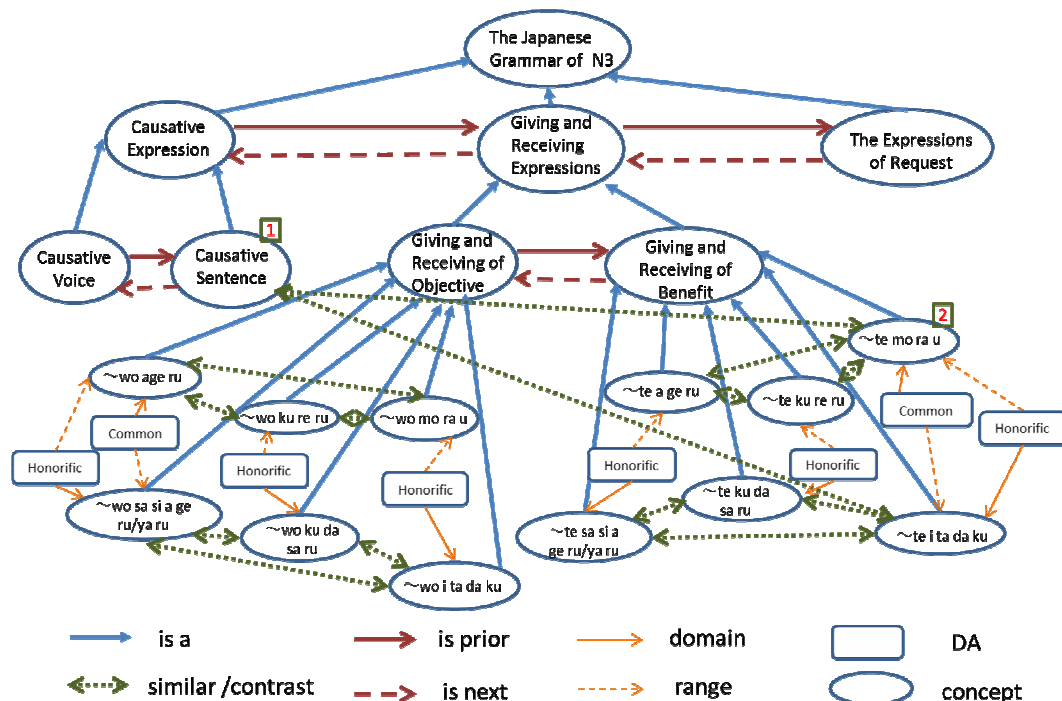


Figure 3. A part of the course-centered ontology of Japanese grammar (Level 3)

Beside the common relations is-a, relations including is-prior, is-next, similar/contrast are considered according to the teaching procedures and teaching goal of the book [5]. When two concepts have the same SA (for example, Items 1 and 2 in Figure 3

have the same SA “request sentence”), a similar/contrast relation exists between them, which make it more convenience for learner to compare their different SAs.

2. Learning process

The learner in this learning support system is first required to take an identical pre-test (Item 1, Figure 1); then, customizable learning objects are provided (Item 2, Figure 1); next, a questionnaire survey to evaluate the teaching method and a post-test to examine learner perception of the learned contents are conducted (Item 3, Figure 1); and finally, a motivation mechanism (Item 4, Figure 1) provides encouragement (for example, gives the performance comparison with other peers, like “Congratulations! Your performance is in the top 10 of this class!”) to the learner. In the subsequent iterations of this process, items 2, 3, 4 in Figure 1 are repeated in new customizable learning materials. The learning history, which includes the involved learned contents, time on task, learner interest and preference survey results, and the academic performance, is recorded in the log files (Item 6, Figure 1). Some data mining techniques can be directly applied in the evaluation mechanism to capture the internal rules and learner characteristics.

3. Conclusion and Future Work

In essence, the personalization of learning support system is to provide individualized e-learning environment for maximizing the performance improvement. The core is how to match the course contents to the learner characteristics. These above machine-interpretable ontologies will facilitate matching performance because of the formalization.

Besides the initial ontology construction, the existing ontologies should be expanded to allow for adaptation to changes in learner characteristics. Graphical interface will be developed for instructors to enable the development of ontologies and the organization of learning objects. Following the system framework in Figure 1, a prototype system will be developed and evaluated by means of analysis of learner data from the foreign language department of a Chinese university.

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