The proposal of an Expression of the Instructional Model of Information Education based on Ontology Theory

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Abstract: A goal of information education is to enable students to acquire the ability of using information in order to live in a modern information-oriented society. Such meta-ability cannot be learned in the traditional Japanese instructional way of knowledge being transmitted by teachers. When a teacher designs an instruction plan for information education, it is necessary to include not only the target goal of the unit but also other related goals determined by types of teaching tools and teaching materials. The purpose of this study is to support the teacher of information education in the process of designing the instruction plan. First, we propose a process for instructional design that is different from the traditional one and which is adapted to information education. Next, we present concepts, which comprise designed instruction and information education clearly and systematically based on ontology theory.

Introduction

In Japan, the subject "Information" will be studied in high school from April 2003. However, most of the teachers who will deliver "Information" are the incumbent teachers of other subjects because there are very few specialist teachers of "Information" as of yet. Because of this, we can imagine a situation where most of the teachers who instruct the subject "Information" do not have technical knowledge about the topic. Furthermore, it is difficult to learn the knowledge that is necessary for teachers of information, because the concepts of the educational goals and the situations for education are not clearly defined for the subject "Information". For example, though using information systems is indispensable to information education, most teachers who are not specialists, mistakenly believe use of technology itself is the main goal of information education.

Many instructors and researchers have published opinions about the various concepts of information education and relationships between these (Ministry of Education, 2000, The Meeting of Tuesday, 2002, Hajime, 2001). Most of these opinions showed factors which are useful for the usual instructional design process, such as situations and contents of education, in order to attain the educational goal. But it is also necessary, in the subject "Information", to add other educational goals which are related to the main goal of a unit, according to the contents of education and the situations of education too. Because, the main goal of the subject "Information" is an enhancement of the meta-ability to make use of information in the various situations. This problem can be solved by teachers who have technical knowledge about information due to their prior learning and experiences. But for teachers who are not specialists in information technology, it is difficult to even understand this problem.

One of the causes is that various concepts about information education are not defined clearly. Because most of the guidelines and commentaries about the subject were provided by presenting the concepts in a mixed fashion, we believe that these contents were not conveyed to the teachers effectively. To solve this problem, it is necessary to clarify and to tease apart the discrete concepts that compose information education. We think that this problem can be solved by applying ontology theory. And regarding instructional design, not only the traditional process in which a teacher determines the strategies to employ to attain the goals of education, but also a more flexible process is necessary. In the guidelines and commentaries about information education, only details about how to attain the goal outlined by each unit is shown. An evaluation of the learner's enhancement of ability to make use of information according to given projects and situations cannot be expected by this method. As for the instructional design process

of information education, a more flexible process which can add related goals according to the projects and situations is necessary.

In this study, first we identify features of the subject "Information", by comparing it with other subjects, and propose an instructional design process model which is suitable for this subject. Next, we express the concepts which compose instruction, the concepts of the subject "Information" and the relations which exist between these, clearly and systematically based on ontology theory.

The features of the subject "Information" and the instructional design process

The feature of the subject "Information"

In Japan, the goals of information education are described as follows: To learn a scientific point of view and technology about information, to understand the roles and influence of information and information technology in society and to enhance the abilities and attitudes which help one to cope with the development of computerization independently. The Ministry of Education prepared three viewpoints (The scientific understanding of the information, the practical ability to use the information and the attitude which enables participation in the information society) for the achievement of these goals. It prepared three sub-subjects (Information A, Information B and Information C) that attach importance to each viewpoint for the subject "Information" in high school.

We show the features of the subject "Information" which were found by comparing it with other high school subjects in the following:

> The importance of meta-ability is higher in the educational goal, and contents of education are decided for achieving it.
>
> The meta-ability (the ability which it makes use of information for) is a main goal, and an instructional form based on the constructivism is more important.
>
> Teachers of information education must take the whole contents of the subject into consideration in each sub-subject, because students in high school select only one of these.

The reason for these features is not because the structure of the subject is different. It is because the contents of education are taken more seriously in other subjects for the purpose of higher education entrance examinations. The structure of the subject "Information" is shown on the left of figure 1. In this figure, an upper concept is more abstract. The structure of the subject "Information" is composed of the goals of the subject, the goals of the sub-subjects, the goals of the instruction and the contents of the instruction as well as other subjects.

The other reason for these features is that most educational goals of the subject "Information" are meta-ability, so it is difficult for children to attain this by transmission of the knowledge by teachers. An instruction form based on the foundation that students learn the necessary ability themselves in each given situation is effective.

The instructional design process model

An instructional design process model by Gagne is typical of one of the models presented so far (Gagne, 1979). This instructional design process model is composed of four levels (Two levels of the system levels, the level of the subject and the level of the instruction). The instructional design process in this study focuses on the process that is involved from decision of the goal for a unit up to preparation of the instruction plan in the level of the instruction. The instructional design process of Gagne's model has five steps. These steps are 1,2,3,4 and 7. These meanings of the numbers are shown below:
1. The decision regarding the goal of the instruction.
2. The decision regarding the contents of the instruction.
3. The decision concerning the situation of the instruction.
4. The choice of the media for the instruction.
7. The preparation of the instruction plan.

This process may be applied to other subjects and the steps are almost the same as with other models published so far. However, in the design process of the instruction, it is not only necessary to decide the instructional situations to attain the goal of a unit but also necessary to add the goal of the instruction which relates to its situations and the teaching materials based on constructivism. The Ministry of

Education in Japan says that to deliver the several contents which relate to each other with the same teaching materials, across the unit, is also important (Ministry of Education, 2000). Therefore, the step to add a goal of instruction according to the instructional situation and the teaching materials in the instructional design process is necessary too. For these reasons, we propose the instructional design process model which has the seven steps 1,2,3,4,5,6,7. In this model, two steps are added to the above model. The descriptions of the two added steps are shown as follows:

5. The addition and choice of the goal of the instruction.
6. The reselection of contents of the instruction.

We think that this instructional design process can provide for a more effective instruction design whereby students can not only enhance the ability stipulated in a unit but also enhance other necessary abilities in the situations given. This is very important to attain the main goal of the subject "Information", that is, to enhance the ability to use information according to each situation. And, we think that this instructional design process model is effective in instruction not only for the subject "Information" but also for other subjects if it is based on constructivism.

The expression of the instructional model of the subject "Information"

In this chapter, we describe the expression of the instructional model of the subject "Information". First, we propose two ontologies which are used for expression of its model. Then, we explain the features of the instructional model that are expressed based on these ontologies.

The ontology of the structure of the instruction

In this section we show the component concepts, which make up the instruction designed in the proposed instructional design process, that were described based on ontology theory. Here, we explain the ontology simply. The ontology clearly shows the concepts and the relations which exist between them and gives their specific semantic definitions. Because of this, ontology promotes reclamation and joint ownership of the concepts and the models which were described with these. And, this ontology was described in the ontology editor (Kouji, 2000).

The ontology of the structure of the instruction shows the contents which comprise the instruction of one unit. The structure of teaching (The instructional model) a unit is composed of three component concepts which are; goals of the instruction, contents of the instruction and situations of the instruction. Goals of the instruction are composed of a goal of a subject and a goal of a unit. Contents of the instruction are composed of a content of education of a subject and a teaching material. Here, a teaching material means a theme in the actual instruction, it doesn't contain concepts which are educational aids and the way to teach. Situations of the instruction are composed of some stages of the instruction. Each stage of the instruction is divided from a unit according to the specific learning activities, and it is comprised of the environment of the instruction, the development of the instruction and time allocated for this stage. Development of the instruction is described with a purpose of the learner's activities and a purpose of the teacher's activities. These are the main features of the ontology that we propose in this study for the development of the instruction. The development of the instruction has been described with regard to both the learner's and the teacher's activities in most instructional models. But, it is expressed with the goals of education in this study. These show the goals of education that a teacher expects learners to attain. And they can be described for each stage of the instruction in addition to the main goal of a unit.

It is important for teachers to be clearly conscious of the goals of education underlying the learner's activities when they design the instruction based on constructivism. For this reason, this ontology of the structure of the instruction is focused on the goal of education.

The ontology of information education

In this section, we describe the ontology of information education which clearly expresses the concepts that compose information education.

The ontology of information education is composed of a goal of information education and a content of information education. A content of education means the contents of education of the subject "Information" which the Ministry of Education has prescribed. A goal of information education is

composed of three viewpoints which are decided by the Ministry of Education. We extracted lower concepts for more than three viewpoints based on the course of study which was prescribed by the Ministry of Education. The concepts shown in this figure are used to describe an instructional model for information education which is based on the above ontology of the structure of the instruction.

The features of the instructional model that is expressed based on two ontologies

In this section, we explain the features and the advantages of the instructional model which is described based on the two ontologies above. We presume that the teacher describes this model before preparation of the instruction plan. Its advantages are shown in the following:

The teacher can describe the goals of education in each learning activity aside from the goal of a unit.

The teacher can be clearly conscious of the goals of education, which otherwise are easily hidden.

If a lot of these models are accumulated, teachers can refer to the true nature of the instruction (the goals of education) because the superficial information, which is about the type of the media and the learner's activities, does not confound them.

A proposed instructional model does not contain information about the instructional strategy. But, by accumulating both this instructional model and the instruction plan, the teachers can refer to the instructional strategy which is distinguished from the goals of education. So, we think that this approach can promote the joint ownership and reclamation of the instructional model.

Conclusions

In this paper, we proposed the instructional design process model adapted to the features of the subject "Information". Then, we presented two ontologies which provide the necessary concepts to describe the instructional model of information education based on this instructional design process. And, we explained that designing the instructional model based on these ontologies has some advantages. Furthermore, we showed the outline of the approach for supporting an instructional design process with the above two ontologies.

In future work, we intend to build a system which supports the teacher of information in setting tangible goals in the instructional design process stage based on these concepts and provide it for teachers of information education.

References

Gagne, R.M. and Briggs, L.J. (1979), Principles of Instructional Design (2nd Ed.). Holt, Rinehart and Winston, New York.

Ministry of Education (2000), The Commentary of the Course of Study about "Information" in the High School, Kairyudo Publishing.

The Meeting of Tuesday (2002), The goal list of Information Education, Mail-Magazine of the Meeting of Tuesday, http://kayoo.org/home/project/list.html.

Okayama Prefectural Information Education Center (2002), High School New Subject "Information" Reference Document, http://www.jyose.pref.okayama.jp/jweb/index.htm.

Hajime O., Takahiro T., Toru H., Yasushi K., Takeo T. (2001), How to Instruct the Information Course, Ohmsha.

Kouji K., Yoshinobu K, Mitsuru I, Riichiro M. (2000), Development of an Environment for Building Ontologies which is based on a Fundamental Consideration of "Relationship" and "Role", The Sixth Pacific Knowledge Acquisition Workshop (PKAW2000), pp.205-221 ,Sydney.