

Total Resolution for Human Resource Development Based on Competency Ontology

*Kenji Hirata, **Mitsuru Ikeda, **Riichiro Mizoguchi

*The Sanno Institute of Management<hirata_kenji@hj.sanno.ac.jp>, **Osaka University

Abstract

While there are various advancement of education system development, an issue namely Interoperability occurs particularly in Human Resource Development, which is the largest obstruction factor for utilizing information technology in HRD. In order to resolve such obstruction factor, we thought that the perspective on the whole education system in designing would be needed rather than one on each piece of the system. Therefore, we modeled a total education system, on which various systems and persons are concerned to exchange data and reach a mutual consensus. Furthermore, in developing a HRD design support system from the standpoint of total design, we set each ontology related to HRD as foundational technologies, that is, "Competency", "Benefit of Learning Contents" and "HRD Needs". Through such experiments, we made the design process and activities explicit, which were depended on judgment call and tacit knowledge conventionally, and made some linkage possible on shared understanding. Until now, HRD design was not able to be absolutely covered by human processing ability and was not stable enough to assure its quality. Then we showed the framework for HRD design. To be concrete, only formative information has been used to reach a mutual consensus in the HRD design process among participants, but these ontologies we developed will move their attention to understanding of content of a educational plan and to lead a rational design and mutual consensus.

Keywords: Competency Ontology, HRD Design, Interoperability, Share and Reuse Learning Contents

1. Introduction

Many systems, related to various kind of education, have been developed. In the present situation, these have been developed individually. On this account, a connection among these systems does not make progress, so the issue of "Interoperability" has occurred. Interoperability is an important subject in order to deal with information of education, especially in business education. At a separate point of view, this situation have each training firm and company hesitate to pay much cost needed to computerize for large quantities of learning contents. Because Interoperability does not realize, as a result, to share and to reuse learning contents did not progress. "A total design" and design support on a "foundation for information technology" are important to do development systems that have broad frame. The former is the design that focuses on upper process rather than instructional design (ID). The later is the rules that can make interaction among various systems themselves and human, and that can make systems and human understand about contents of data and system functions.

In this paper, we focus on a HRD design as an upper design. ID pays attention to job and duties task generally. And ID does not treat what designer cannot describe as educational objectives definitely. We take up a concept of competency that cannot be treated with ID. On the other hand, we thought that a research about domain analysis and data modeling in the field of HRD are necessary. So we also take up "Ontology" as a core of technological foundation. It is assumed and examined that ontology led some concept share among system tools and/or persons who used these.

2. A Flow Model of Total HRD Design

Figure1 is illustrated HRD design function in Human Resource Management System. This also shows that ID should be based on upper design, and based by HRD manager or planner. Then, Figure2 shows a flow model about activities in HRD design as upper one. This model is drawn from the viewpoint of time-flow. A cycle of design includes needs investigation, deciding needs, prediction of effect, operation or management, and measurement of HRD effect. The result of measurement of HRD effect is to reflect to needs investigation at the next cycle.

On the first phase, HRD needs are specified based on HRD strategy, HRD policy, and analysis of real situation. Each phase among the second to the fourth is planning phase. On these phases, needs are transformed into concrete educational needs and training plan. On the second phase, a HRD planner searches some adaptive objects from learning object repository. On the third phase, he selects more adaptive objects and materials by comparing them picked-up on second phase. The data compared in selecting is learning benefit that is to include or attribute in learning objects. A benefit about a learning object is like a meta-data or a meta-knowledge that are described as knowledge, skill or competency. When there are not suitable learning objects in learning object repository, he must develop something as fitted these needs. On the

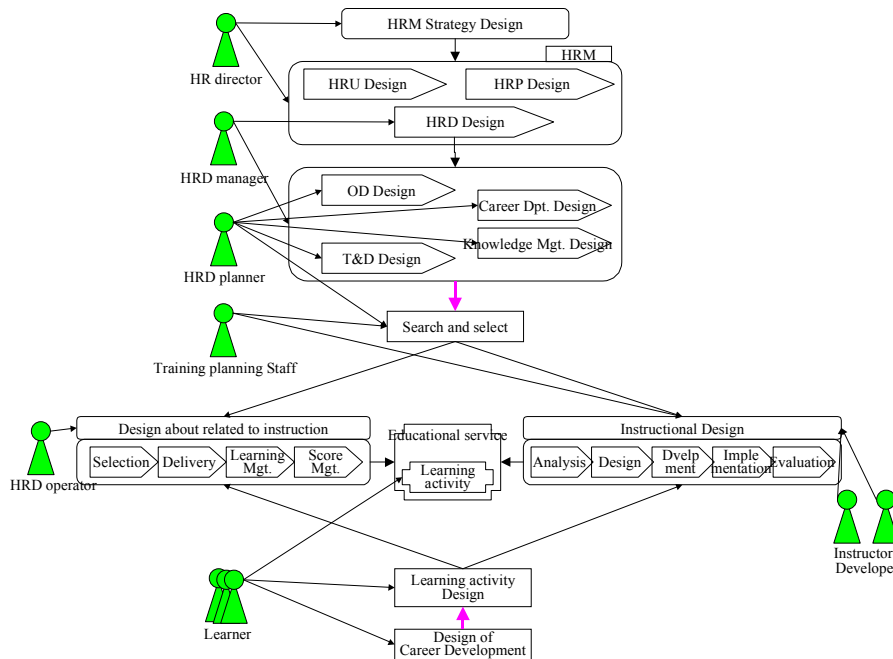


Figure1: HRD Design Function in Human Resource Management System

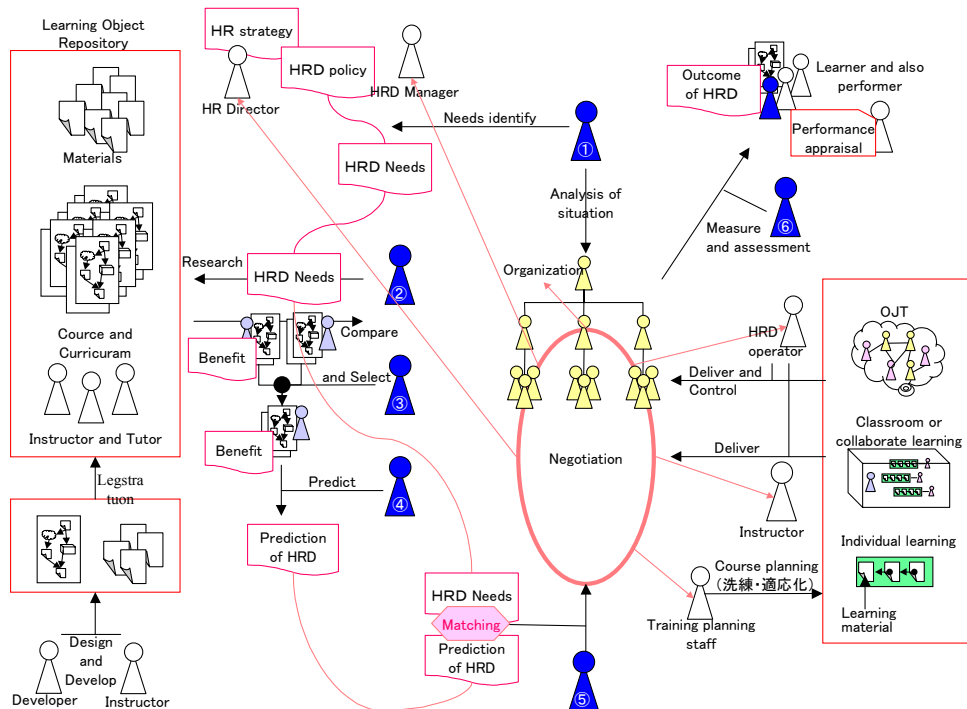


Figure2: A HRD Design Flow Model

fourth phase, a HRD planner predicts HRD effect whether needs is satisfied with selected learning objects. The consequence through this phase is some learning objects with which a HRD staff can expect to fill HRD effects. On the fifth phase, all participants do negotiation with this consequence. An important thing is what a HRD staff can explain as a reasonable plan passed through a design process in this negotiation phase. Once mutual consensus makes up in negotiation, training planner, instructor and administrator can proceed to the next phase. After implementation, a HRD staff measures HRD effects on the sixth phase. In other words, he evaluates achievement for HRD needs.

We are going to support the process from the first phase to the sixth phase with some tools. So we made some HRD ontologies as base of connection between tools. These ontologies lead us to share and reuse learning objects. And we developed an authoring tool, which support to design in ID process, based on ontologies. Furthermore, we have developed "LOCOS" as an upper ID tool, it can support HRD staff among analysis phase to negotiation phase. In Chapter5, we explain about this design support system. We made enormous knowledge of educational design clear, and we can communicate by using it knowledge. And we suppose that using these systems can make HRD staff build mutual consensus on contents among various participants. Through these developments, We aim at building a structure to assure the quality of complex HRD design.

3. Ontology and HRD Design

Basically, ontology is a set of definition of concepts and relationships, and a model is a set of instances. Roughly speaking, a role of ontology is to direct user towards the correct model. An ontology plays an important role to embody the above idea (Mizoguchi et al. 1996). One of the most important role of ontology is to lay the theoretical foundation for educational system development process(Hayashi et al. 1999). It provides human friendly vocabulary/concept for authors to describe the learning contents along with design intention (Hayashi et al. 2000).

HRD always links to other activities and systems. For example, it is Human Assessment system in organization. Human assessment is to evaluate human performance and/or human competency. Human assessment links with salary system as one of reward systems. And, competency dimension as evaluation items should be closely related to training. It will be the problem that to learn a competency by HRD activities like as training and education and to improve his performance are not linked to reward system. Human assessment must be related with HRD activities and systems. If it is not related with reward, order of an organization may be disturbed and confused. We think that using ontology described as human competency will be able to link to various activities and systems.

4. HRD Design Support

4.1. Knowledge to Specify Needs: from ID to a HRD Design

Using general ID is to analyze duties task to some subtasks or to describe them in detail. ID can specify some knowledge and skill that are assumed important in each task as educational needs. Or using general ID is usually to assume an ideal task performance. So we can measure the gap between ideal one and the present one, and also can specify some knowledge and skill to fill up the gap. It is beneficial to specify educational needs on the basis of such analysis, for course planning in practice and for training of duties task. On the step of ID process to specify educational objectives from educational needs, knowledge and skill should be described definitely. And a achievement standard must be indicated to measure the effect of education and training. In ID process, it is needed to construct a concept structure of contents that should be learned. A concept structure makes easy decide a sequence about teaching and instructional activities, and also make possible evaluate ID effect itself.

However, as for designing HRD with general ID, there is a limit. First of all, we show three points demanded on HRD design from a standpoint of organization, and from a standpoint of individual later. Primarily, ID must be based on a present duty task, so that ID can deal with only short range of performance improvement for both individual and organization. Therefore ID cannot set needs corresponding to long-term performance improvement. Second, HRD is needed to reflect change of society and market, and to connect with subjects for management in each organization. Thus top-down design is more effective than bottom-up design such as ID. Besides, the proactive design that can create new knowledge, market, and an ideal organization is needed for HRD system design more than the reactive design (Kaufman, et al. 1997). Third, ID is directly related only in activities of course designer/developer and learner.

On the other hand, HRD design is required to consider various kinds of persons and their roles in addition to designer and

learner. The judgment for training course applied to ID depends on result of individual learning. However, in HRD design, doing negotiation and building mutual consensus about meaning and necessity of education are more important than the result of individual learning. As for the individual viewpoints, there are two demands. We must pay attention to learning of workers here. A lot of learning are done on works and in community of practice, that is just workplace. Workplace learning, "Experience in practice", can classify two meanings roughly. One is a learning as solving problem that just occurs in real task, the other is learning for career and competency development that occur through many work experiences(Hirata, et al.2000). ID can deal with the former, but the latter cannot. HRD design must include learning about not only knowledge and skill specified duties task, but also competency, self-efficacy and work belief.

4.2. Competency as Contents of Needs Design

4.2.1. Competency Definition

There are various kinds of definitions about "Competency". We reviewed competency definitions by a lot of researchers(e.g. Rothwell, Spencer, Sternberg, Sandberg et al.) in order to specify common nature of competency. We found three one as below. Primarily, competency is described as underlying characteristic or capability based on person. Second, competency is related to high performance or superior result on task and work in practice. Third, competency emerge by person doing something, and emerge at not only one specific domain but also various domains and situations in stability. And "Competence" is a non-countable noun, while "Competency" is a countable noun, so we assumed that a individual can have more than one competency. Accordingly Hirata(1999) defined "Competency, which emerge variously and widely in working or functioning as performance, is an underlying characteristic or capability of individual that is causally related to effective or superior performance or results in work and its situation.

4.2.2. Competency Model in Performance

The purpose of this research, which is mentioned above, is to systematize a HRD concept from standpoint of competency. With this purpose, we will make some attributes to characterize a HRD concept and make relationship clear between these constitution elements. Because a concept of competency is abstract, so that it is necessary to arrange systematically procedure and its background, and to make mutual consensus each other. Competency is not based on specific task, so it is difficult to realize a relationship with real task performance. For these reasons, it is necessary to explain selection methods and educational methods of a concrete learning contents in order to recognize a relationship in practice.

Figure3 showed a relationship among knowledge, skill, competency, task and performance. Arrows in this figure represented sequential relation for performance done. We explain the outline of these relationships in the following. A worker is evaluated at points of efficiency(E) and quality(Q) of his performance(P) for job tasks in practice. In performance, it is classed in behavioral performance(BP) and cognitive performance(CP). Behavioral performance is driven by behavioral skill(BS) and/or cognitive skill(CS). Skill(S) functions on routine task with the characteristic as fixed

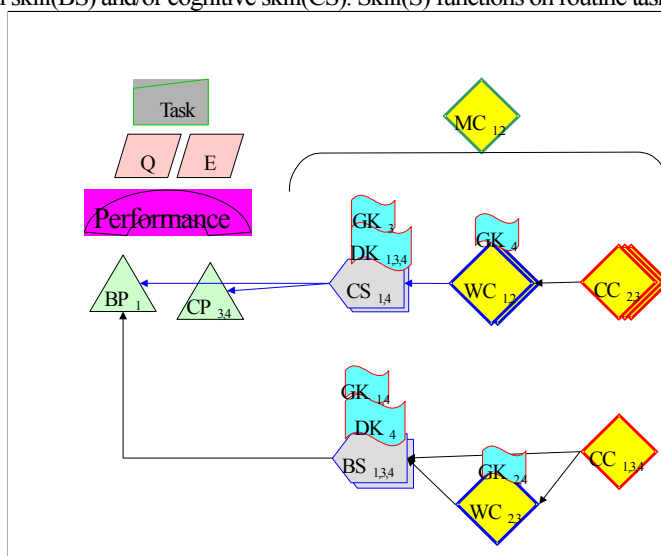


Figure3: Relationship Performance and Competency

procedure. In practice, both domain specific knowledge(DK) and general knowledge(GK) are used. Skill is based on competency. Competency functions in using some skills appropriately and in decision making in practice. There are three types of competencies. Core Competency(CC) is general aspect, Work Competency(WC) is related to work and/or occupation in direct, and Meta Competency(MC) is related to monitoring or learning other competencies. Core Competency is the basics of Work Competency.

4.2.3. Competency Ontology

By concept of human competency, we can recognize various activities in business and HRD(Hirata, et al.2000); "Personnel planning" is to design required competency. "Training" is to educate ones competency. "Human assessment" is to evaluate human competency. "Employment" is to supply human resource as competency. "Rotation" is to utilize competency. "Organization development" is to breed human competency. "Knowledge management" is to actualize and circulate human and organizational competency. "Career development" is to plan ability development for a long term. "Learning" is to acquire competency. "Performance" is to transform ones competency into task actually. "OJT" is to communicate competency. We can connect and integrate of various systems by using the concept of competency.

Modeling for integration may depend on "Competency ontology"; Figure4. This competency ontology is made by a lot of researches and literature review; these are basic psychology, faculty psychology, organization psychology, and also management practice.

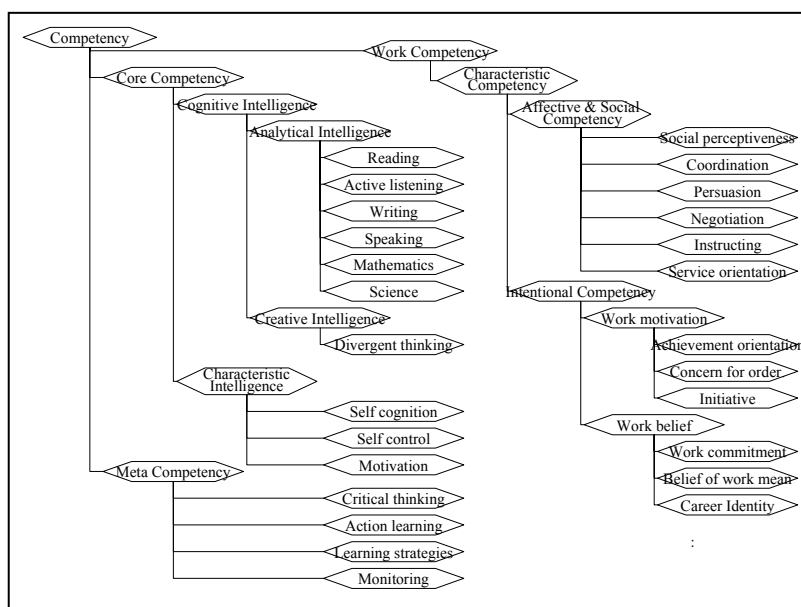


Figure4: Competency Ontology (in part)

4.3. Data Models of HRD Needs and Learning Benefit for Sharing and Reusing Learning Contents.

An information concerned with HRD activity flows between human and systems mutually. The center of contents of HRD information is related to human ability such as knowledge, skill and/or competency. These should be educated and be made clear in HRD design. In other words, these are educational/HRD needs.

In HRD design, we should also specify what learning contents meet with HRD needs. Hence HRD design is the process to match between HRD needs and benefit of learning contents. The content applied in this matching process is just human competency. And domain analysis and data modeling about competency are needed for system development. With this purpose, we analyzed and made modeling about HRD needs, which was included competency ontology. And we analyzed and did modeling about benefits on learning contents. We analyzed documents that we collected from 151 HRD planner.

We classified 1,222 description data and made a model as a HRD needs ontology at Figure5. And we

classified 1,225 description data and made a model as a HRD benefit ontology at Figure6. We show a part of each one.

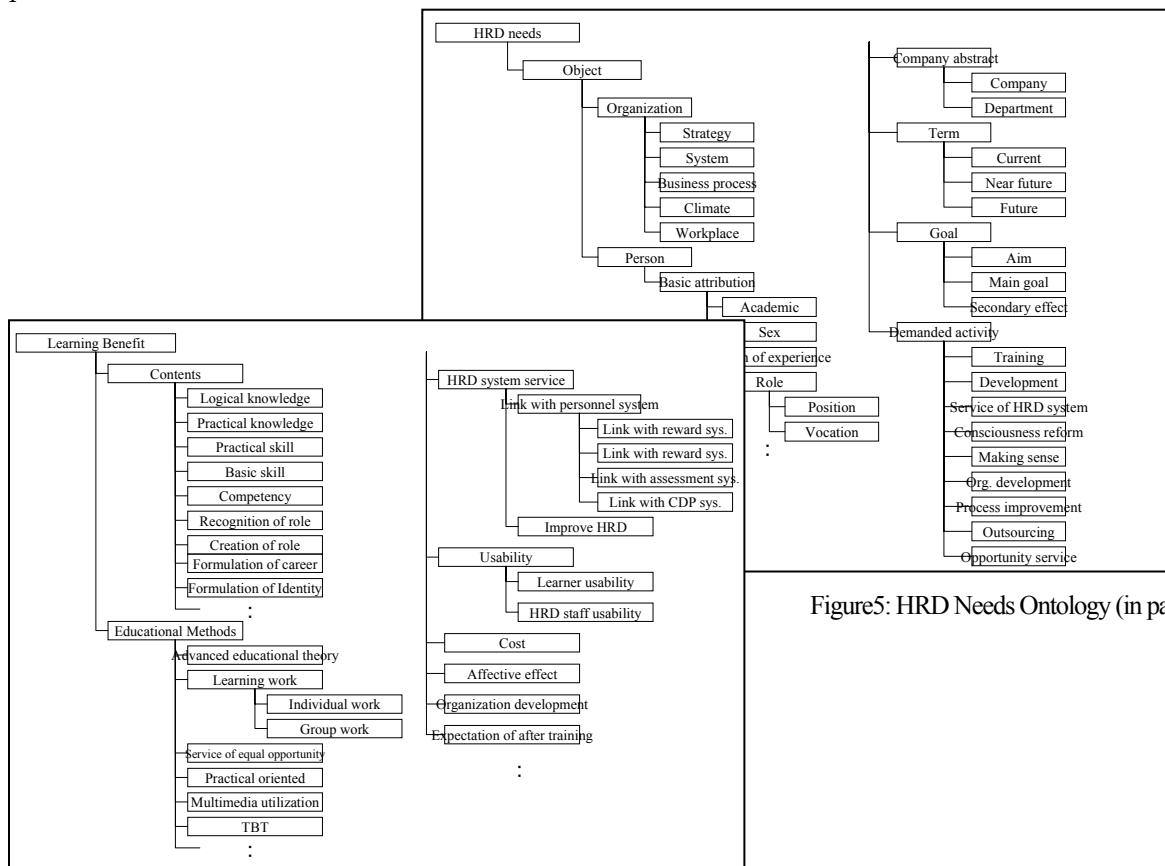


Figure5: HRD Needs Ontology (in part)

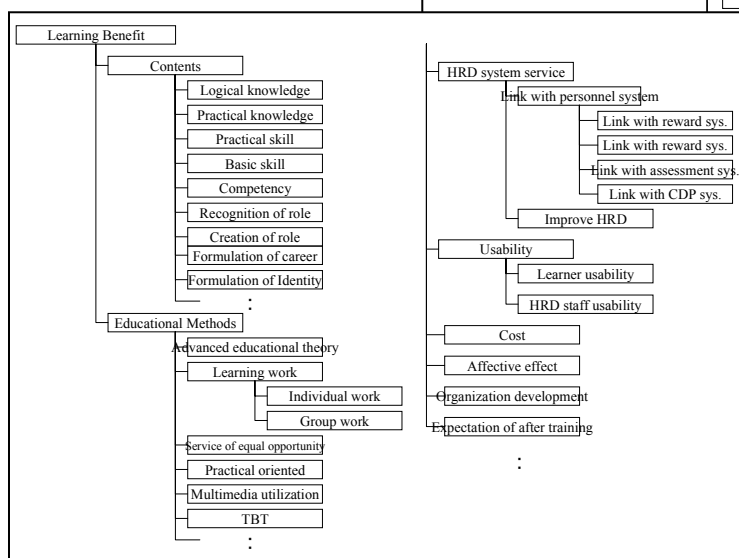


Figure6: Benefit Ontology for Learning Contents (in part)

5. LOCOS

LOCOS is an upper ID tool designed as a total design tool and as a negotiation support tool. We will report functions in detail by a different paper. This paper explains a role of ontology on HRD design mainly. Figure7 shows an outline of LOCOS. Figure8 shows the interface as a worksheet. A worksheet consists of seven columns. Three lines of the left side mean a situation of a customer who has educational needs, and three lines of right side mean a characteristic of learning objects. A central line means conformity reason (Utility) with needs and benefit of learning objects. A node means an entry of each column. For example, a node of a need column means a HRD need of a company. A basic procedure will let the right edge shape the education course that needs included by will constitute a description from the left side by a network sequentially. A description of node is done using a presented key word by a glossary list such like the window that is the center of this figure. A glossary list is presented as a concept, which is based on ontology shown in Chapter 4, to be related to contents of each column.

This figure is an example of description of a key word of a need column. Needs are constituted by "a concept of subject" and "a concept of educational activity"; "improve achievement consciousness" or "make cost consciousness". This worksheet is not a simple description tool. LOCOS possesses functions of repository search connected with ontology server, learning object repository and case repository. For example, at the sixth line shown prospective benefit of a learning object, or at seventh lines shown a characteristic of a learning object, we can search appropriate learning objects from this repository. LOCOS leads a proper design process indirectly by restricting a glossary list in description. Therefore a model on a worksheet becomes a logical proposal one reflected the rational design process.

There are four reasons for a rational design. Primarily, in negotiation on a total design, LOCOS can specify demands of various staff. Second, it can describe design process and contents of HRD needs.

computer.

Finally we propose our three assertions. Primarily, in addition to ID as a design of a training course, HRD design is more important. Second, competency ontology is necessary, so that HRD activity can be linked with HRM and all organizational activities. Third, in HRD design, those ontologies about needs and benefit are effective for HRD staffs in practice.

7. Reference

- Hayashi,Y., Ikeda,M., Seta, K., Kakusho,O., and Mizoguchi,R. “Is What You Write What You Get?” ITS 2000
- Hayashi,Y., Jin,L., Ikeda,M., and Mizoguchi,R.et al. 1999 “A Multiple View Authoring Tool for Modeling Training Materials” ICCE’99.
- Hirata,K 2000 “An ontological approach for Human Resource”, Annual Meeting Proceeding of Japanese I/O Psychology.
- Hirata,K., Mizoguchi,R. Ikeda,M. et al., 2000 “Effectiveness of Human Resource Ontology”, JCET2000.
- Hirata,K. et al. 2000 “An Empirical Research on a State of Knowledge & knowledge Acquisition Behavior in Organization”, APDSI2000
- IEEE LTSC, 2001 “Draft Standard for Learning Object Metadata” IEEE P1484.12/D6.0.
- Kaufman,R., Thiagarajan,S. and MacGills,P. 1997 “The Changing Realities of Human and Organizational Performance Improvement” in The Guidebook for Performance Improvement, Jossey-Bass.
- Langdon,D.G 1997 “Business Unit Performance Analysis and Development”, in The Guidebook for Performance Improvement, Jossey-Bass.
- Mager, R.F. 1988 “Making Instruction Work or Skillbloomers”, Lake Publishing
- Mizoguchi,R. and Sinita,K. 1996 “Task Ontology Design for Intelligent Educational/Training Systems”, ITS’96
- Rosenberg,J. 1995 “Performance Technology, Performance Support, and the Future of Training”, Performance Improvement Quarterly, vol.8(1).
- Rothwell,W.J. 1996 “ASTD Model for Human Performance Improvement”, ASTD press
- Rothwell.W.J. and Kazanas,H.C. 1998 ”Mastering the Instructional Design Process”, Jossey-Bass.
- Sandberg,J. 2000 Understanding Human Competence at Work. Academy of management journal.vol.43(1)
- Spencer,L.M. and Spencer,S.M. 1993 “Competence at work”, JohnWiely and Son.
- Sternberg,R.J. 1997 “Successful Intelligence”, Plume.
- Van den Breg,P.T. 1998 “Competenies for Work Domain in Business Computer Science”, European Journal Work and Organizational Psychology, vol.7(4).