

A Knowledge-Based Systems Approach to Educating Creative Legal Minds

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ABSTRACT

Rapidly changing global societies of this century require us to have many good lawyers. "Good" lawyers must have creative legal minds. It is important to educate law students so as to enhance creativity as well as to ensure their knowledge of the law. We have, therefore, established a project on "the development of a legal education method for fostering creative legal minds." In this paper, we would like to present the results of one of our studies as an application of the legal knowledge based system developed by the authors to promote students creative legal minds. The basic idea is as follows: The traditional legal education in Japan, which belongs to the continental, statutory law culture, has been based on the lecture method, which uses a top-down implantation of legal knowledge. Our new approach involves an integration of four methods: problem-solving, Socratic, interpretation and discussion, which together lead to a more interactive, bottom-up development of legal knowledge using the legal knowledge based system (LKBS). In this paper, the authors introduce a LKBS (LES6) they developed, discuss the applicability of the LKBS to legal education for creative legal minds and report an example of training of creative ability of students in the systematization of legal knowledge.

Categories and Subject Descriptors

I.2.1 [Applications and Expert Systems]: Law and Legal Education.

General Terms

Design, Experimentation.

Keywords

Legal Expert System, Knowledge Based System, Creative Legal Minds, Law Education.

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1. INTRODUCTION

Society is changing rapidly, and globalization is surging forward. It has become very important for legal practitioners to cope with such change in this time of intense transformation; that is, to provide appropriate solutions to legal problems that deal with the rapid progress of society¹. There are many criteria for being an excellent lawyer, but the capacity for creative and flexible legal thinking that is adaptable to this rapidly-changing society is especially in demand. With the backdrop of this era, cultivation of this creative legal thinking ability is offered as one of the vital educational objectives of law schools. We refer to education that cultivates this creative legal thinking ability as "creative legal education."

We have thought that the research (and results) of artificial intelligence could be applied toward this objective of implementing creative legal education. For this reason, we have brought to fruition some aspects of the development of the legal knowledge-base². We have thought, "Couldn't we contribute to the realization of this objective utilizing these accomplishments, or developing and expanding them further?"

The traditional legal education in continental law countries (sometimes referred to as civil law countries), to which Japan belongs, is based on lecture methods. In lectures, professors pass on to students the legal knowledge that they themselves possess, and the students have to understand and remember it. This is a top-down implementation of legal knowledge.

A new approach is an integration of problem methods, Socratic methods and discussion methods. Ultimately, it is designed to be a bottom-up development of legal knowledge, using a knowledge-based system.

¹This is especially the case for Japan. There have been numerous cases in which Japanese companies lost legal disputes in the U.S. and other countries, causing Japanese legal professionals to become viewed as unreliable in comparison to their American counterparts. The demands of the financial world have pushed the political establishment to a systematic reform that will establish a graduate law school attempting to train a greater number of skilled lawyers.

²"Legal Expert System LES-5" and others have been developed through this research project[1] [2][3][4][5].

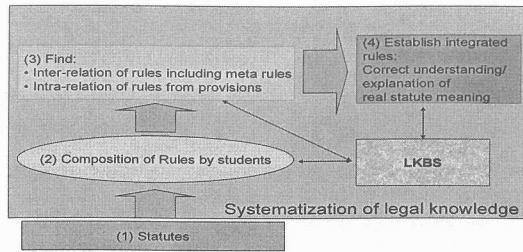


Figure 1. Developing rules from statutes

The basic idea is represented above in Figure 1. (1) Students are to start from statute provisions. (2) Students try to compose statutory rules with the goal of establishing a deductive system. (3) Through these composition activities, students can find the intra-relation of rules from provisions, on the one hand, and the inter-relation of rules, including meta rules, on the other hand. (4) Finally, students can establish appropriate (integrated) rules which constitute a deductive system of law. This means that students understand the real statutory meaning and can explain it correctly.

A "creative legal mind" is the thinking ability to properly solve legal problems by creating new legal rules. A creative legal mind includes not only proposing new legal rules, but also constructing a new logical structure in a lawyer's brain.

In this paper, we will clarify that the legal knowledge-base can contribute to the aspects of creative legal education. We will thereby introduce practical examples in which the legal knowledge-base is applied toward creative legal education.

Before we begin, let us define our conception of legal creation. According to the authors, legal creation is the establishment of legal propositions that cannot be deduced from the existing legal system. Legal propositions are laws expressed in sentence form. To carry out the formation of legal propositions, a certain reasoning process is required, and when sentences are devised following that process, they become legal propositions. Legal propositions are not limited to statutory laws, which are laws—such as the Constitution, the Civil Code, and the Penal Code—that are enacted by the vote in the Diet. Because statutory laws are expressed with abstract terminology, those who seek to apply a statutory law must perform an interpretation of the law that embodies the meaning of the terminology within it to actually and concretely adapt the law to a particular case³. Also, the person interprets the systematization of the law through the systematic relation among the various individual legal rules within the statute. Legal propositions are to be established through these interpretive processes by virtue of the authority of the person applying the law.

³ This will be mentioned hereinafter.

The establishment of legal propositions carried out through this sort of legal application process is referred to here as legal creation. Creative legal thought, then, is legal thought that establishes these kinds of legal propositions and resolves disputes appropriately.

2. APPLICABILITY OF LEGAL KNOWLEDGE-BASE TO CREATIVE LEGAL THOUGHT

Let us consider how the legal knowledge-base can be applied to creative legal education. The purposes of this application are divided into two main categories. One is the acquisition of fundamental knowledge and skills pertaining to legal thought as a premise for creative legal thought. The second is the promotion of the creative side of creative legal thought. It can be said that the former is the acquisition of the fundamental technique and basic form of legal thought necessary for performing the latter creative legal thought.

First, in order to properly acquire the fundamental knowledge and skill of legal thought, it is necessary on the one hand to understand the systematic structure of legal knowledge, and, on the other hand, to practice actual legal thought through problem-solving case simulations. In the former, this is accomplished by (1) understanding the general logic system of legal knowledge⁴, (2) understanding the general structure of legal reasoning, and (3) understanding the concrete knowledge structure of positive law (understanding the concrete structure of knowledge in specific fields such as the Civil Code, the Commercial Code, and

⁴ Because there is a logical structure in terms of law that is common among the Civil Code, the Commercial Code, the Penal Code, the Constitution, and other such laws, this point is to understand the type of structure. However, what we call logical structure here is not restricted to the pure syntactical aspect, but also includes the function or meaning of the specific common predicate that logically systemizes legal knowledge.

international business law)⁵. In the latter, it is accomplished by (4) understanding the structure of problem-solving reasoning when faced with hypothetical examples, (5) performing simulations for each example using the system of legal problem-solving reasoning, and (6) training in the drafting of problem-solving and explanatory manuscripts based on the knowledge and skills detailed above⁶. We believe that the legal knowledge-base can be effectively applied toward the development of these abilities in thought and comprehension.

Second, we believe that the legal knowledge-base can be utilized toward points (7) – (9) (which follow) in order to promote the creative side of creative legal thought: (7) comparison of various theories and legal precedents related to problem-solving (through these comparisons, students can understand the various ways of thinking and, through this understanding, also form their own thought methods); (8) construction of a system that simulates the process of the generation and counter-proof of legal hypotheses, since generation and counter-proof of hypotheses is the structure of legal creation; and (9) creation of the knowledge-base itself (that is, computerized systematization of the knowledge. By doing so, students acquire the creative thought that is the systematization of legal knowledge⁷).

Of the above points (1) – (9), applicable to creative legal thought education for the legal knowledge-base, we will focus on points (1) and (9) using practical examples in the next section.

3. PRACTICAL EXAMPLE OF CREATING LEGAL EDUCATION USING THE LEGAL KNOWLEDGE-BASE

3.1 Understanding the general logical structure of legal knowledge

In order to construct a legal knowledge-base, we must clarify the structure of legal knowledge. For this purpose, we formalized the law into logical union of legal propositions using limited first-order predicate logic (Horn clause logic).

In order to understand the general logic system of legal knowledge, we first broke legal knowledge down into its simplest elements, which we then logically combined. Legal propositions comprised of these fundamental elements are divided into the following three pairs of legal propositions: fact propositions and rule propositions; object propositions and meta propositions; and elementary propositions and complex propositions.

⁵ Understanding of this formal structure is useful in comprehending the law and solving concrete problems. It is also useful for presenting proof of a legal conclusion, as well as clearly grasping the framework that is used when considering and establishing new legal propositions.

⁶ Using the legal knowledge-base, one can clearly grasp the various rules and appropriate order used for reasoning, and by specifying these, can draft a clear report. Students become able to write systemized reports because they utilize the systemized knowledge and grasp this structure of reasoning.

⁷ That the systematization of legal knowledge is an act of legal creation has been expressed previously.

Legal propositions are first, from a syntactical point of view, divided into fact propositions and rule propositions. This is nothing more than a purely syntactical distinction. Fact propositions use a structure of "f(a)," or, "a is f," whereas rule propositions use a structure of "legal requirement → legal consequence." The legal consequence portion of a rule proposition is an atomic logical formula, whereas the legal requirement portion is a logical expression, i.e. an atomic logical formula, or conjunction of expressions, or disjunction of expressions. A separate fact proposition, distinct from rule propositions and fact propositions – and which originates from the legal consequence portion of the rule proposition – is derived according to the inference rule.

Legal propositions are secondly divided into object propositions and meta propositions, according to the difference of the target denoted by the legal proposition. A legal object sentence describes an object. An object in the legal domain is an obligation. Consequently, an object proposition describes an obligation. On the other hand, a meta proposition describes a legal proposition. Or, to put it more accurately, a meta proposition describes the validity of a legal proposition. When an object proposition – that is, a legal proposition describing an obligation – has validity, it is described in the legal society that "there is an obligation." Accordingly, in the legal domain, or, more specifically, in judicial relations, when a settlement is reached, it is, in summary, a settlement of what kind of legal object proposition is existent or valid. The validity of an object proposition is described by a meta proposition. Consequently, in the legal domain, the kind of obligation that exists is decided by the validity of the meta proposition that describes the validity of the object proposition. The validity of this meta proposition is ordered by various other meta propositions. When all is said and done, the legal domain is one that delineates various legal propositions derived through reasoning from actual facts, which is related to various meta propositions that are valid in certain times at certain places, or, in short, in a certain context.

Legal propositions, thirdly, are classified as elementary propositions and complex propositions. Legal propositions have names, and one unit rule of a legal proposition is endowed with one unique name. When several legal propositions are combined and grouped together, this group is also given a name. The former are called elementary propositions, and the latter are called complex propositions.

In determining the validity of complex propositions, it is not necessary to separately determine the validity of the individual propositions. The various legal propositions here do not exist separately, but form a mutual relationship and a system. In that respect, it is essential to know the kind of combination and system that those legal propositions mutually form. To know the connection among legal propositions is to know the system of law. The legal system is organized as the logical relationship among the three aforementioned pairs of legal propositions. In that regard, the legal meta rules, in which positive law provisions act as precedents, are validated, and through the placement of the various provisions of the positive law under this framework, a logical systematization becomes possible. Based on this legal system, we constructed the legal knowledge-base system, LES-5, of the United Nations Convention on Contracts for the

International Sale of Goods (hereinafter CISG). By using LES-5, students can properly learn the general logical structure of the law.

In order to establish legal knowledge, based on the understanding of the general logical system that accompanies the legal knowledge, it is necessary to carry out this creation by synthesizing two sides: the process side that embodies the meaning of the law, in order to apply it to concrete examples; and the side that systematizes legal knowledge by placing the various legal regulations in their systematic relationship, under the framework of the general legal knowledge logic system, in order to make the solutions of the various concrete examples justifiable.

Better understanding is promoted through comprehension of both the general logic system and legal structure of legal knowledge and the basic framework of legal creation, and also through the application of legal knowledge to concrete problem-solving. It can be beneficial to use the knowledge-base system in this area.

3.2 Learning of systematization of legal knowledge

We previously explained that the creative side of legal interpretation is the methods of creating the meaning of the law and the methods of systematizing laws, but this paper will abbreviate the creation side and focus on the systematization of legal knowledge.

Systematic legal thinking, is not something scattered among individual bits of legal knowledge, but rather, is something within its systematic relations. Legal specialists already possess, in addition to common-sense legal terms, the principle knowledge necessary to integrate legal knowledge, and in utilizing this have the ability to systematize and comprehend all kinds of legal knowledge⁸, especially legal articles.

Here, systematization is the construction of a deductive-reasoning system. This deductive-reasoning system is not a pre-existing entity determined beforehand through legal problem-solving, but is appropriated through a fixed framework and constructed in concrete detail in order to justify the problems' solutions. Furthermore, although the legal knowledge system is a dynamic system in comparison to the deductive-reasoning system of domains such as mathematics and natural science, it could be considered in certain situations, and from certain points of view, to have a deductive-reasoning system similar to that of natural science.

This systemic ability is the ability to construct a deductive-reasoning system. Deductive reasoning in law is not a given system. To systematize the law is not to recognize a given system, but to create a system. People who attempt to understand the law have to create it themselves. Actual legal regulations in themselves do not compose a strict system. People who apply and interpret the law systematize it themselves. The systematization of law is creative legal thought.

⁸ This knowledge includes meta knowledge related to the application of knowledge. It can be thought that systematic legal thought may be the ability to compose reasoning of deductive justification using this meta knowledge.

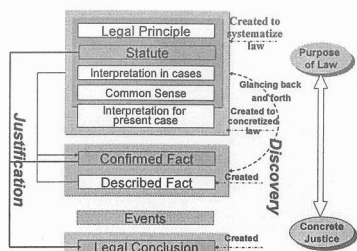


Figure 2. Structure of Legal Inference with Concretization and Systematization

Students who aspire to be the legal professions must develop this systematic thinking ability in themselves. Law schools must also provide this training. In order to instill this systematic legal thinking in students, first, it is useful to (1) explicitly present this general system structure of legal knowledge. Moreover, it is also effective to (2) actually put this legal knowledge to use: that is, to practice reasoning through the application of legal knowledge to problem-solving. In addition, (3) it is vital for the students themselves to practice systematization of legal knowledge. By carrying out the systematization themselves, students can develop systematic legal thought.

Utilization of the legal knowledge-base is effective for (1) and (2), while creation of the legal knowledge-base is effective for (3). We will explain (3) in more detail, namely by discussing examples of legal systematization by students applying the CISG to the hypothetical problems.

4. EXAMPLES OF TRAINING OF ABILITY IN LEGAL SYSTEMATIZATION

At first, the target domain is the CISG. Let us consider three types of examples, such as those in Table 1 below⁹.

Here, certain articles of the CISG apply. In Figure 2 above, it is the systematization of legal creative reasoning that discovers the applicable portion of the legal principle.

The relevant CISG articles are as follows:

Article 23

A contract is concluded at the moment when an acceptance of an offer becomes effective

⁹ In actuality, this is taught using six examples, but for ease of explanation, we will simplify the demonstration by only using three examples.

Table 1. Three Example Problems

	Date	Problem 1	Problem 2	Problem 3
Events	4/1	On April 1, A sent a letter to B indicating that A would sell farming machines for \$10,000.	Same as Problem 1	Same as Problem 1
	4/7		On April 7, A called B and said, "I sent a letter indicating that I would offer to sell farming machines for \$10,000, but I would like to withdraw my offer."	On April 7, A sent a letter to B saying, "I sent a letter indicating that I would offer to sell farming machines for \$10,000, but I would like to withdraw my offer."
	4/8	The letter with the offer arrives to B on April 8.	Same as Problem 1	Same as Problem 1
	4/9			On April 9, the letter that A sent on April 7, withdrawing A's offer, arrives to B.
	4/10	On April 10, B called A and said, "I accept your offer."	On April 10, B called A and said, "I accept your offer."	On April 10, B called A and said, "I accept your offer."
	?	Was the contract completed, and if so, when?	Was the contract completed, and if so, when?	Was the contract completed, and if so, when?

Article 15

- (1) An offer becomes effective when it reaches the offeree.
- (2) An offer, . . . , may be withdrawn if the withdrawal reaches the offeree before or at the same time as the offer.

Article 16

- (1) Until a contract is concluded an offer may be revoked if the revocation reaches the offeree before he has dispatched an acceptance.

Article 17 An offer, . . . , is terminated when a rejection reaches the offeror.

Article 18

- (2) An acceptance of an offer becomes effective at the moment the indication of assent reaches the offeror

Upon directing students to construct a knowledge-base to solve Problem 1, the students generally begin systematizing as shown in the following Figure 3.

This systematization adds Article 23 of the CISG to the knowledge-base as a direct prerequisite to Article 18 (2). Even

through this systematization, in Problem 1, one can deduce the conclusion "the contract was concluded on April 10" (that itself is correct). However, the Article 15 (1) rule, "The offer becomes effective when it reaches the offeree," is applicable in reality, but has not been applied at all here. Thus, this systematization overlooks the fact that "the effectiveness of the offer" is an essential requirement for the completion of a contract. We then alter the hypothetical problem, presenting Problem 2 to the students and directing them to solve it. In this new example, "The contract is not concluded" is the correct answer, but the above systematization will not lead to that conclusion. That is where students revise their knowledge-base. Figure 4 is the students' revised systematization.

In Figure 4, the students add the offer's effectiveness as one requirement to conclude the contract. Thus, they establish a statute regarding contract conclusion, the "contract law statute," that integrates the rules, "An offer becomes effective when it reaches the offeree" (15(1)) and "Consent becomes effective when it reaches the offeror" (18(2)), and succeed in a systematization that is improved from the previous response. With this systematization, the correct conclusion can be reached in both Problems 1 and 2. We then present Problem 3 to the students and ask them to reconsider. Keeping this systematization as it is, the correct conclusion does not emerge because students cannot properly address the fact that the cancellation of the offer

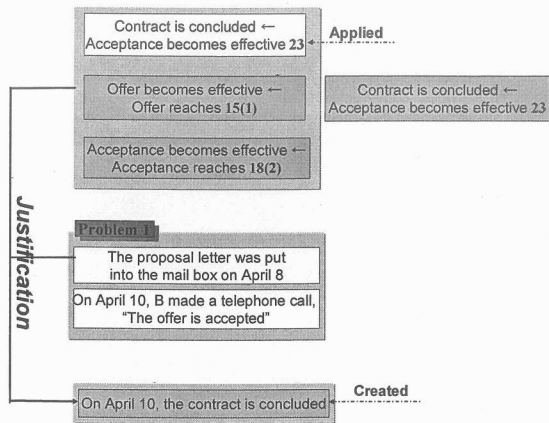


Figure 3. A Student's Systematization to Problem 1

dissolves the contract's validity. The students are made to attempt systematization again, and they submit response.

Through this systematization, the cancellation of the offer is effective, and the offer's effectiveness is lost, thus proving that the contract is not concluded. Students realize through this systematization that not just validation of the offer, but the offer's effectiveness at the time of agreement is needed to conclude the

contract, and on that basis have arrived at a much more appropriate systematization as shown in Figure 5.

Though the scope may be limited, this manner of constructing a legal knowledge-base and applying it to various problems achieves the legal thinking ability to systematize the law.

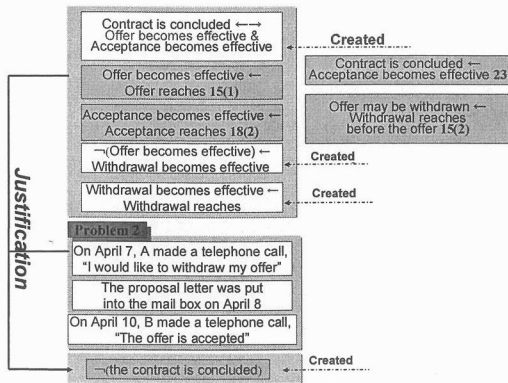


Figure 4. A Student's Problem 2

Systematization to

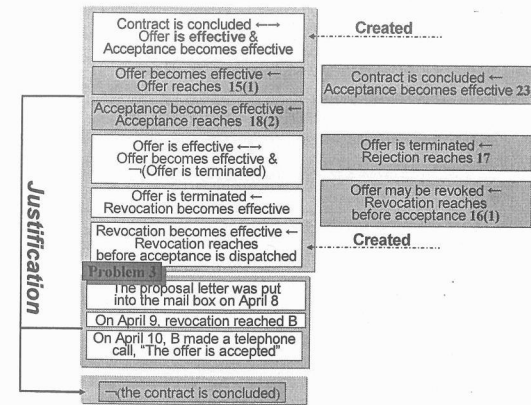


Figure 5. A Student's Systematization to Problem 3

5. A SOFTWARE SYSTEM FOR SUPPORTING OUR EDUCATION METHOD

This section describes a software system for supporting our education method. The software system is currently being implemented on a Web application server.

5.1 System overview

While our education method needs an ability to construct a knowledge-base, it is not so easy task for a student as a novice programmer. To alleviate the task, an editor and an inference engine have been designed on a Web application server. As a Web application server, Zope[6], which is an open source Web application server written in python, is selected as a platform. Zope is composed by ZODB, which is an object oriented DB manager and Zpublisher, which outputs HTML files from ZODB. Plenty of knowledge-bases, which are generated or abandoned by students in our education method, can be stored in ZODB as objects. Furthermore, Plone[7], which is a product to construct a Portal site on Zope, is used to manage user accounts. By using Zope/Plone, the learning history of each user will be accumulated. Since the accumulated learning history can be used for analysis of learning effect, example problems or instruction strategies will be refined based on the analysis.

5.2 Structured editor on Web

For a student of graduate law schools, it is not so easy to understand the syntax of a logic program such as Prolog and the

notion of "term." If all of students knew the syntax and notion of "term," our method could be directly applicable. However, since few of students are assumed to have programming knowledge, some assistant system should be prepared. In such a system, editing knowledge should be utilized.

Since HTTP is mainly implemented by only POST and GET operations, the interaction between the server and the user is very restrictive to implement an editor. A structured editor is well-known as an editor for lisp programs and it works on teletype terminals. In other words, the structured editor of lisp works well on a half duplex communication line. The behavior of the structured editor is very simple. It only reads the user's command and writes the result of user's command. Since the requirement portion of a rule proposition can be represented as a list data structure¹⁰, the structured editor of lisp is suffice to edit the requirement portion of a rule proposition. The current commands are (1) deleting an expression, (2) introducing a conjunction and (3) introducing a disjunction, and (4) introducing a negation.

After editing rule and fact propositions, students must designate a collection of rule and fact propositions. Since Zope has an object oriented ZODB, a hierarchical knowledge-base can be easily constructed by using the inheritance function.

5.3 Inference Engine

After the temporary construction of a knowledge-base, the correctness of the knowledge-base can be verified through actual

¹⁰ In the current prototype implementation, only function free logic programs are considered.

simulations. In order to solve or trace the given query, an inference engine is needed. As all of interfaces are on a Web application server, light weight inference engine is desirable. PyLog[8], which is a Prolog interpreter written in python, converts a Prolog program into python programs. As the knowledge-base is compiled into a python program, the query with respect to the knowledge-base can be directly executed as a server side script like ASP, JSP or PHP. If the query is solvable successfully, its proof tree will be presented to the user like LES-5[1][2][3][4][5]. As a result, students revise their knowledge-bases according to the result of the inference engine.

6. CONCLUSION

Legal study up to this point has been mostly a matter of the professor simply explaining law by presenting students with legal knowledge acquired through many years of study or research and telling them, "Here's what the law is." The students would imbibe that teaching, undergo rote learning, and for some students it would just go in one ear and go out the other. At any rate, students' attitudes toward education were continually passive, and their ability to creatively think for themselves was poor. Thus, the traditional legal teaching methods, which use a top-down approach, have been mostly unsuccessful.

In educational training of legal systematic thought, utilizing the legal knowledge-base system, as outlined in this paper, through application to multiple examples and problem-solving exercises, and by constructing the legal knowledge-base, students can learn and develop creative systematic thinking. Consequently, this legal knowledge-base system is designed to operate from the bottom-up, in contrast to the traditional top-down teaching methodology.

We began partly testing this educational approach in both the "Legal Method" class and "Law and Artificial Intelligence" class at Meiji Gakuin University graduate law school, which opened in April 2004; we also used this approach in the "Law and Computers" class at Keio University School of Law. We would like to say that upon its actual utilization in a classroom setting, law school students began to find their own mistakes and gradually corrected them to achieve better systematization rules. Students' reaction have been positive, including refreshed interests, and, overall, students have found this training useful in learning and acquiring systematic knowledge and general structure. Consequently, we believe that its effectiveness has, to some degree, been confirmed in the educational domain.

Regarding systematic thinking, aside from the systematization issues of legal articles and concepts explained in this paper, there is also a need for legal thought that inductively discovers laws (principles) from examples of individual judgments. Training in this legal thinking ability is the goal of education that uses case method and the Socratic Method, especially in countries that practice common law (England, the United States, etc.).

Introduction of this training is currently being tested in our country, especially in law schools. The application of information technology, especially artificial intelligence theory and technology, to this education is in demand. We are pushing forward with this experiment. Systems supporting the Socratic Method were touched on in another report. We would like to introduce education of legal deduction reasoning in a future manuscript.

The aforementioned matter is the systematization side of legal interpretation; of course, legal creation education is not on this systematization side, but rather the embodiment side, and in this area, having students create embodiment rules for concrete example problem-solving is not only possible, but also essential. The legal education base, or the construction of the legal education base, is also thought to be effective toward this purpose. Educational utilization on this side will become a key issue in the not-too-distant future.

7. REFERENCES

- [1] Hajime Yoshino et al. (eds.), *Artificial Intelligence in Law* (in Japanese). Tokyo: Soseisha, 2000.
- [2] Hajime Yoshino, Research on Development of Legal Education Methods for Creative Legal Minds -- Towards the Science of Law Creation -- (in Japanese), *Journal of the Japanese Society for Artificial Intelligence*, Vol.19, No.5, 2004, 527-529.
- [3] Hajime Yoshino, Reasoning of Legal Creation and Education for Creative Legal Mind (in Japanese), *Journal of the Japanese Society for Artificial Intelligence*, Vol.19, No.5, 2004, 530-536.
- [4] Hajime Yoshino and Seiichiro Sakurai, Legal Education for Creative Legal Mind Using the Legal Knowledge Based System (in Japanese), *Journal of the Japanese Society for Artificial Intelligence*, Vol.19, No.5, 2004, 549-554.
- [5] Hajime Yoshino, Logical Structure of Contract Law System -- For Constructing a Knowledge Base of the United Nations Convention on Contracts for the International Sale of Goods, in: *Journal of Advanced Computational Intelligence*, Vol.2 No1, Tokyo: Fuji Technology Press, 1998, 2-11
- [6] The Web Site for the Zope community. <http://zope.org>.
- [7] Plone: A user friendly and powerful open source Content Management System. <http://www.plone.org>.
- [8] Christophe Delord *PyLog -- A first order logic library in Python*. <http://christophe.delord.free.fr/en/pylog/>.