Trial for E-Learning System on Information Security Incorporate with Learning Style and Consciousness Factors

Kiyoshi Nagata(✉)
Daito Bunka University, Tokyo, Japan
`nagata@ic.daito.ac.jp`

Yutaka Kigawa
Musashino Gakuin University, Saitama, Japan

Tomoko Aoki
Heisei International University, Saitama, Japan

Abstract—In Japanese higher educational institutions as in universities, many studies and practices on e-learning have been reported, but the state of trial and errors are still continuing. Thus, we consider an e-learning system incorporating not only with learner's consciousness but also with their learning style. Our proposing system is consistent of three individual parts and one integration phase. The first part is composed of tools, methods, and facilities used to provide the e-learning environment. The second part is composed of review of theoretical or practical works on learning styles. The third part is composed of learner's consciousness factors on information security which we have studied so far. In the integration phase, the components of e-learning discussed in the first part are evaluated from learning style related psychological aspects. In this paper, we propose a trial version of e-learning system which includes several types of content with proper links to information security factors and to learning styles.

Keywords—e-learning system, learning style, consciousness factors, information security

1   Introduction

In the early 2000s, just after the e-Japan was proposed, research and argument on e-learning have been actively conducted in Japan. Learning systems using e-learning has been established to some extent in several areas such as education of employees in companies, video learning materials in language studies, so-called preparatory schools, etc. In higher educational institutions as in university's education, many studies and practices on e-learning have been reported, but the state of trial and error are still carried out. The difference between the situation of companies, preparatory

school and language teaching material learning and that in university is thought to be the learning motivation of learners. In Japan, universities or junior colleges students select classes from various motives, and not everybody is interested in the lecture contents nor enthusiastic to acquire knowledge, and it is difficult to deal with learners' motives and learning styles with conventional e-learning systems.

As one of methods of the active learning which have been actively advocated recently in Japan, flipped or inverted teaching is adopted and practiced in some educational institutions. E-learning systems, which are considered as personalized, interactive, self-studying system, and free from time and place constraints, are important factor for the flipped teaching. Learners can select subject or item to study at any time and from any place, and an important advantage of e-learning is that it can help to respond the diversity of each learner's motivation and his/her learning preference.

We have been investigated an e-learning system on information security which takes in account learners' consciousness and educational experience. In our previously proposed system, questionnaire on information security issues are initially posed, then calculate some fixed factors from which priority of items to study is determined. However, the subject and each item on information security issues are not so familiar to many students especially in social science studies, and it is not easy to cheer them up for self-learning. Thus, we try to propose constructing an e-learning system incorporating not only with leaner's consciousness but also with their learning style.

Our proposing e-learning system is consistent of three individual parts and one integration phase. The first part is composed of tools, methods, and facilities used to provide proper e-learning environment for learners. Here we discuss the managing cost, practical efficiency by reviewing several research papers or reports. The second part is composed of theoretical or practical result on learning styles. In this part, we discuss the learning style in psychological aspects, and focus especially on MBTI (Myers-Briggs Type Indicator), Kolb's four knowledge types, and 4MAT. The third part is composed of learners' consciousness factors on information security which we have studied by conducting questionnaire survey to some Asian countries' university students during past several years. In the integration phase, referring the table illustrating the relationship between components of inverted classroom and students' learning styles by M. J. Lage et al. ([8]), components of e-learning discussed in the first part are evaluated from learning style related psychological aspects. The consciousness factors are also linked to preferred learning styles. We consider the learning style preference can be combined with learning tools, methods, facilities, etc., and consciousness factors is mainly combined with content which learners should study. Thus, the system leads learner to his/her recommended contents to study in the learner's preferable situation suggested by learning style aspects. For these tasks, we need some functions describing the relationship among e-learning components (tools, methods, and facilities etc.) and learning style types and consciousness factors.

The ultimate goal of our research project is to develop the useful and effective total e-learning system helping learners to improve their knowledge and ethical sensitivity on information security related issues. At the time being, in order to implement our proposing system as a computer program, we need to prepare many types of educational content discussed in the first part of our paper on information security issues.

Some text based contents with scores related to the information security conscious-ness factors are already made, and a small application program was completed. Antic-ipated result in the paper is that we create a prototype which includes several types of content with proper links to both the information security factors and the learning styles. At the same time, for the improvement of the system, data on media preference in relation to psychological aspects of learning style should be accumulated. We have some plans to ask for the test usage by university students in some Asian countries.

2   E-learning - Merit and Demerit, Environment -

In recent years, e-learning has enabled communication between teachers and learn-ers, among learners, even among teachers through the advancement and spread of remarkable information technology. Here we list up various elements related to e-learning, and classify them from several aspects such as the environment, tools, meth-ods, and the other by taking into account of their merit and demerit from learners' point of view.

At first, we try to clarify the merit and demerit of e-learning, then consider the con-stitution elements of e-learning environment from those viewpoints.

2.1   Merit and Demerit

When we consider from various point of view, there are many merits and demerits of e-learning. In this paper our aim is to propose an e-learning system accompanied with learner's learning style and his/her consciousness factors especially on infor-mation security items. Thus, we focus on some merit and demerit only in learner's point of view.

Major merit and demerit. E-learning has a merit and a demerit because it may cause a change in the relationship between a conventional teacher and learners. When considering them from the learner's side, the main items are listed as below.

─ Merit for Learner
  • Free from time and place constraints
  • Learn according to individual's skill level and at one's own pace
  • Available to get uniformed or standardized lectures
  • Quick feed back from automated evaluation system
  • Self estimation of one's performance
─ Demerit for Learner
  • Difficult to sustain learning motivation
  • Difficult to solve problems on the spot such as questions
  • Difficult to interact with teachers and other learners
  • Difficult to concentrating on thinking or learning

It is said that the "blending" education of face-to-face and e-learning should be performed in a way to compensate for demerits and take advantage of merits.

2.2 E-learning environment

Here we first list up constitution elements of e-learning environment in three categories such as tools, methods, and facility or system. Then, consider some of them from certain perspectives of merits.

Tools. As hardware tools for e-learning, PC (on-line or off-line), tablet, and mobile device, equipped with web-cam, microphone, or speaker will be considered. Although an e-learning system accessible from tablet or mobile devices provide the freedom from time and place constrains, it might have disadvantage in view of concentrating on learning.

Figure 1 and Figure 2 describe the degree of hardware and software tools in the time and place freedom plane respectively. Of course, the mobile devices such as smart phone generally has higher degree of freedom both in the time and the place than tablet or personal computer (PC). However, when one should use speaker or camera, the constraint in place increase and the time for speaking via these tools might be limited.
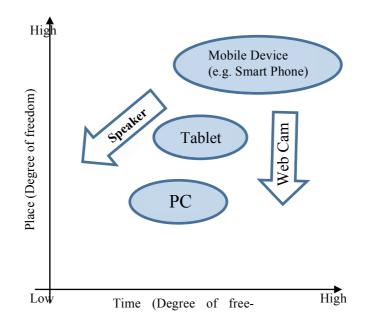

Fig. 1. Hardware Tools from Time and Place

As software tools or methods for distributing learning contents, there are many types of application related files such as audio, video, text, web page, picture, animation, presentation (with or without audio, video, etc.), and work sheets.

From the learners' perspective, watching video or listening to audio in the public place is not always effective for learning.
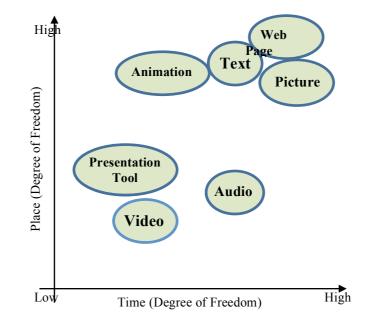
Fig. 2. Hardware Tools from Time and Place

Methods. These days, SNS (Social Networking Service) including simple blogs becomes very popular especially among younger people, and real time remote communication technologies such as Skype also becomes available with lower cost. These systems release learners from time or place constrains. Quizzes, reports, collaborative learning, on-line office hours, real or non-real time question receiving and responding system are also considered as methods for educations.

Figure 3 describes the required skill and studying pace flexibility of several methods. Using e-learning methods, learners can study at their own pace and try for quizzes whenever they think they obtain skills or knowledge on a subject.

But report assignments are sometimes imposed by a teacher with a certain deadline, and a certain skill is required to accomplish it. The collaborative learning though a real time interactive media such as Skype restricts time, and adjustment of the time with learner's colleagues is needed. When learners use SNS such as Line or facebook, it seems that they could do collaborative learning with each person's pace. But someone wait other's quick response impatiently, and many of members might feel pressure for sending replay.
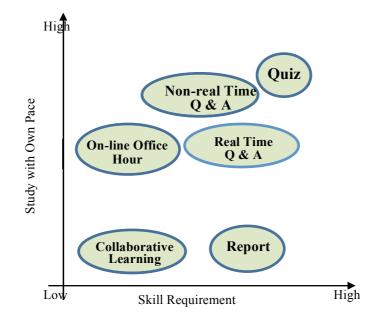
Fig. 3. Hardware Tools from Time and Place

Facilities or Systems. Several learning environments for e-learning, such as Computer-Assisted or -Aided Instruction (CAI), Computer-Based Training (CBT) and Web-Based Training (WBT), have been delivered. Learners can access them not only to get learning materials but also to see their performance level or what they should study. They also provide many systems or functions such as the attendance management, the performance evaluation and grading support, report distribution and collection function, distribution function of various information on the lecture. Some systems also provide e-portfolio or Rubric for evaluating learner's performance.

3 Learning Styles -Theoretical or Practical Works-

By using technologies of e-learning, it is becoming possible to provide learners with individualized environments. In this section, we try to look at individual differences in learning styles aiming to provide students with optimum learning environments or to have learners aware of their own learning styles so that they can choose their own optimum learning environment. There are many ways in classification of learning styles based on different theories such as theories of intelligence, experiential theories by Kolb ([7]), sensory modalities (the VARK model [4]), cognitive styles, or psychological types by Briggs Myers, see [2]. Here we refer Kolb, 4MAT in the middle layer, "Information Processing Style", of the Lynn Curry's onion model of learn-

ing style ([3]), and MBTI (Myers-Briggs Type Indicator) in the inner layer, "Cognitive Personality Style".

3.1   Kolb's Learning Style

Kolb's learning style (1984) is one of the best-known and widely used learning style theories. He believed that our individual learning styles emerge due to our genetics, life experiences, and the demands of our current environment. In addition to describing four different learning styles, Kolb also developed a theory of experiential learning and a learning style inventory.

As shown in Table 1, a person with a dominant learning style of "doing" rather than "watching" the task, and "feeling" rather than "thinking" about the experience, will have a learning style which combines and represents those processes, namely an "Accommodating" learning style, in Kolb's terminology. This type of learner solves problems in an intuitive, trial-and-error manner, and sometimes seen as impatient.

A person with a dominant learning style of "watching" rather than "doing" the task, and "feeling" rather than "thinking" about the experience, will have a learning style which combines and represents those processes, namely an "Diverging" learning style. This type of learner views situations from many perspectives, adapts by observation rather than action, and interested in people.

A person with a dominant learning style of "watching" rather than "doing" the task, and "thinking" rather than "feeling" about the experience, will have a learning style which combines and represents those processes, namely an "Assimilating" learning style. This type of learner is more concerned with ideas and abstract concepts than with people, and thinks that the logically sound idea is more important than practical one.

A person with a dominant learning style of "doing" rather than "watching" the task, and "thinking" rather than "feeling" about the experience, will have a learning style which combines and represents those processes, namely an "Converging" learning style. This type of learner does best in situations like conventional intelligence tests, and prefers dealing with technical problems rather than interpersonal issues.

Table 1. Kolb's Learning Styles

	Doing (AE) **Active Experimentation**	**Watching (RO)** **Reflective Observation**
Feeling (CE) Concrete Experience	Accommodation	Diverging
Thinking (AC) Abstract Conceptualization	Converging	Assimilating

3.2   4MAT

Based on Kolb's learning style theory, Bernice McCarthy developed the framework for designing learning activities named 4MAT System ([9]). There are four quadrants clock-wisely turning around in the order of "Diverging", "Assimilating",

"Converging", and "Accommodating" in the Table 1, and each quadrant has right- and left- brain modes of processing techniques. These quadrants also correspond to learner's stages as follows.

- Imaginative Learner: Demand to know 'why'. Likes to listen, speak, interact, and brainstorm.
- Analytic Learner: Want to know 'what' to learn. Likes observing, analyzing, classifying, and theorizing.
- Common-sense Learner: Want to know 'how' to apply the new learning. Likes experimentation, manipulation, improvement, and tinkering.
- Dynamic Learner: Want to ask 'what if'. Enjoy modification, adapting, taking risks, and creating.

Table 2. Instructional Events in the 4MAT System (by William G. Huitt)

	Left-Brain Activity	**Right-Brain Activity**
WHY? (Motivate and Develop Meaning) (Sensing/Perceiving)	2. Analyze/reflect about the experience (EXAMINE)	1. Create an experience (CONNECT)
WHAT? (Reflection and Concept Development) (iNtuitive/Thinking)	4. Develop concepts/skills (DEFINE)	3. Integrate reflective analysis into concepts(IMAGE)
HOW? (Usefulness and Skill Development) (Sensing/Judging)	5. Practice defined "givens" (BY)	6. Practice and add something of oneself (EXTEND)
WHAT IF? (Adaptations) (iNtuitive/Feeling)	7. Analysis application for relevance (REFINE)	8. Do it and apply to more complex experience (INTEGRATE)

source: http://www.edpsycinteractive.org/papers/4matonweb.html

William G. Huitt describes the 4MAT system for a Web-based Instruction in ([5]) like as the Table 2 where the learning process proceeds from 1. to 8. The first type of learner, the imaginative of Concrete-Random learner, demands to know "Why" he/she should be involved in the activity. The second type of learner, the analytic or Abstract Sequential learner, wants to know "What" to learn. The third type of learner, the Common-sense or Concrete Sequential learner, wants to know "How" to apply the learning. The last type of learner, the Dynamic or Abstract-Random learner asks "If" this is correct how can one actively modify it to make it work for one-self. He also indicates each type of learner to the MBTI, and we describe them at the end of each row in the first column of the Table 2.

3.3   MBTI

As a prominent psychological type theory based on Jung's psychological types, we focus on the MBTI ([10]) developed by Katherine Cook Briggs and Isabel Briggs Myers. Here, let's take a look how a person's preferences in terms of Jung's and Briggs Myers' approach to personality type may influence learning styles. MBTI is the preference of general attitude with four dimensions such as Extroverted (E) vs. Introverted (I), Sensing (S) vs. iNtuition (N), Thinking (T) vs. Feeling (F), and Judging (J) vs. Perceiving (P), as described in Table 3.

The E/I dimension which is very similar to Kolb's AE/RO dimension reflects the direction of an individual's general interest and, indicates where one's interests and motivation lie. Person high on extroversion tends to be doer, while one high on introversion tends to be watchers. An introvert's motivation and interests primarily stem from and are driven by their inner world, whereas an extrovert is primarily motivated by the world outside of oneself, and most of interests are externally focused. This pair of styles is concerned with the direction of one's energy. If one prefers to direct the energy to deal with people, things, situations, or the outer world, then his/her preference is for extroversion.

The N/S dimension reflects the preference perceive for the world and thinking. Person high on the intuition has the preference perceive for the world and thinking in broader categories, whereas one with sensing have that in a more concrete and direct way. This pair concerns the type of information or things that one process. If one prefers to deal with facts, what you know, to have clarity, or to describe what you see, then his/her preference is for sensing. If one prefers to deal with ideas, look into the unknown, to generate new possibilities or to anticipate what isn't obvious, then the preference is for intuition.

The F/T dimension is very similar to Kolb's CE/AC dimension. Person high in the feeling and concrete experience areas tends to be more focused on the here-and-now, while one high in the areas of thinking and abstract conceptualization prefers to focus on theoretical concepts. Person with high on feeling preference tends to judge and respond to events based on his/her feeling, whereas one with high thinking preference tends to do it based on reason and logic. This pair reflects one's style of decision-making. If one prefers to decide on the basis of objective logic, using an analytic and detached approach, then his/her preference is for thinking. If one prefers to decide using values - i.e., on the basis of what or who one believes important - then the preference is for feeling.

The J/P dimension reflects the preference for learning style. Person high on the judging preference comprehends information in a more structured way and is likely to prefer a more systematic and structured learning process, whereas one high on the perceiving preference might favor a less rigid, more heuristic approach to learning and might prefer a trial and error method of comprehending information. This final pair describes the type of lifestyle one adopts. If one prefers his/her life to be planned, stable and organized then the preference is for judging (not to be confused with "Judgmental", which is quite different). If one prefers to go with the flow, to maintain

flexibility and respond to things as they arise, then his/her preference is for perceiving.

The MBTI was specifically designed as a tool to categorize individual's personality type in general, and to address the approaches to make relationships with others. For this reason, the MBTI differs in tone from other influential personality trait theories, by being more positive or neutral in its descriptors. This aspect may account for its influence in the learning style's field, where theorists who have drawn upon it have tended to emphasize descriptors of normal behavior and actions, rather than the identification of pathological traits or tendencies.

Table 3. The Components of MBTI Type

E/I	S/N	T/F	J/P
"Attitudes or orientations of energy"	"Functions or processes of perception"	"Functions or processes of judging"	"Attitudes or orientations toward dealing with the outside world"
Extraversion (E) Energy is directed "mainly toward the outer world."	**Sensing (S)** Focus is "mainly on what can be perceived by the five senses."	**Thinking (T)** "Basing conclusions on logical analysis with a focus on objectivity and detachment."	**Judging (J)** Preference for "decisiveness and closure that result from dealing with the outer world using… Thinking or Feeling," the Judging processes.
Introversion (I) Energy is directed "mainly toward one's inner world."	**Intuition (N)** Focus is "mainly on Perceiving patterns and interrelationships."	**Feeling (F)** "Basing conclusions on personal or social values with a focus on understanding and harmony."	**Perceiving (P)** Preference for "the flexibility and spontaneity that results from dealing with the outer world using… Sensing or Intuition," the Perceiving processes.

source: Myers et al. MBTI manual (1998)

Combining the letters associated with each preference, we get the Myers Briggs personality type. For example, having preferences for E, S, T and J gives the personality type of ESTJ. Thorne and Gough([11]) picked out 10 most common types by mentioning with some positive and negative traits as follows.

- [**INFP**] Artistic, reflective, sensitive ⟺ Careless, lazy
- [**INFJ**] Sincere, sympathetic, unassuming ⟺ Submissive, weak
- [**INTP**] Candid, ingenious, shrewd ⟺ Complicated, rebellious
- [**INTJ**] Discrete, industrious, logical ⟺ Deliberate, methodical
- [**ISTJ**] Calm, stable, steady ⟺ Cautious, conventional
- [**ENFP**] Enthusiastic, outgoing, spontaneous ⟺ Changeable, impulsive
- [**ENFJ**] Active, pleasant, sociable ⟺ Demanding, impatient
- [**ENTP**] Enterprising, friendly, resourceful ⟺ Headstrong, self-centered
- [**ENTJ**] Ambitious, forceful, optimistic ⟺ Aggressive, egotistical
- [**ESTJ**] Contented, energetic, practical ⟺ Prejudiced, self-satisfied

4   Learners' Consciousness Factors on Information Security

We have proposed an e-learning system based on research on information ethics of foreign students since 2003. In many Japanese universities and colleges, there are lectures on information ethics, and many of them are carried out on the premise of students who grew up under Japanese culture, education and social environment. However, there is no information ethics education in consideration of the social environment and the current situation of education in other countries where international students are from. Based on this idea, we thought that the information security education for each international student with different cultures and social background should be conducted.

Therefore, in 2008, we started "Developing Information Ethics Education Teaching Materials Considering Education and Legal System in the Countries of International Students". By conducting a questionnaire survey on information ethics for students from China, Taiwan, South Korea, Philippines and Singapore from 2008 to 2010 in order to know the characteristics of international students, ([6]).

During our research activities, we could notice that we should take the personal characteristics and the educational experiences into account for the education of the contents of a certain field such as information ethic and security. Since the human resource for education are not so rich to correspond to each student, an e-learning system with the potential for personalization is needed as complementary educational tools which might cope with even one's learning style, ([1]).

4.1   User Consciousness Oriented E-Learning System (prototype version)

Our having proposed e-learning system in [6] consists of two major parts, one is the data part such as database of stories categorized according to information security related issues, the other is user's interface representing stories, explanations, and so on. In this system, some stories on each topic such as copy right, personal information etc. are to be presented according to the priority values calculated from learner's consciousness factor scores.

The flow of the system is described as follows,

1. Login the system using the learner's ID and password
   (a) If it's first time to login, then ID is issued and a password is set
2. Choose the country or language from the selection box
   (a) Show the initial page of the e-learning system with selected language.
   (b) Three buttons are disposed in the "Menu Area" on the left, see Figure 4
   (c) The white box on the right, called "Presentation Area", is used for presenting user's characteristics and learning materials
3. Choose one of three buttons
   (a) If the "Attribute Q" button is selected, the attribute questionnaire sheet, see Figure 5, is displayed as an individual window, and the attribute file of the user is created or recreated,

Fig. 4. Initial Page of E-Learning System

(b) If the "Consciousness Q" button is selected, the consciousness questionnaire sheet is displayed as an individual window, and the consciousness file of the learner, in which the learner's individual scores for each of three consciousness factors are recorded is created or recreated

(c) If the "Recommended Study Stories" button is selected, learner's consciousness scores along with rating comments by comparing each score value to the average value of students in the same country, and some buttons for recommended stories appear in the "Presentation Area". The white box on the right, called "Presentation Area", is used for presenting user's characteristics and learning materials

Fig. 5. Attribute Part of Questionnaire (English version)

4. Learning is repeated by showing each story and its explanation, see Figure 6
   (a) When learner first selects the "Best Story" button, the first story that seems to be the best for the current user appears in the box just below the button, and the "Best Story" button disappears
   (b) If learner selects the "Next Story" button, the next best story will be displayed in that area
   (c) If learner selects the "Show description" button, a description about the story currently displayed in the story area will be displayed in the white box.

Fig. 6. Presentation of Consciousness Score and Story

One of unique points of the system is reflecting learner's individual and educationally experienced characters when choosing learning subjects. In this system, the fuzzy out-ranking method was applied to put each story in order. It can happen that several stories have the same order, and we can give them a dynamic order using time-dependent random number system. The data part consists of several data files, such as ID file, learner's attribute file, user's consciousness factor files, story file, and explanation files. The procedure of inner process is as follows.

1. ID file stores user ID with corresponding hash value
2. Attribute file is created when the attribute questionnaire is completed, and used to determine the preferable degrees of story categories such as "Personal Information", "Copyright", and so on
3. Consciousness factors' score file is created when the consciousness questionnaire is completed. Story file involves several stories in each category, and a vector with three value components corresponding to consciousness factors is assigned to each story. These values should have been given carefully considering the meaning of story
4. There are number of stories explanation files in which each story is explained and commented in several perspectives such as legal, ethical, Netiquette, safety, financial, etc. Especially in legal point of view, differences between laws in Japan and user's original country are taken up and explained

5   Integration of Three Parts

In our proposing system, there are two independent concepts, one is learning style and the other is learner's consciousness on information security. Figure 7 describes the image of the framework of the e-learning system.

The upper part is on content choosing process according to the learner's consciousness factors, and the lower part is constructed by integrating e-learning environments and learning style theories we referred in Section 3. M. J. Lage et al. gave a table describing the learning methods with some of learning style theoretical relations, ([8]). Following them, we give evaluation scores to the tools or methods in the Section 2.2. On the other hand, after earning learner's MBTI type, the learner is mapped on the 4MAT circle according to the value of the indicator. Then, the system determines the preference degree of each tool or method. About the content on information security, we adopted the system described in the Section 4. Thus, some recommended contents will be proposed to learn in the preferred tools or method in order with uncertainty.
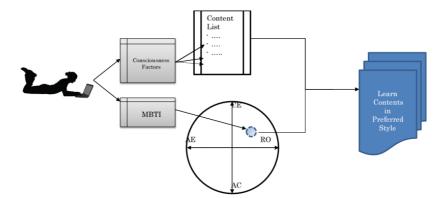

Fig. 7. Framework Image of the Proposed System

For implementing our system, we need to prepare the followings,

－ Learner's consciousness extracting system
－ MBTI generating system
－ 4MAT circle where all tools and methods is put on
－ Contents list on information security issues to be learn
－ Different types of tools and methods for each content item

Huitt pointed out that "Instructors must remember that Web-based instruction is more dependent on materials and activities than is classroom-based instruction.". Thus the critical part of our e-learning system is the corresponding function between Kolb's four learning styles or MBTI and learning material or method. Table 4 is a trial version of the correspondence where we quote most of MBTI checking parts from the table in [8]. We give the indication of learner type from the Table 2 by considering MBTI and brain types.

Table 4. Table Between Learning Tools and MBTI, Learner Type (Trail Version)

	MBTI				Brain Type	Leaner Type in Table
	E/I	*N/S*	*F/T*	*J/P*	*Left/Right*	
Tools						
PC	I				Left	
Tablet	E			P		1,2
Mobile device	E		F	P	Right	1,8
Methods						
Video	I	N		P	Right	1,3,8
Text	I		T	J	Left	4,5
Picture		N	F			3,4,7,8
Animation		N	F	P	Right	1,3,8
Audio			F			7,8
Reports	I	S	T	J	Left	2,4,5
PowerPoint		S		P		1,2,5,6
WorkSheet (group work)	E	S	F	J	Left	2,5,7
Quizzes	I		T	P	Left	2,4
Office hours (on-line)	I	S		J	Right	1,6
Chat room	E			J	Right	6
SNS	E	N	F	P	Right	1,3,8

source: Myers et al. MBTI manual (1998)

6 Conclusion

We proposed the total system of e-learning which chooses recommending contents according to learner's information security related consciousness factors in learner's preferred learning style. In order to make an application program, we have many things to clear described in the Section 5. We need to complete the Table 4 by consid-

ering much more details of tools and methods, and make the correspondence more proper.

Since the inner process programming is not difficult, on the assumption that the MBTI patent issues are resolved, we can construct a prototype system with relatively small database of learning contents in several contents type such as text, video, etc.

7 Acknowledgment

8 References

[1] Aoki, T., Kigawa, Y., Nemenzo, F., Nagata, K., E-Learning System based on User's Consciousness and Characteristic, *Proceedings of 2015 International Conference on Computer Application Technologies*, pp. 108-113, (2015) https://doi.org/10.1109/CCATS.2015.35

[2] Coffield, F., Moseley, D., Hall, E. and Ecclestone, K., *Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review*, Learning and Skills Research Centre, (2004)

[3] Curry, L., An Organization of Learning Styles Theory and Constructions, *ERIC Document*, 235 185, (1983)

[4] Fleming, N. D. and Mills, C., VARK a guide to learning styles, (1992) http://www.vark-learn.com/English/index.asp: available 2018/01/28

[5] Huitt, W., Using the 4MAT system to design web-based instruction, *Delivered at the 8th Annual Conference Applied Psychology in Education, Mental Health, and Business*, http://www.edpsycinteractive.org/papers/4matonweb.html: available 2018/01/28

[6] Kigawa, Y., Nagata, K. and Aoki, T., Multilingual E-Learning System for Information Security Education with Users' Consciousness, *Advances in Web-Based Learning - ICWL2014, Lecture Notes in Computer Science 8613*, Springer, pp. 201-206, (2014)

[7] Kolb, D. A., *Experiential Learning*: *Experience as the Source of Learning and Development*, New Jersey, Prentice Hall, (1984)

[8] Maureen, J. L., Glenn, J. P., and Michael T., Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment, *Journal of Economic Education*, Vol. 31, Issue 1, pp.30-43, (2000)

[9] McCarthy, B., Using the 4MAT System to bring learning styles to schools. *Educational Leadership*, 48(2), pp. 31–37, (1990)

[10] Myers, I. B., McCaulley, M. H., Quenk, N. L., and Hammer, A. L., *MBTI manual*: *A guide to the development and use of the Myers-Briggs Type Indicator (3rd ed.)*, Palo Alto, CA: Consulting Psychologists Press, Inc., (1998)

[11] Thorne, A. and Gough, H., *Portraits of type*: *an MBTI research compendium*,2nd ed. Gainesville, FLA: Center for Applications of Psychological Type, Inc., (1999)

9 Authors

Kiyoshi Nagata is a Professor in Faculty of Business Administration, Daito Bunka University, Japan. He received a Ph.D. degree in Engineering from Chuo University, Tokyo, Japan in 2009. His current research interests are error-correcting coding theory, information security evaluation system, and education in computer ethics. His email address is <nagata@ic.daito.ac.jp>.

Yutaka Kigawa is an Associate Professor in Faculty of International Communication, Musashino Gakuin University, Japan. He received a Master's degree in Laws from Nihon University, Tokyo, Japan in 1991, he also received a Master's degree in Economics from Dokkyo University, Saitama, Japan in 1998. His current research interests are Management Information System, information Law, and education in computer ethics. His email address is <kigawayutaka@gmail.com>.

Tomoko Aoki is a Professor in Faculty of Sports and Health Studies, Heisei International University, Japan. She received a degree of Ph.D. in psychology from Rissho University, Japan in 2003. Her current research interests are clinical psychology, collage therapy, and education in computer ethics. Her email address is <aoki@hiu.ac.jp>.