A System to Depict the Cognitive Process of Trainees Based on Multiple Skill Parameters

System validation involving normal individuals with an electrician's license

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Abstract— **Instructors of vocational training are increasingly encountering trainees, such as individuals with developmental disorders, who need special accommodations. Flexible teaching of diverse trainees requires the characteristics of trainees to be comprehensively ascertained from an educational perspective. This paper describes a system to depict the cognitive process of trainees based on multiple skill parameters to comprehensively ascertain the characteristics of trainees from an educational perspective. The system to depict the cognitive process while feeding back to the trainee skills essential for vocational training. Instructors of vocational training will give optimum instruction to each trainees based on the cognitive process generated by the system. From the simulation using the theoretical value and the verification by the field, we confirmed that the cognitive process visualization of the trainee can be performed with 32 multi-dimensional skill parameters.**

Keywords-Vocational Training; Theory of Multiple Intelligences; Action Research; M-GTA; Developmental Disabilities; Cognitive Information Processing Model.

I. INTRODUCTION

In vocational training, trainees in every age group have various vocational and educational backgrounds. Over the past few years, there have been an increasing number of situations where trainees, such as individuals with developmental disorders, need special accommodations. Instructors of vocational training have to teach them in accordance with their abilities.

In general schools for vocational training, a method to learn from causality analysis of successes and failures is used to deal with people with developmental disabilities[1] [2] [3]. However, the information obtained from this method is only the causal relationship between factors that affect a specific situation. Therefore, dealing with various situations encountered in reality is difficult. In other fields, there have been attempts to explore parameters with which to comprehensively ascertain the characteristics of subjects, and these parameters have been used in national policies and education[4]. However, parameters with which to comprehensively ascertain developmental disorders are mainly those used for diagnosis[5], and there are no parameters from an educational perspective.

Until now, there are training practices that use evaluation scales such as interpersonal skills and social skills[6] [7]. In addition, a system to measure skill gap by measuring physical exercise skill using a haptic device has been reported[8] [9]. However, these efforts target specific skills necessary for vocational training.

This paper describes a system to depict the cognitive process of trainees based on multiple skill parameters to comprehensively ascertain the characteristics of trainees from an educational perspective. The system to depict the cognitive process while feeding back to the trainees skills essential for vocational training. Instructors of vocational training will give optimum instruction to each trainee while judging whether the deficient multiple skill parameters are due to under-experience or ability based on the cognitive process generated by the system.

II. A THEORETICAL MODEL OF TEACHING COMPETENCIES FORMATION PROCESS OF VOCATIONAL TRAINING INSTRUCTORS

In vocational training, conventional teaching methods do not work, and struggling to respond to trainees who need consideration to cause unexpected reactions and behaviors. From such a problem, the purpose of this study is to realize evidence-based training from the cognitive process of trainees generated by the system. In a previous study, the current authors analyzed the development of teaching competencies in experienced instructors of people with developmental disabilities using a modified grounded theory approach [10].

Figure 1 shows a theoretical model of teaching competencies formation process of experienced instructors(hereinafter referred to as the theoretical model). This theoretical model was constructed by M-GTA. The M-GTA makes unique modifications to technique, improving GTA [11] for greater practicability, developed by Kinoshita. Unlike GTA, M-GTA does not use technique of slicing data, but uses the concepts of the Analytical Theme and Analytically-Focused Person[12]. M-GTA is an inductive method for creation of a theoretical model, requiring skill and experience in analysis and involving a high degree of
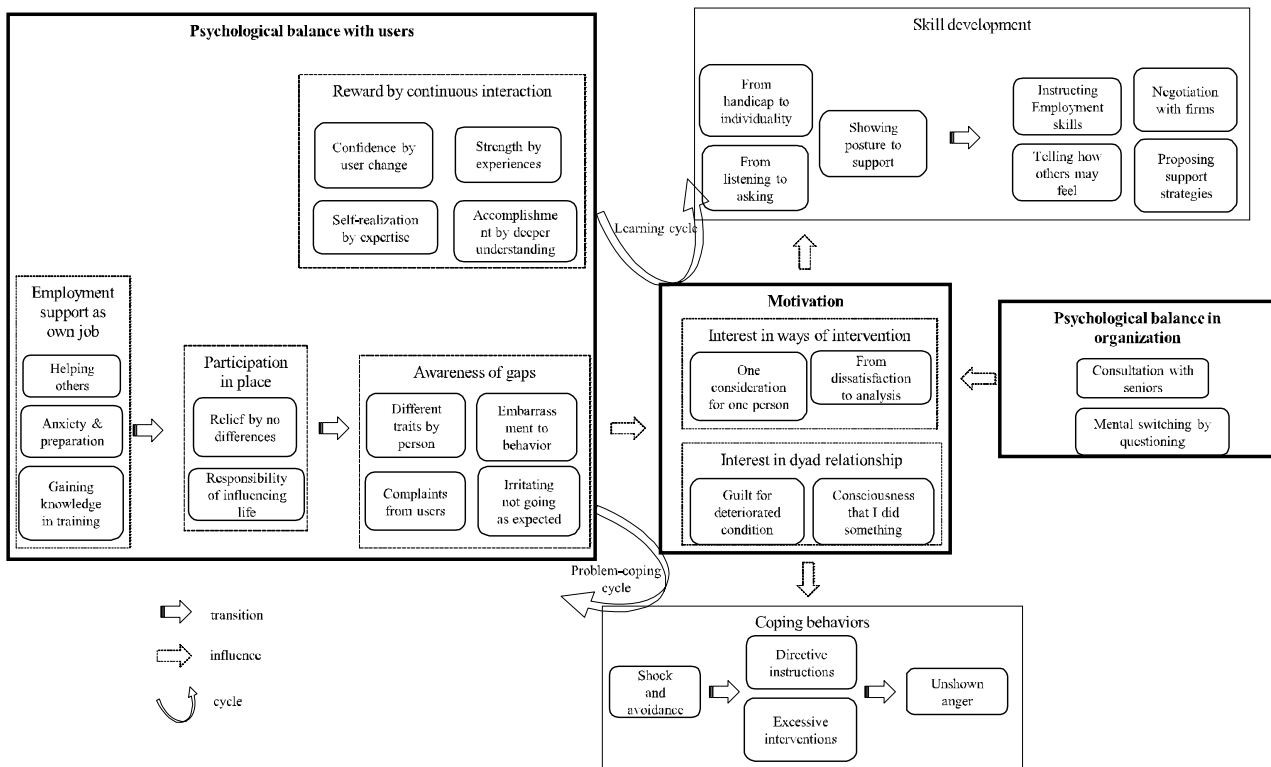
Figure 1.   A theoretical model of teaching competencies formation process of experienced instructors (Details of the concept are shown in Figure 6.)

TABLE I.   INTERVIEW GUIDE

No	Questions
1	Please tell me about your current job. (A) responsible work, (b) teaching skills, (c) stakeholders
2	Please tell me about your experience of employment assistance. (A) year, (b) content, (c) number of students
3	Compared to the past, is the concept of trainees different from now? (What triggered the event)
4	Compared to the past, is the way of teaching trainees different from now? (What triggered the event)
5	Compared to the past, is the relationship with the trainee different now?
6	What kind of troubles or problems you have ever had?
7	What kind of idea did you do?
8	When do you feel joy, pleasure, rewarding?
9	In the beginning, what did you most want?
10	What is the biggest problem at work?

difficulty. Dr. Takeshita, one of the authors, is a supervisor of the M - GTA Study Group and has sufficient experience.

This theoretical model was constructed by semi-structured interview with 15 senior instructors who specialize in teaching people with developmental disabilities. The semi-structured interview was conducted by the interview guide shown in Table 1.

In this theoretical model, Instructors first are interested in investigating the causes of problems dealing with persons with developmental disabilities by recognizing their lack of experience. Then, instructors will "skill formation" against "user" and "organization". The instructors will grow to become an experienced instructor through such "learning

cycle". If a problem-coping cycle occurs, instructors become frustrated that trainees fail to meet their expectations and instructors see no way out. The plight of people with developmental disabilities worsens, and instructors who are "Interested in ways of intervention" fall into a Problem-coping cycle as they become "Coping behavior". To escape from such a Problem-coping cycle, it is necessary to make a "Psychological balance in organization" by consultation with seniors and mental switching by questioning. In other words, the theoretical model shows the need to improve the environment of "Psychological balance in organization" and the smooth circulation of "learning cycle ".

The basic approach to this study is to adopt an action research methodology involving mutual feedback of

"theories" and "practice." This system realizes "skill development" by circulating "learning cycle" in the theoretical model. The multiple skill parameters are a common measure for "skill development". By storing best practices with multiple skill parameters as key, we can construct a training environment based on evidence.

III. DEPICTION OF THE COGNITIVE PROCESS OF TRAINEES

In Section3, we describe depiction of cognitive processes of trainees. The system measures skill factors that cause trainee's unexpected reactions and behaviors from actions selected in a part-time job interview and training at a family restaurant. The trainees will deepen the recognition of his / her skills while receiving feedback on the selected actions. The vocational training instructors decide the overall class guidance and individual guidance from the state of the skill output by the system, and aims to train all participants.

A. Definition of theoretical construct

Depiction of the cognitive process of trainees are realized by three processes: definition of theoretical constructs, design of questions by stories, and implementation in the system. This section describes definition of the theoretical construct. A theoretical construct abstracts cognitive patterns from human behavior and predict human behavior.

Figure 2 shows the theoretical construction based on the cognitive information processing model of Card[13]. The theoretical construct is based on a simple Card cognitive information processing model which is easy for the instructors to understand. The cognitive information processing model of Card is widely known in the cognitive science field trying to understand the intellectual system and the nature of intelligence from the viewpoint of information processing. Card's cognitive information processing model consists of three systems, "perception system", "cognitive system", and "motor system", and each system includes a memory and a processor. However, since human perception is known to have a deep relationship with psychology, we define a theoretical construct that consists of four systems that add "emotional system". The multiple skill parameters of "cognitive system" and "motor system" are measured by computer. Meanwhile, "perception system" and "emotion system" are measured by instructors by trainee observation.

The multiple skill parameters are the root of problem behavior in vocational training and are the minimum elements for instructor to develop teaching skills. Many problem behaviors in vocational training are thought to have resulted from a combination of 32 multiple skill parameters. Instructors learn basic countermeasure strategies for each multiple skill parameters, and as a next step, respond to the combined case.

Extraction of multiple skill parameters is extracted from 192 cases occurred in the vocational training written in "Support and correspondence guide for trainees who need special consideration" published by Japan Organization for Employment of the Elderly[14]. Dr. Fukae is one of the authors of this book. Multiple skill parameters are extracted based on a theoretical construct by inductive reasoning

which considers the cause from the problem behaviors in vocational training. The extracted multiple skill parameters are classified into six categories in the MI theory shown in Table 2. In the MI theory[15], " Naturalistic " " Musical-rhythmic and harmonic " exists in addition to these six categories, but excluded because they are intelligences not related to vocational training. The MI theory advocates that the human frame of mind is 8 intelligences. Educational practices of MI theory are widely practiced in the world[16][17].
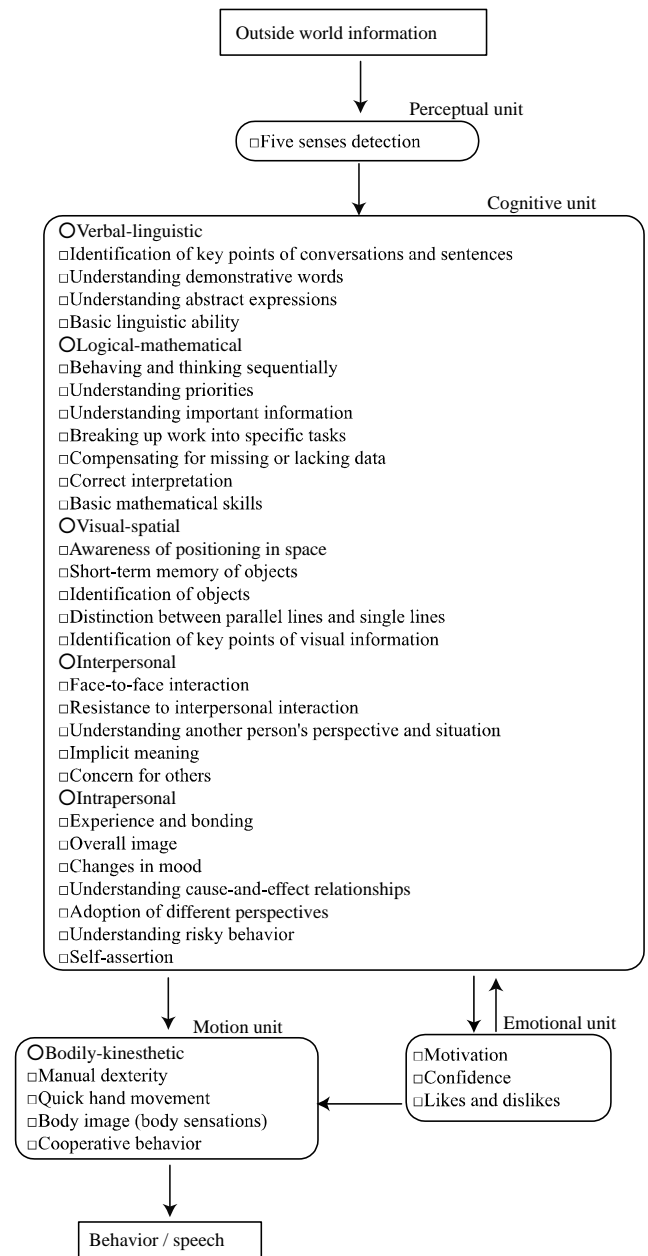

Figure 2.   Cognitive information processing model using Card

TABLE II.   MULTIPLE SKILL PARAMETERS CATEGORIES

Multiple intelligences	Characteristic	Typical example
○Verbal-linguistic (Vl)	Word smart	I like the teaching materials explained in detail.
○Logical-mathematical (Lm)	Number reasoning smart	I like to be reasonably explained.
○Visual-spatial (Vs)	Picture smart	I like to think about while drawing.
○Bodily-kinesthetic (Bk)	Body smart	I like to memorize with the body.
○Interpersonal (Ie)	People smart	I like to learn in groups.
○Intrapersonal (Ir)	Self smart	I like to learn while looking at examples.

TABLE III.   MULTIPLE SKILL PARAMETERS

Multiple skill parameters	Typical example
○Verbal-Linguistic Vl1: Identification of key points of conversations and sentences Vl2: Understanding demonstrative words Vl3: Understanding abstract expressions Vl4: Basic linguistic ability	Copying unnecessary information from a blackboard into a notebook. Only understands words superficially. Unable to understand sarcasm or indirect references. Has difficulty reading.
○Logical-mathematical Lm1: Behaving and thinking sequentially Lm2: Understanding priorities Lm3: Understanding important information Lm4: Breaking up work into specific tasks Lm5:Compensating for missing or lacking data Lm6: Correct interpretation Lm7:Basic mathematical skills	Confused by a complicated description of steps involved in wiring. Unable to understand what to do when instructed to perform several tasks. Confused when several friends talk at the same time. Unable to appropriately allocate time when taking a test. Fails to understand when a conversation is not logical. Becomes upset after mistaking instruction directed at another student as intended for oneself. Has difficulty performing simple calculations.
○Visual-spatial Vs1: Awareness of positioning in space Vs2: Short-term memory of objects Vs3: Identification of objects Vs4: Distinction between parallel lines and single lines Vs5: Identification of key points of visual information	Collides with objects and desks more often than other students do. Confused when an instructor returns to a previous slide to explain a point. Cannot draw a straight line (either by freehand or with drafting equipment). Cannot clearly draw a double line. Cannot adeptly hit a ball or shuttlecock with a bat or racket.
○Bodily-kinesthetic Bk1: Manual dexterity Bk2: Quick hand movement Bk3: Body image (body sensations) Bk4: Cooperative behavior	Beautifully written script and notes. Unable to copy information from the blackboard during class. Often hits his hand when using a hammer. Has difficulty choosing clothing appropriate to the season due to hypersensitivity.
○Interpersonal Ie1: Face-to-face interaction Ie2: Resistance to interpersonal interaction Ie3: Understanding another person's perspective and situation Ie4: Tacit understanding Ie5: Concern for others	Always alone in class. Agonizes when working in a group or in a lab. Unable to converse if a friend suddenly strikes up a conversation. Fails to understand when called on rule violations during a game. Coolly points out things people may be self-conscious about.
○Intrapersonal Ir1: Experience and bonding Ir2: Overall image Ir3: Changes in mood Ir4: Understanding cause-and-effect relationships Ir5: Adoption of different perspectives Ir6: Understanding risky behavior Ir7: Self-assertion	Is always exploring something. Unable to envision the positioning of parts when drawing a schematic. Strikes things when he dislikes something. Unable to envision his position or role as part of a team. Starts work without knowing or even thinking about procedures. Preoccupied with comics or games during class. Immediately asks a question if he is curious about something.

Table 3 shows the details of the multiple skill parameters. The multiple skill parameters consists of 32 in six categories in MI theory. The minimum factor for the instructors to develop teaching skills are the correspondence to the case shown in the typical case in Table 3. After that, instructors will be able to teach closer to experienced instructors by learning correspondence to typical cases combined cases.

B.   Design and implementation of questions with story by cartoon

Next, design and implementation of questions with story by cartoon. Questionnaires using psychometric measures are commonly used for grasping behavior with psychological phenomena. However, question papers written in language have problems such as dependency on language

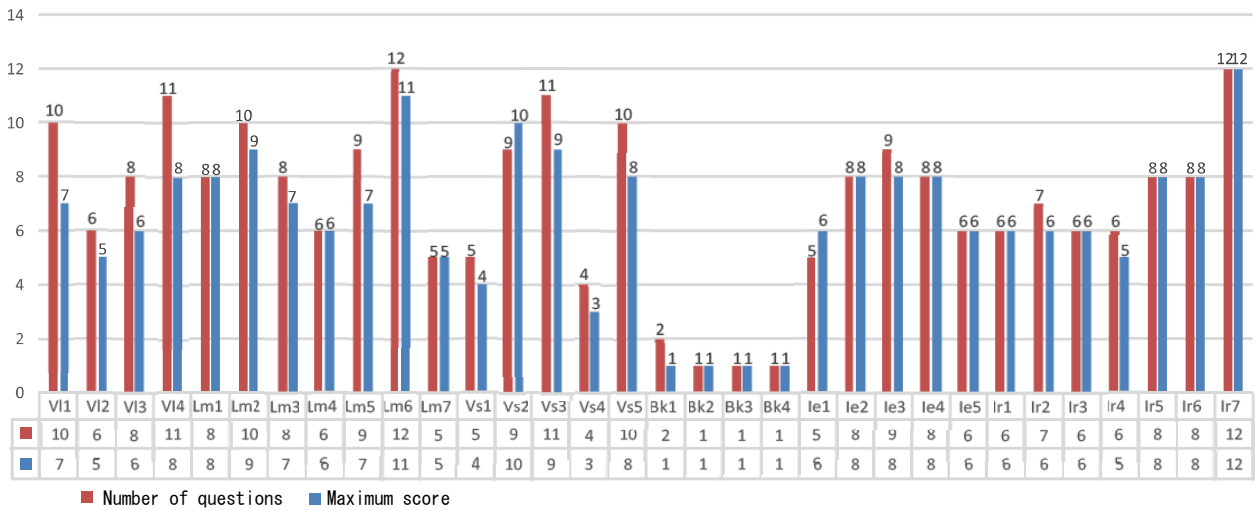|	Vl1	Vl2	Vl3	Vl4	Lm1	Lm2	Lm3	Lm4	Lm5	Lm6	Lm7	Vs1	Vs2	Vs3	Vs4	Vs5	Bk1	Bk2	Bk3	Bk4	Ie1	Ie2	Ie3	Ie4	Ie5	Ir1	Ir2	Ir3	Ir4	Ir5	Ir6	Ir7
■ Number of questions	10	6	8	11	8	10	8	6	9	12	5	5	9	11	4	10	2	1	1	1	5	8	9	8	6	6	7	6	6	8	8	12
■ Maximum score	7	5	6	8	8	9	7	6	7	11	5	4	10	9	3	8	1	1	1	1	6	8	8	8	6	6	6	6	5	8	8	12

Figure 3.   Number of questions and scores of the system

comprehension degree, difficulty in deeply grasping inner side in linguistic expression, existence of false and socially desirable answers[18]. Therefore, it is difficult to guarantee "reliability" and "validity" in vocational training conducted in various "age", "occupation history", "learning history". Therefore, this system develops a system with a story by cartoon, not questionnaire by language. To set up questions, make the case shown in Table 4 on an episode basis. After that, we implemented questions with a comic story on the system, implemented on the group of subjects to be measured, and repeated individual interviews to ensure practical "reliability" and "validity".This system converts typical cases of multiple skill parameters into context to work part-time at family restaurant. Trainees have visualized cognitive processes by choosing actions in the context of performing work at family restaurants. The standard implementation time is 30 minutes. The total number of questions are depending on the answer and is 24 to 34 subjects. The question format has problems involving work on the computer and questions asking actions in 5 alternatives. In the question of asking actions by choosing one of the five questions, we always have the option of "I do not know". In addition, although it does not count to the number of questions, as a reference information, it is a free description formal, and prepares a question "hobby" and " requests from my teacher". Development of the system is made with ArticulateStoryline[19] authoring tool for e-learning which is widely prevalent globally.

Figure 3 shows the number of questions and scores of the system. Depending on the multiple skill parameters, the number of questions and points involved are different. There are not only plus points but also minus points as options. For example, Vl1 has a maximum score of 7 for 10 problems. The number of related questions and the score are determined normatively between members. Also consider the independence of the six categories in the MI from the score. In the trial production of the system, one question was associated with one multiple skill parameter. However,
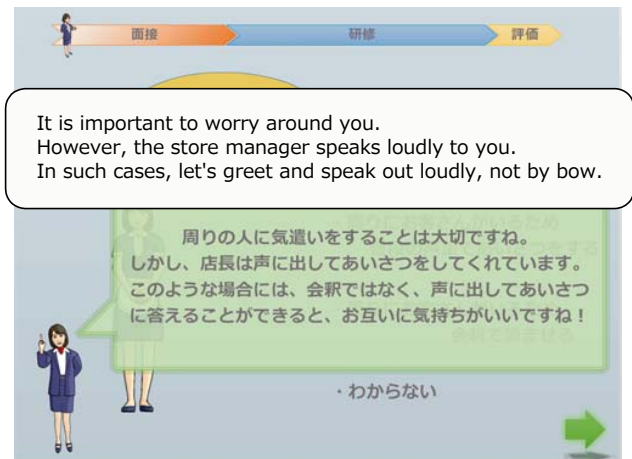

Figure 4.   An example of feedback to the trainees

without increasing the number of questions, accurate viewpoints of this study demonstrated that the cognitive process of the trainees can depict thirty-two multiple skill parameters from 34 questions(Total number of questions 274 in Figure 3).

Figure 4 shows an example of feedback to the trainee. This example is the scene of the first greeting to the manager with part-time job interview. People differ in behavior depending on skill characteristics. For example, some people greet themselves with a small voice, paying attention to people around outside, others always say a loud voice regardless of the surrounding circumstances. That is, the skill characteristics are related to the actions to be selected. The system depicts the cognitive process of the trainees based on which skills are emphasized. After the trainees respond, the system will feed back to the socially desirable direction that respects the individuality of the trainees. The role of many feedbacks is to inform trainees of the characteristics of their

cognitive processes and to realize training in which both trainee and instructor cooperate.

Figure 5 shows a question example with a branching structure. This is a scene where the store manager instructs to take an order machine. If you can not take the order machine
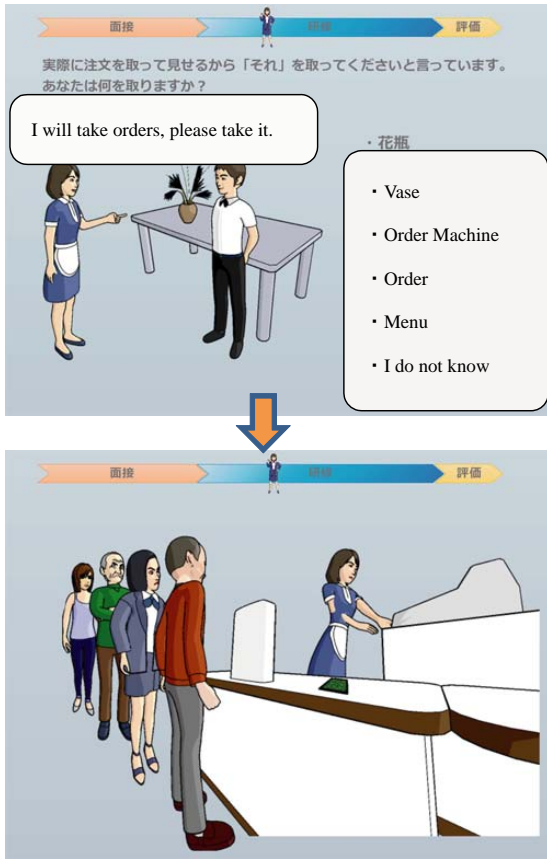

Figure 5.   A question example with a branching structure

correctly, it will become a scene where customers waiting for accounting will get angry for slowly working clerks. The multiple skill parameter common to these two scenes is "tacit understanding" in the conceptual model of Figure2. If there is only one trainee who does not have the skill of "tacit consent", the overall guidance of the class will teach using the language, gesture, model, body using the sequential proximity method based on behaviorism[20]. Until now, the usefulness of overall guidance design that matches the skill characteristics of individual classes has been confirmed in practical cases of active learning[21] using Just-In-Time[22] Teaching. In this way, this system is useful for both guidance design and individual guidance design of the whole class.

IV.   EVALUATION

As system evaluation, from the simulation using the theoretical value and the verification by the field, confirm depiction of the cognitive process of the trainee through 32 multi-dimensional skill parameters. This study was approved by the Ethical Committee of the Polytechnic University of Japan(No.607).

Table 4 shows simulation results of abnormal values using theoretical values. The system outputs the evaluation value in five stages. For abnormal value detection, output with evaluation value of 2 or less. The theoretical value A 'is a simulation of a trainee who detected an abnormality in a specific skill such as tacit consent. The theoretical value B 'is a simulation of a trainee who detects an abnormality in the language category and also has another category. The theoretical value C 'is a simulation of a trainee who detects abnormality by skill of physical movement category and other category has high skill. From these simulation results, the system is able to output outliers with categories and skills.

Table 5 shows the assessment results of 10 Trainees. Subjects are the top trainees in the class who acquired the electrician's license. It is understood that the skill level

TABLE IV.   SIMULATION RESULTS OF ABNORMAL VALUES USING THEORETICAL VALUES

	Vl1	Vl2	Vl3	Vl4	Lm1	Lm2	Lm3	Lm4	Lm5	Lm6	Lm7	Vs1	Vs2	Vs3	Vs4	Vs5	Bk1	Bk2	Bk3	Bk4	Ie1	Ie2	Ie3	Ie4	Ie5	Ir1	Ir2	Ir3	Ir4	Ir5	Ir6	Ir7
A'	5	3	①	5	4	4	4	3	5	5	3	4	5	5	3	5	5	5	5	5	②	5	①	①	5	4	4	①	②	②	①	5
B'	②	②	②	②	②	②	3	3	3	3	3	3	4	3	②	5	5	5	5	5	4	4	3	4	3	4	②	4	3	3	②	4
C'	4	4	4	4	5	4	5	4	5	4	4	4	4	4	4	5	①	①	①	①	4	4	5	5	4	4	4	4	4	4	4	4

TABLE V.   TRAIAL RESULTS

	Vl1	Vl2	Vl3	Vl4	Lm1	Lm2	Lm3	Lm4	Lm5	Lm6	Lm7	Vs1	Vs2	Vs3	Vs4	Vs5	Bk1	Bk2	Bk3	Bk4	Ie1	Ie2	Ie3	Ie4	Ie5	Ir1	Ir2	Ir3	Ir4	Ir5	Ir6	Ir7
A	4	4	4	4	4	5	3	4	4	3	4	5	3	3	3	4	5	5	5	5	5	5	5	4	4	4	4	3	3	3	3	4
B	4	5	4	4	3	4	3	3	4	4	4	5	3	4	4	4	5	5	5	5	4	3	4	3	4	4	4	3	4	3	4	5
C	4	3	3	4	4	4	3	4	4	3	4	3	4	5	5	5	5	5	5	5	4	5	4	4	4	5	4	3	4	4	4	5
D	4	5	4	4	4	4	5	4	5	4	5	4	4	4	5	5	5	5	5	5	3	4	4	4	4	5	5	5	5	4	5	5
E	4	5	5	4	4	4	4	4	5	4	4	5	3	4	4	5	5	5	5	5	5	5	4	4	5	4	3	4	4	5
F	4	4	4	4	4	4	5	4	5	4	3	4	5	3	4	4	5	5	5	4	3	5	4	4	4	5	4	5	4	4	5
G	4	5	②	4	4	4	5	4	5	4	4	4	5	4	4	4	5	5	5	5	4	3	4	4	5	5	5	4	5	3	4	5
H	3	②	①	5	5	5	②	5	①	3	5	①	3	4	4	②	5	5	5	4	4	3	3	4	4	4	②	3	②	3	3
I	5	5	4	4	4	4	4	4	5	5	3	4	4	3	4	4	5	5	5	4	4	4	4	4	5	4	3	4	5	5
J	5	5	5	4	4	5	5	4	4	4	4	5	4	4	4	5	5	5	4	4	4	4	4	4	4	5	4	4	5

related to qualification acquisition is uniformly high and there are variations in skills. However, Trainee H has many items with low skill level. Trainee H has a low skill level overall. In a later interview, he said that he had worked in a hurry without time. In this system, we emphasized familiarity by embedding context, but it is not perfect.

From the simulation using the theoretical values and the verification by the field, we confirmed that the cognitive process of the trainees can be depicted by the multiple skill parameters defined in this paper.

V. CONCLUSION

In this paper, we described a cognitive process depiction system of trainees based on multiple skill parameters which comprehensively grasp the skills necessary for vocational training from the viewpoint of education. From the simulation using the theoretical values and the verification by the field as described above, we confirmed that the cognitive process of the trainees can be depicted by the multiple skill parameters defined in this paper.

The originality of this work has been to comprehensively ascertain developmental disorders from an educational perspective. This originality is achieved through the followings:

1) We defined a theoretical construct based on a simple Card cognitive information processing model, which the instructor can easily understand.

2) We extracted and weighted the pluralistic skill parameters from the theoretical construct.

3) We classified the pluralistic skill parameters in the intellectual category of MI theory from the viewpoint of education in vocational training.

Future tasks are verification for people with developmental disabilities and construction of a database of teaching methods carried out by skilled instructors.

ACKNOWLEDGMENT

REFERENCES

[1] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers, " Research on promoting employment of people with developmental disabilities using technology and support for continuing work , " Research ReportNo.149, 2010, Japanese.

[2] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers, " Effective vocational training examples for people with developmental disabilities, "Research ReportNo.119, 2007.Japanese.

[3] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers , "Vocational training handbook of people with developmental disabilities , " 2008.Japanese.

[4] Alfred B, Jacqueline C, "Characterizing Criminal Careers, "Science , Vol.237, No.4818, pp.985-991, 1987.

[5] Kaufman, Alan S. , "Lichtenberger, Elizabeth (2006). Assessing Adolescent and Adult Intelligence (3rd ed.)," Hoboken (NJ): Wiley. pp. 3, 2010.

[6] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers , " Research on

characterization of communication skills of people with developmental disabilities , " Research ReportNo.119 , 2014.Japanese.

[7] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers, " Research on human resource development program using SST , " Research ReportNo.124, 2014.Japanese.

[8] Fujita , N. , Hayashi , T. , Yamasaki , T. , "Torch Operation Learning System Based on Welding Skill Parameters , "The IEICE transactions on information and systems (Japanese edetion), J90-D, Vol.9, pp.2522-2529, 2007. Japanese.

[9] Aswathi P., Amritha Natarajan, Namitha K., "Bridging the skill gap using vocational training simulators:Validating skill assessment metrics, " IEEE Conference Proceedings, Vol.2016, No.ICACCI, pp.645-651, 2016.

[10] Takeshita, H. and Fujita, N, "Psychological intervention in an Employment transition support center: Support staff psychological balance", Poster session presented at the 22nd World Congress of Social Psychiatry-WASP2016 , New Delhi, 2016.

[11] Glaser B, Strauss AL., " The discovery of grounded theory. Chicago (IL)", Aldine, 1967.

[12] Nishigaki , K. , "Changes in Mothers' Psychosocial Perceptions of Technologydependent Children and Adolescents at Home in Japan:Acknowledgement of Children's Autonomy , "Asian Nursing Research , pp100-105, 2016.

[13] S.K.Card and T.P.Moran , "The Psychology of Human – Computer Interaction, " Lawrence Erlbaum Associates , 1983.

[14] Japan Organization for Employment of the Elderly, Persons with Disabilities and Job Seekers, "Support/ correspondence guide for students who need special consideration in the progress of training / learning (practical edition) , "2015 .Japanese.

[15] Gardner , H. , "Multiple Intelligences: The Theory in Practice, Basic Books; Reprint Edition edition, " 1993.

[16] Gardner , H. , "Assessment in context:The alternative to standardized testing.In B.R. Gifford , & M.C.O'Connor(Eds.) , Changing assrssment:Alternative views of aptitude , achievement , and instruction. , "Boston: Kluwer. , 1991.

[17] Gardner, H., Krechevsky, M., Sternberg, R. J., & Okagaki, L., " Intelligence in context: Enhancing students' practical intelligence for school. In K. McGilly(Ed.), " Cambrige: Bradford Books/MIT Pree, 1994.

[18] Yokouchi , H , " Basic understanding of psychometric scale,"J Jpn Soc Intensive Carw Med , Vol.14 , No.4, pp.555-560, 2007.Japanese.

[19] Articlute Storyline

http://www.articulate.com

[20] Dennis H. Reid, Carolyn W. Green, "Preference-Based Teaching: Helping People with Developmental Disabilities Enjoy Learning without Problem Behavior , "Habilitative Management Consultants, Inc. , 2005

[21] Novak, G. M. and Patterson, E. T. , "Just-in-Time Teaching:Blending Active Learning with Web Technology, " Addison-Wesley,pp1-188,1999

[22] Deslauriers, L., Schelew, E., Wieman, C., "Improved Learning in a Large-Enrollment Physics Class", SCIENCE, Vol.332, No.862, pp862-864,2011

No.	Concept	Definition (This phenomenon is that ...)
1	From dissatisfaction to analysis	A staff considers the causes of communication failure, without accusing the user.
2	Guilt for deteriorated condition	A staff feels responsibility because his/her intervention led user condition deterioration.
3	Anxiety & preparation	A staff thinks facing with users' disability traits as a part of own job.
4	Self-realization through expertise	A staff utilizes their experiences on their welfare and business practice through supporting users.
5	Helping others	A staff finds value in supporting other's life.
6	Shock and avoidance	A staff is shocked by user's background and trying to leave the user to his colleagues.
7	From handicap to individuality	A staff accepts the user's disability traits as individuality.
8	From listening to asking	A staff receives the user's reaction and asks the cause and background.
10	Unshown anger	A staff does not take attitude even if feels anger in the user's behavior, and dissatisfaction is accumulated.
11	Consciousness that I did something	A staff feels sad by thinking that he/she did something for the user but the user did not responded.
12	Accomplishment by deeper understanding	A staff feels accomplishment by understanding the background of a user's behavior.
14	Awareness of gaps	A staff notices the gap between the goals and the reality.
15	Consultation with seniors	A staff can ask a senior whenever he / she can not understand the user's behavior.
16	Relief by no differences	A staff pleasantly surprises because the users' behaviors do not differ from his / hers.
17	One consideration for one person	A staff notices that each user needs one consideration.
18	Embarrassment to behavior	A staff is surprised by the sudden behavior of user and feel uncomfortable.
19	Irritating not going as expected	A staff is irritated and exhausted, as having no sign of improvement of user's condition.
20	Telling how others may feel	A staff tell a user how the user's behavior is seen from the third party.
22	Mental switching by questioning	By being asked by seniors about the cause of user's behavior, frustration will switch to questioning.
25	Gaining knowledge in training	A business-experienced staff learns basic knowledge of supporting persons with disabilities in training.
26	Proposing support strategies	A mid-level staff creates and proposes support plans each other in various viewpoints.
29	Confidence by user change	A staff gains self-confidence by the progress of users.
30	Responsibility of influencing life	A staff feels responsible because his / her intervention influences the employment (life) of users.
35	Showing posture to support	A staff lets the user disclose thoughts and circumstances by showing posture to support.
36	Instructing Employment skills	A business-experienced staff trains necessary skills for employment to users.
37	Strength by experiences	By having experienced, a staff will not be upset by the disastrous background of individual users.
38	Different traits by person	Since the situation of users is different for each person, basic knowledge is not applicable.
42	Negotiation with firms	A staff can negotiate with the company about employment of users.
43	Directive instructions	A staff instructs and requests at the ordinary workplace level to a user.
59	Excessive interventions	A staff has excessive interest and intervention to a user.
60	Complaints from users	A staff receives complaints concerning oneself and facility from a user.

Figure 6. Details of the concept