Liu, C.-C. et al. (Eds.) (2014). Proceedings of the 22nd International Conference on Computers in Education. Japan: Asia-Pacific Society for Computers in Education

Assessment of Developmental Stages of Generic Skills: A Case Study

Katsuko T. NAKAHIRA[a*], Makoto WATANABE[a] & Muneo KITAJIMA[a]
[a]*Nagaoka University of Technology, Jaoan*
*katsuko@vos.nagaokaut.ac.jp

Abstract: Generic skills (GS) are meta-competencies necessary for acquiring knowledge from provided information in classes. This paper assumes that GS consists of a skill associated with the literacy for pulling information from the accessible contents in the classes, and a skill associated with the literacy for pushing knowledge stored in the students' brain for obtaining useful information from the instructors. Based on the assumption, we propose a method for assessing developmental stages of GS. Observational studies were conducted in a real classroom for testing this assumption. For preparation, we defined a micro-structure of GS. Using the structure, we identified three critical parameters that should characterise the students' performance on the micro-structure. Then, we selected elite monitors to verify whether micro-structure works in our study. The results suggested that the micro-structure of GS works well in classroom situations. We conclude that three critical parameters are good parameters for assessing developmental stages of GS.

Keywords: Meta cognition, Generic skills, Cognitive Chrono-Ethnography, Human behaviour

1. Introduction

There are a number of versions of the definition for generic skills. However, they commonly suggest that high-order, transferable skills are necessary for almost all complex endeavours. Particularly, the importance of these skills is clearly summarised in "Defining Generic Skills" as follows: "*Generic skills are important because jobs today require flexibility, initiative and the ability to undertake many different tasks. ……. Internationally, there is increasing emphasis being placed on active citizenship and community capacity as reflected in the extensive work on learning communities. Generic skills feature prominently in this body of literature as fundamental to developing successful, progressive communities.* – adapted from *Defining generic skills: at a glance, 2003. 12*" Six common elements listed in "Defining Generic Skills" are as follows: Basic/fundamental skills, People-related skills, Conceptual/thinking skills, Personal skills and attributes, Skills related to the business world, and Skills related to the community.

Under the current state of the society, higher-educational institutions have begun to consider introduction of the skills in their education. In order to handle those skills in the education effectively and efficiently, it would be critical to establish reliable methods for assessing the state of developmental stages of generic skills, or assessing the six elementary skills that support generic skills, in the respective education fields.

A number of methods for assessing generic skills have been proposed. For example, in US, the case for generic skills and performance assessment was introduced by Roger *et al*. (2012). It adopted a batch of multiple-choice and short-answer tests for assessment, which have been the dominant testing regime for generic skills. Another example is Berwyn *et al*. (2003), which proposed assessment methods of generic skills. The assessment is done on the basis of skills and knowledge checklists. The checklist consists of the items such as the things that learners should know, what they should know in order for them to be able to access information, what they are able to do, and the documents that could provide them with evidence of their competence. In this case, learning materials are developed from the checklists, so generic skills are fully mapped to skills and knowledge, and are built-in from the beginning of the training development process. Assessing generic skills includes such activities as completion of workbooks, supervisors' reports, participation in professional networks, and so on.

As for the methods for developing generic skills, there are several propositions, but most of them are based on self-regulating learning. For example, Luca (2002) proposed an instructional design strategy that supports generic skills development, consisting of the following three key learning principles for designing effective learning environments – authenticity, self-regulation, and reflection. The framework was integrated with the ICT technologies. Thus, the pedagogical methods of developing generic skills are growing year by year. Especially, the methods are shifted their focus to integration of ICT technologies probably due to the rapid proliferation of e-Learning.

In this research, we propose a new assessment method for developmental stages of generic skills using trainee's behaviour by implementing a set of controlled learning task sequences. The assessment is supposed to be applied to educational institutions, so the target is higher-education institutions' classes. Hence, we focus on the generic skills characterised by the following features: collecting information, organising knowledge, and literacy, related to basic/fundamental skills and conceptual/thinking skills.

2. Methodology

To construct an assessment method, we need to focus on the target of generic skills, conformable to higher educational institution pedagogy. In this case, the place where assessment is done would be classes. Taking into account the constraint imposed on conducting observation at classes, however, we need to select the suitable items of the generic skills. And therefore, we focused on the collective notion of "key competencies", suggested by Dawe (2002), which represents the important features of the generic skills within all education and training. One of the important key competencies is "collecting, analysing, and organizing information (Council *et al*., 1992)." This competency includes the following capacities: (1) to locate information, (2) to shift and sort information in order to select what is required and present it in a useful way, and (3) to evaluate both the information itself, and the sources and methods used to obtain it. These three capacities define a basis for assessing developmental stages of generic skills. The results of measurement of these capacities in classes would provide the information where a specific student is located in the spectrum of developmental stages of generic skills.

2.1 Monitoring Students' Behaviour

In this research, we adopted Cognitive Chrono-Ethnography (CCE). CCE is a methodology for

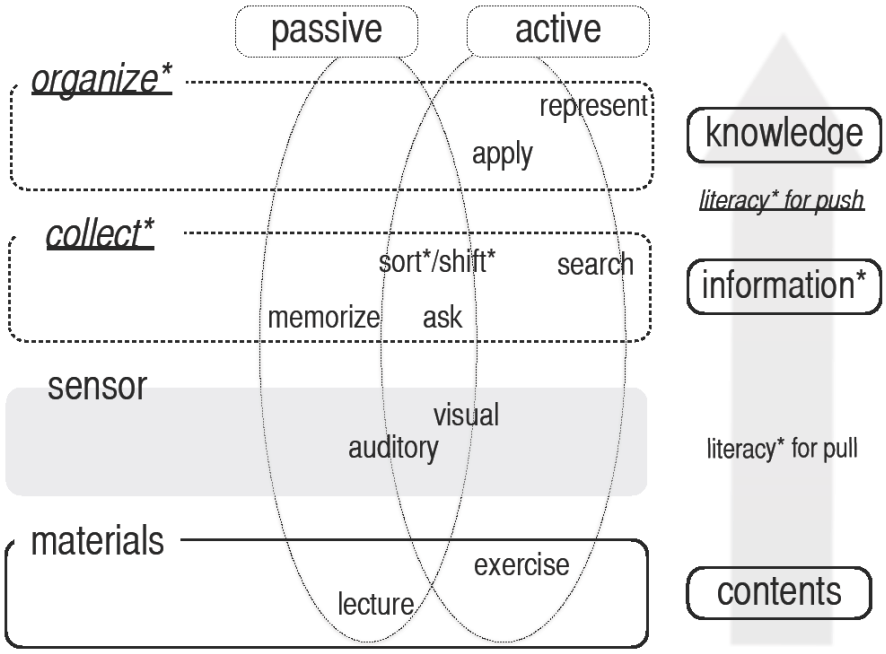

Figure 1. Micro-structure of Generic Skills. *'s are the concepts introduced in Council et al.(1992).

understanding people's daily *in situ* behaviours (Kitajima *et al*., 2010, Kitajima *et al*., 2012, Kitajima, 2012), and has been successfully applied to a number of topics to understand people's behavioural changes such as "how some of baseball fans have become aficionados", *etc*. CCE consists of the following six steps; Choose the field of study, Define critical parameters, Recruit elite monitors, *i.e.*, representative subjects in the space defined by the critical parameters, Observe elite monitors' behaviour in the study field, Define a space for representing the observed phenomena, and Analyse the observed behaviour from the viewpoint of the critical parameters. In short, a CCE study would provide detailed descriptions for the representative people's behaviours in the study field, which is characterised by a set of important, or critical, parameters. The students' learning activities in classes would be characterized by a set of parameters, and they would be categorized into a number of activity patterns, each of which is associated with a particular combination of values of the critical parameters.

This paper defines critical parameters that should be associated with generic skills. Each of the critical parameters has values, e.g., high or low. Each student is located at one of the legal points in the parameter space. The students placing at the same point would show similar activities in the classes, providing concrete examples of students' activities with the generic skill level defined by the point in the parameter space.

2.2 Generic Skills

When students attend the class, they try to get some knowledge from the lecture. We assume that generic skills are critical determinant of the way how students organise their activities in the class.

Figure 1 shows the micro-structure of generic skills. It consists of four layers for representing students activities, i.e., materials which the students pay attention to, sensing to convert the physical stimuli on the materials to the perceptual representations, collecting and organising the sensed data for comprehending them as meaningful information, and three layers that correspond to the depths of information processing, i.e., physical contents (data), information (meaning), and knowledge (long-term memory of the students), and three layered framework to generate knowledge from contents material or information. The four layers' elements represent human behaviour; materials, sensor, two activities – collect and organise, which have strong relation to generic skills. The three layers' elements represent the processes of changing materials; contents, information, and knowledge.

Materials : The first layer, *materials*, represents the source where students get information for the subjects instructors are giving in their classes. When instructors make lectures, they construct several professional context and use technical words for explaining them. Sometimes, they make some exercises to give a chance to apply the information or knowledge which students have got through the class. Basically, *materials* are constructed by means of contents which include text, audio talking, figures, and so on, as physical signals or codes. The students pay attention to some materials but not all, depending on their developmental stages of generic skills.

Sense : Human receives these signals through some sensors, such as auditory or visual. The signals are converted to useful information in human brain. Again, the control of sensing, namely which channel to open, is dependent on the developmental stages of generic skills.

Collect : In this process, the brain requires the ability of *literacy for pull*. The collect layer includes some activities, and is divided in two domain modes – passive and active. The passive domain mode has the following features: (1) students get information and memorise it without any comprehension or thinking processes, (2) students ask the instructor for useful information without any deep thinking, and so on. The active domain mode has the following feature: (3) students have a desire to get useful information, and accomplish it by searching literatures by themselves with clear purposes. Each element in this layer is associated with one of the modes exclusively but it is not the case for the sort and shift elements because these elements can operate in either mode depending on the status of students. We assume sort and shift work in the both mode.

Organize : Once the *collect* layer is done, students move to the final layer, *organise*, to convert information to "knowledge". To do this, students make some activities, such as applying the information to several exercise or examples, and integrating the results of application in the form of organised information. Through the process, the mere information changes to knowledge stored in long-term memory, which can be used in the future as needed. In this process, a skill, *literacy for push*, is required. Using this framework, we can make a plan for observing students' generic skills via their behaviours in the real classes.

2.3 Cognitive Chrono-Ethnography

Critical Parameters : Comparing the focused generic skills and Figure 1, we can set reasonable critical parameters. In the figure, human behaviours arise in the processes of collect and organise layer, and *literacy for push*. And therefore, we can identify the following correspondences between them: locate information corresponds with collect process, shift and sort information in order to select what is required and present it in a useful way corresponds with *literacy for push*, and evaluate both the information itself and the sources, and methods used to obtain it corresponds with organise process. Thus, we identify the three items – collect, organise, *literacy for push* – as critical parameters. Then we need to define how to observe these parameters.

Motivation : The motivation of the study is to propose an assessment method of developmental stages of students' generic skill. To do this, we need to construct a model of students' cognitive activity. As shown in Figure 1, we have already done it. Using the frame, we studied it by analysing students' products such as reports or minutes note which summarise the contents of the lecture they attend and make comments or academic questions to the instructor. There are several ways for the analysis. This paper reports the first analysis has done for an exercise style class to which a small number of students attend, considering whether our frame is good for describing students' behaviour in the class or not.

Elite Monitors : In this practice, we chose an exercise style class to which attended nine second grader from the undergraduate course of the university. Each student knew how to search information using the search engines in the web, but they were poor at or did not know how to draw graphs. We used a consecutive 3 classes which took 135 minutes per class. The instructor set three themes for a statistical graph drawing exercise with a spreadsheet application whose difficulty levels were set to low, middle, and high. Through the exercise, the instructors did not provide any textbook or documents. If they wanted to finish the exercise and did not have the necessary skills for drawing graphs, they needed to search the available sources of information for ICT literacy for using the spreadsheet application, knowledge for handling data statistically, or raw data to do the exercise. In this situation, if students' generic skills were high and good for literacy for both push and pull, students would show active domain mode behaviour.

Our goal is to identify students' conditions whether they can acquire knowledge from the contents that were given to them or were found by their efforts. Table 1 shows the relationships between the students ability and what they finally acquired from the contents through a series of conversion processes. Although we tend to assume intuitively that students can always organise knowledge from clear and good information, there are complex processing steps that are necessary for converting such information to well-organised knowledge. Even if a student has high ability for collecting and organising information, he/she would not be able to construct knowledge from the information without high *literacy for push*. Or, if a student has low ability for collecting and/or organising information, he/she would not be able to give appropriate representation for the information unless enough time is available. This table shows the conditions of the states of students for characterising various manifestations of generic skills, including elapsed times, quality of products, activity logs which they check webpage, and so on.

Through this consideration, we set some critical parameters to evaluate students' generic skills; – activities for collecting information and organising knowledge, and *literacy for push*. To observe these critical parameters, we gathered students' behavioural data.

Observation : After preparation, we started to observe students' behaviour, in this case, "observe students' behaviour" means gathering students' behavioural data. We set the gathering data from students as: (1) searching activity logs which include the elapsed times per 15 minutes and the URLs students visited, and (2) products which students draw graphs with finished time. With the parameters and frame, we consider some important relationships -- *short elapsed time to solve exercise* and *long elapsed time to solve exercise*. After these considerations, we set three critical parameters for collecting, organizing, literacy. For literacy, we can assess just *literacy for push* because the ability of *literacy for pull* is the activity in human brain so we cannot check unless represented with language. We observed students' activities using these critical parameters. Through these observations, we found good

Table 1. the relation of students' behaviour and layers for constructing knowledge. The codes in table header are: "A" means active mode, "P" means passive mode, "AT" means human attitude for collecting/organizing information, "F" means the final reception form of contents. The codes in each cells are: "H" means high ability, "L" means low ability, ● means high level of knowledge, ○ means low level of knowledge, and ■ means just contents.

Collect	H								L							
Organize	H				L				H				L			
Literacy For pull	H		L		H		L		H		L		H		L	
Literacy For push	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
AT	A	P	A	N/A	A	P	A	N/A	A	P	A	N/A	A	P	A	N/A
F	●	information							○	information						■

relationships between these critical parameters, and found several patterns of students' types. Through these verifications, we conclude the three critical parameters are useful for generic skill assessment.

3. Apply The Method of Generic Skill Assessment For Mass Students

After showing the validity of the critical parameters, we would like to apply the method of generic skill assessment for mass class students. In this case, we cannot obtain detailed students' active logs. In place of active logs, we used "minutes notes", which are generated by students at the end of five to ten minutes in each class. The note consists of two questionnaire: (1) please write new knowledge you have got in this class, (2) please make comments or questions for this class.

We applied this assessment method to a lecture to which attended up to 60 graduate students of the university. From the registered students of the class, we selected 28 students, who attended 10 to 12 classes. The following pieces of information are included in the minutes note: (1) technical term(s) which were used in the class, (2) question(s) which students had, (3) narrative impressions which students felt. We extracted the values of the critical parameters as follows:

for collecting : We counted the number of technical terms in the first question of the minutes notes. When studentsgot new technical terms in the class, we assume they felt the word conveying important information. It is regarded as just "collect" information.

for organizing : After collecting new technical terms in the class but just "collecting", technical terms keep "information" status. They are not converted information to knowledge unless being "organised".

for literacy : We counted the number of nouns, verbs, and adjectives for the first question in the minutes notes to observe students' literacy. Writing process of minutes note, the students had to use their ability of literacy. Here, we focus on *literacy for push*. Though the students got good information or not in the class, they represented their thinking or new information with terms, such as verbs, nouns, and so on. If students' had rich vocabulary, they would have ability to represent their thinking by selecting appropriate words in their vocabularies.

Figure 2 shows a part of results of the generic skill assessment. Results of assessment are represented by numerical conversion, so we can make visualisation for these results.

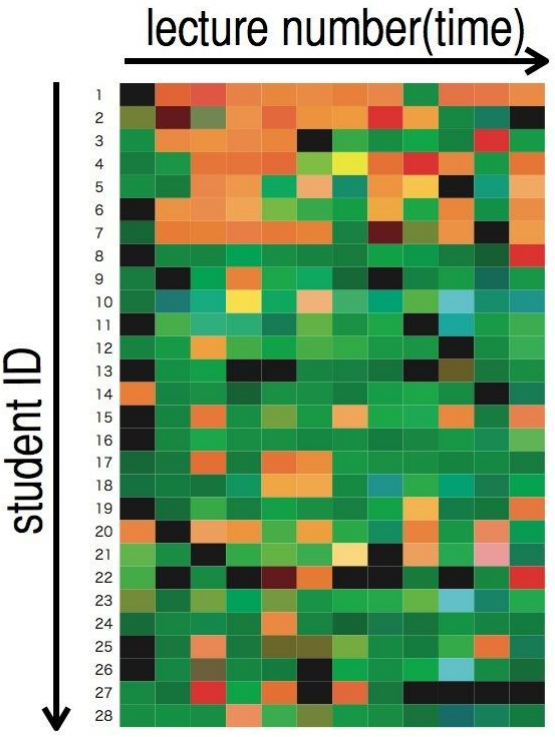

Figure 2. Generic skill assessment applied to 28 student attended classes.

Here, we assigned RGB colour for each critical parameter: blue colour is assigned to collecting information, green colour is assigned to literacy, and red colour is assigned to organisation. The upper group of student IDs in the figure show the red end of the spectrum. It means they might have rich organization generic skills; the ability of converting information to knowledge. The middle ones show the blue/green end of the spectrum. It means they might have rich collecting generic skills or just represent several impressions; the ability of collecting information and *literacy for pull*. From the left side to right side of the figure shows the elapsed time. Most students have not changed their ability – represented almost in the same colour – but several students such as students ID 10 transformed their ability – changing their colour spectrum –. Thus, we conclude the method of generic skills assessment seems to work well.

4. Conclusion

In this paper, we proposed an assessment method for partly generic skills in higher-educational class. The feature of the method is that it is based on "observing" students' activity, and the results of observation is easily quantified by means of visualisation and assessment process is facilitated. For constructing the method, we used the CCE methodology for understanding people's daily in situ behaviours. Most important point of the proposed assessment method is that it defines the critical parameters – collect, organise, and *literacy for push*. Through interpreting the critical parameters, we implemented an observational method for collecting students' information that is related with the parameters. After defining critical parameters, we assessed the method for its effectiveness for the students who attended the university class. Tracking the students' behaviours, we conclude the assessment method is effective. We think one of the supports is to understand students' study style whether they do just collecting new information, tend to organise knowledge which is collected in class, or other type. If we identify the student's study style properly, we can customise the e- Learning contents sequence in such a way that they are fully optimised to the skills of each student.

Acknowledgements

The study described in this paper has been partially funded by the Scientific Research Expense Foundation C Representative: Kumiko Aoki (24531274).

References

Berwyn, C., Kaaren, B., David, M., and Andrea, B. (2003). Assessing and Certifying Generic Skills. *NCVER* Ltd..

Council., A. E., Mayer, E., Council., A. E., Ministers for Vocational Education, E., (Australia), T. (1992). Key competencies : report of the Committee to advise the Australian Education Council and Ministers of Vocational Education, Employment and Training on employment-related key competencies for postcompulsory education and training. *Australian Education Council and Ministers of Vocational Educational Education, Employment and Training*.

Dawe, S.(2002). Focussing on Generic Skills in Training Packages. *NCVER Ltd.*.

Kitajima, M. (2012). Cognitive Chrono-Ethnography (CCE): a methodology for anticipating future user needs. *In Work: A Journal of Prevention, Assessment and Rehabilitation*, 41, 5251–5258.

Kitajima, M., Nakajima, M., and Toyota, M. (2010). Cognitive Chrono-Ethnography: A method for studying behavioral selections in daily activities. *In Proceedings of the Human Factors and Ergonomics Society 54th Annual Meeting, Human Factors and Ergonomics Society*(pp. 1732-1736). Santa Monica, CA.

Kitajima, M., Tahira, H., Takahashi, S., and Midorikawa, T. (2012). Understanding tourist's in situ behavior: a Cognitive Chrono-Ethnography study of visitors to a hot spring resort. *Journal of Quality Assurance in Hospitality and Tourism*, 12, 247–270.

Luca, J. (2002). Developing an instructional design strategy to support generic skills development. *In Eds.), Proceedings of ASCILITE 2002: Winds of change in a Sea of Learning: Charting the course of digital education,* (pp 401-411) UNITEC Institute of Technology.