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Analyzing the Learning Process of an Online Role-Playing Discussion Activity

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ABSTRACT

Instructional activities based on online discussion strategies have gained prevalence in recent years. Within this context, a crucial research topic is to design innovative and appropriate online discussion strategies that assist learners in attaining a deeper level of interaction and higher cognitive skills. By analyzing the process of online discussion in depth using a specific instructional strategy, we may discover the characteristics and limitations of this strategy. This case study utilizes an online discussion activity adopting a role-playing strategy in a college course and conducts an empirical analysis to explore and evaluate both the content structure and behavioral patterns in the discussion process. We propose and adopt a new method of multi-dimensional process analysis that integrates both content and sequential analysis, whereby the dimension of interaction and cognition are analyzed simultaneously. Furthermore, we discuss the patterns, characteristics, and limitations of the role-playing discussions and provide suggestions as references for teachers who utilize online role-playing discussion activities.

Keywords

Online discussion, Role-playing, Behavioral pattern, Instructional strategy

Introduction

Instructional Activity Utilizing Online Role-playing Discussion

Online discussion instructional activities have been widely applied in higher education courses. Furthermore, their effectiveness has been extensively discussed by several researchers (e.g., Gilbert & Dabbagh, 2005; Hou et al., 2007; Yeh, 2010). Instructional activities based on online discussions and appropriate teaching strategies may include the development of the learner's argumentation skills (Driver et al., 2000; Oh & Jonassen, 2007). This approach may help learners gain a deeper understanding and develop higher cognitive skills. As a result, a crucial research topic relates to designing customized, innovative online discussion strategies that facilitate teaching and allow learners to reach a deeper level of knowledge construction and develop advanced cognitive skills. The quality of online discussions is often influenced by the design of the underlying interactive mechanisms (Gilbert & Dabbagh, 2005). There are several interactive learning strategies that are used in discussion-based online teaching activities, such as peer assessment (e.g., Hou et al., 2007) and problem solving (Hou et al., 2008; Oh & Jonassen, 2007). By analyzing the process of online discussion within these strategies, the characteristics and limitations of each strategy can be identified because teachers may not be able to predict the ideal timing for intervention during online discussions (Mazzolini & Maddison, 2007). The findings of the process analysis may help teachers choose better strategies, intervene in discussions at more opportune times, and develop improved facilitative mechanisms that address known limitations. Many behavioral analyses of online discussion activities (Hou, 2010; Hou et al., 2007, 2008; Jeong, 2003) provide insight into process limitations when students conduct discussions without teacher guidance. They also offer teacher guidance strategies based on behavioral patterns such as interactive mechanism design and proper timing of guidance. Furthermore, developers of educational software may also refer to these findings to develop appropriate tools, such as designs with automatic behavioral analysis technology, which can be used to automatically detect behavioral patterns (Hou et al., 2010).

In addition to problem solving and peer-assessment interactive strategies, another teaching strategy involves asking students to learn through role-playing. This approach has been increasingly researched in recent years (e.g., Bos & Shami, 2006; Hou, 2011; Wishart et al., 2007). This type of interactive learning is commonly used to help learners develop skills to handle group decision-making (Bos & Shami, 2006; Pata et al., 2005). Some studies suggest that role-playing also keeps learners motivated (Wishart et al., 2007) and improves communication skills among professionals (Chien et al., 2003). Furthermore, this strategy helps students develop abilities in problem solving by requiring them to assume different roles and confront unstructured problems in scenarios involving the professional domain of the given role.

Several studies explore the roles that students play during the process of collaborative learning (e.g., De Wever et al., 2008; Hara et al., 2000; Strijbos et al., 2004, etc.), such as source searcher, theoretician, summarizer and moderator (De Wever et al., 2008). However, these studies rarely focus on the cognitive process of online teaching activities in which students simulate real-life scenarios in assorted roles designated by teachers. The behavioral pattern of cognitive dimension and knowledge interaction in this role-playing learning process requires a more in-depth exploration. Role-playing should also be amenable to applications in discussion-based online teaching in which a teacher assigns roles and tasks to students (or students decide for themselves), and the students play the roles (such as requiring students to role-play different positions in a company) and discuss a given task such as solving the company's management issues. The purpose of this approach is to increase student interactions during social knowledge construction and produce higher cognitive skills through realistic discussions. There are limited studies on the behavioral patterns of discussion-based online teaching involving role-play tasks. Hou (2011) examined the cognitive dimension of online role-play discussion activities, and concluded that students are better at the diversity of the cognitive aspect when role-playing in problem-solving tasks/scenarios. However, this study focused only on cognitive dimension analysis, and not the in-depth research on knowledge interactive behavior between the roles.

Therefore, an important and interesting topic for research is to explore the characteristics and limitations of both the interaction and cognitive patterns in online role-playing discussion activities. The research presented in this paper comprises an empirical case study exploring the use of role-play in discussion-based online learning in a higher education course. To analyze both the content of the discussion and the interactive behavior of its participants from multiple dimensions, we propose an approach that integrates the dimensions of interaction and cognition.

A Multi-dimensional Process Analysis of the Interactions and Cognition of Online Discussions

Many studies have explored the process of computer-assisted collaborative learning and developed various analytical methods and frameworks (e.g., Daradoumis et al., 2006; Hou et al., 2008). Furthermore, the analytical methods for online learning processes have gradually shifted towards the integration of multiple and diverse trends, such as the layered framework for evaluating online collaborative learning interactions proposed by Daradoumis et al. (2006). This framework includes a multidimensional analysis of social interaction and learning achievement. Hou et al. (2008) also explored the behavioral patterns in online teaching and learning activities that involve knowledge construction and the problem-solving process. Numerous studies have analyzed the process of online discussion as a teaching tool (e.g., Hou et al., 2008; Jeong, 2003). Furthermore, several studies have explored the frequency of interaction in online learning (Black et al., 2008), or conducted social network analysis to understand the state of the learners' social interaction (e.g., Zhu, 2006). However, when focusing merely on the analysis of discussion frequency or social interaction status of online learning activities, the exploration on the "content of interaction" of the discussion is limited. To address this issue, an analysis of the content of discussions may help us gain a deeper understanding of a given discussion activity and the behavior of its participants. Quantitative content analysis has been used in several studies to explore the online discussion process (e.g., Gunawardena et al., 1997; Jeong, 2003). In those studies in which the messages of a learning community's discussion were coded, the collected data allows for further analysis that can increase the understanding of the content structure of the entire discussion. However, simply understanding the content of discussions does not reveal much about behavioral patterns and does not allow us to understand the process of "content-related interactions". To explore both content structure and behavioral patterns, we have therefore integrated content analysis and the lag sequential analysis (Bakeman & Gottman, 1997) as a way to infer sequential behavioral patterns based on discussion content. During the overall discussion process, sequential analysis allows us to determine whether students would further conduct a certain cognitive aspect of discussion after completing another cognitive aspect of discussion. Several studies apply sequential analysis to behavioral analysis regarding teaching and learning (e.g., Hou et al., 2007, 2009; Jeong, 2003; Sung et al., 2008). However, most of these studies only involve sequential analysis of behavioral patterns using a single coding scheme, and they rarely involve a sequential analysis in which additional dimensions are coded simultaneously. Using more dimensional schemes may better demonstrate behavior sequences when the discussion is influenced by multiple factors or may enable improved interpretation of the characteristics and limitations of the given discussion strategy.

Furthermore, sequential analyses of online discussions that cover both "interactive" and "cognitive" dimensions simultaneously are limited. Most of the analyses that have focused on knowledge construction interaction tend to address the learning community's "interactive" behaviors such as sharing, coordination, and joint knowledge construction (e.g., Gunawardena et al., 1997; Hou et al., 2007). This paper provides an in-depth exploration of the "cognitive" processes during discussions including the phases of remembering, understanding, and analyzing, as

described in the Cognitive Process dimensions of the revised Bloom's Taxonomy (Anderson & Krathwohl, 2001). Furthermore, we believe that the integration of the interactive and cognitive dimensions may help us realize the limitations regarding cognition and knowledge interaction among learners.

Based on the above discussion, we have developed a method that can simultaneously analyze the content and behavioral patterns of online discussions. Furthermore, this method can account for both dimensions of knowledge interaction and cognitive process in the discussions, and it helps us better understand the characteristics and limitations of various teaching activities. We propose an innovative analytical approach, which is a multi-dimensional process analysis of online discussion teaching activities. This approach integrates content and sequential analysis while also considering both the dimensions of interaction and cognition. With this proposed method, we devised appropriate coding schemes for the dimensions of interaction and cognition in online discussions. Each posting was coded and quantitatively analyzed according to the coding schemes of each dimension. This made it possible to measure the proportion of each code in order to better understand the content structure of cognition and interaction in learners' discussions. Furthermore, to understand the behavioral patterns of the learning community's interactions and cognition, a sequential analysis was conducted based on the derived codes. The above analyses reveal multi-dimensional data that simultaneously cover interactions, cognition, content, and behaviors. The results of these analyses may allow a more valid triangulation for facilitating an increase in the scope of the process analysis of online discussion instruction.

We explore the following research questions: 1. What are the content structure and behavioral patterns of an online discussion teaching activity using a role-playing strategy?; and 2. What are the characteristics and limitations of both the interactive and cognitive dimensions of an online discussion teaching activity using a role-playing strategy? To summarize, the specific purposes we wish to achieve in our study are as follows:

1. To conduct a typical role-playing-based online discussion learning activity using a general forum tool as well as an empirical observation and quantitative content analysis in which we explore the content structures of the learners' overall knowledge construction interactions and the development of their cognitive skills.
2. To perform a sequential analysis of the coded data so that we may infer the visualized sequential behavioral patterns within the discussions in both the interactive and cognitive dimensions. These results will be cross-examined to further explore the characteristics and limitations of students' social knowledge construction interactions and cognitive skills in role-playing-based discussions. Based on these findings, we will discuss and propose suggestions as references for teachers adopting role-playing strategies.

Method

Participants

There were 70 participants, 34 males and 36 females, in the study. All participants were college students majoring in information management. This study was implemented in a course which focused on common organizational behavioral issues and case analyses of business organizations in the context of online technologies. The participants all had basic Internet and information capacities and knew how to access and use a forum.

Design

We first coded each post and its responses using two coding schemes (i.e., a knowledge construction interaction dimension and a cognition dimension). The coded data were then used in quantitative content and sequential analysis to discover the content structure and behavioral patterns based on the content of discussion. This approach differs from analysis using the records or frequency of online operations (e.g., Black et al., 2008; Hou et al., 2010). Our analytical approach based on quantitative content data allows us to explore the dimension of knowledge content in learners' interactions and to systematically decipher the behaviors hidden in the discussions. In addition, our approach is also different from that of another study in which only the proportion of codes in a quantitative content analysis were manifested. Our method allows a series of calculations based on the matrix of behavioral transition frequency (i.e., frequency transition matrix, conditional probability, conditional probability matrix, and adjusted residuals table) in the lag sequential analysis (Bakeman & Gottman, 1997; Hou, 2010) and enables us to conduct a more structured and visualized analysis of behavioral patterns. Additionally, in our study we utilized two coding schemes that enabled us to analyze both interactive and cognitive dimensions. This approach not only allows us to

understand the content structures of interaction and cognition but also permits us to generate two content structures and sequential behavioral patterns for cross examination and interpretation. Subsequently, a qualitative content analysis is conducted on certain key findings to provide better evidence and clarification for behavioral patterns.

Tools

Online Discussion Forum

To avoid pop-up advertising windows when using forums provided by commercial web sites, we have developed a forum with basic interactive functions as the tool for observation and recording in the study. Our forum contains only basic functions, such as posting a thread, replying to a thread, and listing all threads, and can only be accessed by our participants. After logging in, participants see a list of all thread entries and may choose to post new threads, click on a thread link to read it, check responses to each thread, or respond to a thread. Because a thread may have multiple replies, the system lists the names of those who posted threads and replies so respondents can be identified.

Coding Schemes

To uncover the characteristics and limitations of the interactions in students' online discussions and to analyze interactive social knowledge construction, we adopted the coding scheme of the "Interaction Analysis Model (IAM)", proposed by Gunawardena et al. (1997). This model, which is depicted in Table 1, has been widely used in numerous studies for analyzing learners' interactive social knowledge construction in online discussions (e.g., Hou et al., 2007, 2009; Jeong, 2003). Each phase of the IAM model represents an interactive behavior in social knowledge construction (such as information sharing, co-construction, or negotiation). After students' discussion was coded by the IAM scheme, it will help to understand students' knowledge interactive process of discussion. To explain more clearly the meaning and scope of each code item, we also provided a typical brief discussion example in Table 1 as an illustration.

Table 1. Interaction Analysis Model (IAM) (Gunawardena et al., 1997)

Code	Phase	Description	Examples
C1	Sharing / comparing of information	Statement of observation or opinion; statement of agreement between participants	"I found a website that is also discussing our current topic. The website address is…"
C2	Discovery and exploration of dissonance or inconsistency among participants	Identifying areas of disagreement; asking and answering questions to clarify disagreement	"I have a different opinion on Student S's argument. Why would student S think that the same concept existing in both argument A and argument B is varied? This is different from my initial concept"
C3	Negotiation of meaning/co-construction of knowledge	Negotiating meanings of terms and negotiation of the relative weight to be used for various agreement	"I think the various principles mentioned in theory C need further understanding and discussion, and I personally believe the second principle is more important"
C4	Testing and modification of proposed synthesis or co-construction	Testing the proposed new knowledge against existing cognitive schema, personal experience or other sources	"I think the current plan proposed by everyone is different from my personal experience. The data in database D can support my viewpoint and provide a reference for any plan revisions"
C5	Agreement statement(s)/application of newly constructed meaning	Summarizing agreement and meta-cognitive statements that show new knowledge construction	"After contemplating various options for a new plan, the new proposed plan is as follows..."
C6	Others	Discussions irrelevant to learning topics.	"The episode of the drama tonight was amazing; the female character is gorgeous!"

Table 2. Cognitive dimensions of the revised Bloom's Taxonomy

Code	Phase	Description	Examples
B1	Remember	To access relevant knowledge from long-term memory.	"I remember that theory A consists of 3 principles, and they are…"
B2	Understand	To make sense of acquired knowledge; to associate new knowledge with past experiences.	"The organizational management principles in this book can be understood and explained through some life experiences, such as…"
B3	Apply	To do a job or solve a problem through application (procedures).	"I recommend applying the principles mentioned in this book on our management proposal"
B4	Analyze	To break down and analyze each component of knowledge and point out the relationship between the part and the whole.	"This proposal can be analyzed and explored in two phases, in which phase A is…, and both phase B and A have a causal connection"
B5	Evaluate	To judge and evaluate based on criteria and standards.	"If we use the company's performance analysis table for assessment, personnel D should be evaluated as Level E"
B6	Create	To piece different elements together and form a complete and functional whole. To form a new structure by re-assembling elements through the mental process.	"Could we integrate the first three tasks from proposal F with particular tasks from proposal G and create a new proposal?"
B7	Others	Discussions irrelevant to learning topics.	"Come on! How about catching the new movie together tonight?"

To uncover the characteristics and limitations of cognitive behavior in interactions during the discussions, we adopted the Cognitive Process dimensions of the revised Bloom's Taxonomy (Anderson & Krathwohl, 2001), which has been commonly used to distinguish the dimensions of cognition in numerous studies (Rovai et al., 2009; Valcke et al., 2009). As illustrated in Table 2, each code represents a cognitive aspect. This code classification will help us understand students' cognitive process in online discussion activities. Furthermore, we have provided discussion examples to explain each code item in Table 2. Regarding the review and research of the quantitative content analysis (QCA) method, Rourke & Anderson (2004) suggested that researchers apply the existing and widely used coding schemes to improve the validity of the study. Because the above-mentioned schemes of knowledge construction and cognition have been widely applied or discussed in previous studies, they may positively influence the validity of quantitative content analyses.

Procedures

We conducted a 20-day role-playing discussion activity for the 70 participants to observe how they collaborated in the discussion of a simulation scenario. The scenario concerned a company facing poor internal management. In the activity, the teacher assigned 70 different roles of employees to each of the 70 participants, i.e., 70 students role-played 70 different positions in a corporate office. For example, student A played the financial manager; student B, the sales representative; and student C, the general manager. The 70 participants were asked to discuss and comment on the organizational management-related issues faced by the company. Since all students were involved in playing different roles and interacted simultaneously with each other in the discussion activity, simulated real-life interactions within an organization were achieved. The target objective of the task was to have 70 employees within a corporate company face poor sales performance and management bottlenecks, and to have them rectify and reform issues such as controversy in performance appraisal system and digital organization planning. Therefore, under the guidance of managerial supervisors and the coordination between departments and interdepartmental communication, the task required all role-playing students to act according their job positions, and to draft a proposal for the aforementioned issues on company's management reform.

To make the simulation more realistic, during the whole discussion the participants were asked to show labels stating their job titles and names in their postings. Students making a response comment could do so by posting a thread that others could read and post a reply. To avoid interference from the teacher's subjective guidance and intervention, the

teacher was not allowed to provide any form (physical or virtual) of guidance or intervention before the discussion was concluded.

Data Analysis

We manually coded each message in the discussion in the following manner: each thread was treated as a unit, and the coder coded a thread and all its replies as a message list based on chronological order (the thread content itself is the first message; the first reply is the second message, and so on). There were 219 messages in the discussion. The average number of the learners' postings was not very high. However, in role-playing activities, the number of discussions was relevant to the roles students played. The students who played manager positions did not need to search and share much data or make massive discussions of work details. They only needed to integrate and make a decision based on the collected data. Therefore, the number of postings from these students might be lower than other roles. The number of posted messages for each student differed with the differences of his role category and level of participation in this case study. The sum of discussion numbers was limited, but the students had sufficient discussions for the assigned task in the instructional activity.

Based on the two above-mentioned coding schemes, messages that covered the closest to a particular item within the two schemes were coded chronologically. Upon coding, each thread generated a coded dataset of each scheme, yielding 219 C-codes and 219 B-codes after the coding was completed by researchers with professional backgrounds in psychology. To ensure inter-rater consistency between coders, we gave approximately 70% of the discussion (160 entries of discussion messages) to another coder with the same background to code. The inter-rater reliability Kappa of the dimensions of social knowledge construction (C-code) and cognition (B-code) was 0.67 ($p < .001$) and 0.71 ($p < .001$), respectively. We calculated the distribution of various codes (including code C and code B) to understand the content structure of the discussion. The coded data was chronologically arranged for sequential analysis. The sequential analysis was carried out by conducting the statistical analysis of a series of behavioral transfer sequences from a coding item to another coding item. The analysis process included frequency transition tables, condition probability tables, expected value tables, and adjusted residuals tables (Bakeman & Gottman, 1997; Hou, 2010). Through these processes, we were able analyze each sequence in the matrix (e.g., sequence A-> B), and test if the continuity of individual sequences achieved statistically significance. The significance shown in specific sequences illustrated a behavioral transfer pattern in cognitive and knowledge interaction of the entire community observed. Finally, we also conducted qualitative content analysis in some of the behavioral phenomena observed and carried out in-depth discussions in the overall research findings.

Results and Discussion

Quantitative Content Analysis

The distribution of the codes of social knowledge construction and cognition are shown in Figure 1 and Figure 2, respectively. Because the four codes of C4, C5, B3, and B5 were not found in our study, they are therefore excluded from the figures.

Figure 1 indicates that, in terms of knowledge-construction-related interactions, C1 (sharing and comparing) has the highest percentage (87.67%). This finding suggests that in this discussion-based online instruction, the college students in this study often focus on knowledge sharing and comparison, or they may develop other knowledge construction phases (i.e., C2, C3, C4, and C5) based on C1. The percentage of off-topic discussions (C6: 0.91%) is extremely low, indicating that the level of concentration in knowledge construction interactions may be better achieved through the strategy of role-playing.

Diversity is rather limited in the dimensions of knowledge interaction beyond C1 (i.e., C2, C3, C4, and C5); among these, the percentage of C2 (7.31%) is slightly higher than that of C3 (4.11%), whereas C4 and C5 do not appear. However, C2, C3, C4, and C5 are the key factors in the process of argumentation (e.g., Erduran et al., 2004). The finding that C6 (0.91%) is extremely low is consistent with the idea that learners adopting role-playing strategies are better motivated in learning (e.g., Wishart et al., 2007).

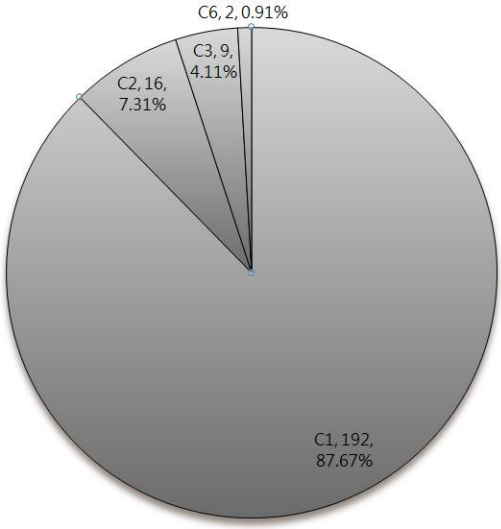

Figure 1. Distribution of the quantitative content analysis of interaction

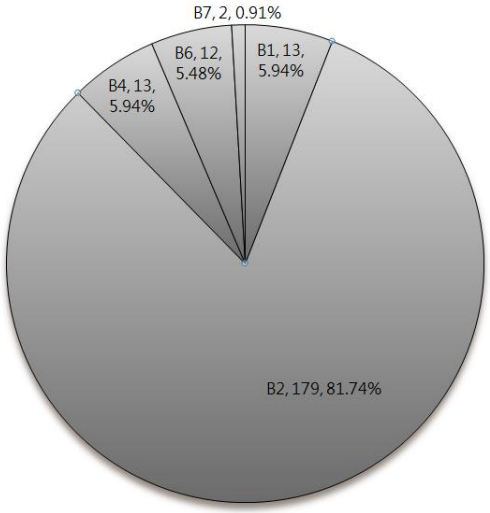

Figure 2. Distribution of the quantitative content analysis of cognition

Figure 2 indicates that the dimension of cognition in the discussion content is mostly dominated by B2 (81.74%), a finding that suggests that roughly 80% of the cognition process in discussions consisted of understanding (such as giving examples or explaining). Notably, B1 (Remembering) (5.94%), B4 (Analyzing) (5.94%), and B6 (Creating) (5.48%) show similar proportions, whereas B3 (Applying) and B5 (Evaluating) were not found in the discussion content. These results indicate that the structure of the students' cognitive processes in a role-playing-based discussion consists of remembering, understanding, analyzing, and creating. However, because role-playing focuses on the training of students' decision-making capabilities (Bos & Shami, 2006; Pata et al., 2005), knowledge may be applied in the decision-making process (B3) to form different plans before they can be evaluated (B5). In our study, however, these two types of discussion are absent, indicating that the teacher should be aware of this limitation and work on this process when conducting a similar activity.

Sequential Analysis

The data coded above underwent sequential analysis to analyze further the visualized sequential behavioral patterns of the role-playing discussion content. After calculating the frequency transition tables, the condition probability tables, and the expected value tables (Bakeman & Gottman, 1997), we derived the adjusted residuals tables for the

two coding schemes, as illustrated in Tables 3 and 4. The z-score value of each sequence was calculated to determine whether the continuity of each reached the level of significance. Each row indicates a starting discussion behavior, whereas each column indicates which discussion behavior follows; a z-value greater than +1.96 indicates that a sequence reaches the level of significance ($p<0.05$). Based on these results, we were able to infer transition diagrams for behaviors that reached the level of significance, as depicted in Figs. 3 and 4, where arrows indicate the direction of the sequences.

Table 3. Adjusted residuals table of the knowledge construction interaction

	C1	C2	C3	C6
C1	1.79	-5.13	-1.62	1.53
C2	-0.92	2.36*	1.18	-0.46
C3	-0.04	0.43	-0.43	-0.3
C6	0.2	-0.44	-0.22	-0.16

*p<.05

Table 4. Adjusted residuals table of the dimension of cognition

	B1	B2	B4	B6	B7
B1	-0.69	-0.38	1.05	2.38*	-0.32
B2	1.01	1.95	-6.52	-5.95	1.54
B4	-0.82	-0.89	3.66*	1.94	-0.39
B6	1.24	-0.1	-0.55	-0.34	-0.28
B7	-0.33	0.2	-0.31	-0.19	-0.16

*p<.05

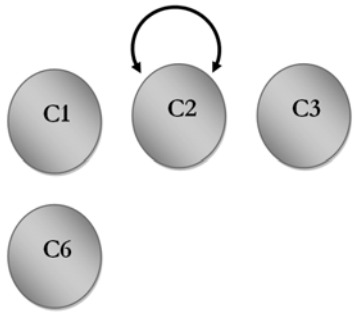

Figure 3. Transition diagram of the dimension of knowledge construction interaction

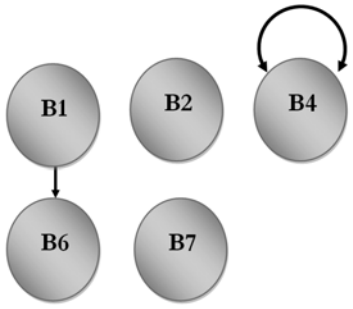

Figure 4. Transition diagram of the dimension of cognition

Figures 3 and 4 indicate that the only significant sequence for interactive knowledge construction was C2->C2, whereas the significant sequences for the dimension of cognition are B1->B6 and B4->B4. C2->C2 indicates that in this role-playing-based discussion activity, the students showed continuity in how they defined or discussed the various different comments from others, whereas B4->B4 also indicates that students showed a certain degree of continuity in their analysis of a given topic of discussion.

The sequences of C2->C2 and B4->B4 indicate that when the strategy of role-playing is utilized, student discussion may show a greater tendency to focus on the discussion of different comments and opinions (C2) as well as a stronger focus and a greater degree of continuity in the process of analysis in the dimension of cognition.

In addition, although B1 and B6 average only 6% of the overall discussion, B1->B6 indicates that in the process of discussion, students occasionally moved directly from remembering to creation (e.g., formulating new decisions). We see that although the content structure includes four cognition-related codes (i.e., remembering, understanding, analysis, and creation) and a certain level of continuity of analysis (B4->B4 behavioral pattern), B3 (Applying) and B5 (Evaluating) are absent, which suggests that a gradual advancement of the cognitive discussion phase (e.g., B1->B2, B2->B3, or B3->B4, etc.) does not occur in the discussion sequences. We also noted that some participants recalled specific shared information or comments directly from memory and went straight to the planning and decision-making aspects of creation (B1->B6) without discussion (e.g., B1->B2, B1->B4).

In order to further explain these findings, we focused on the qualitative content analysis of students' discussion to better understand its context. In qualitative analysis we found that students in the role-playing process have a certain degree of understanding (B2) and analysis process (B4), but the proportion of its analysis level (B4) is still limited. This result is similar to the finding of previous studies (Hou, 2011). However, we also found that new ideas would appear in some of the discussion context without full understanding, application, analysis and evaluation. This is similar to the above B1-> B6 finding, as is in the following excerpt of a student discussion:

> *Sales rep A (# S0113): Enterprise Resource Planning; ERP, Supply Chain Management; SCM, Customer Relationship Management; CRM, Knowledge Management; KM and other systems … can increase efficiency. (The student then describes the individual function of these systems…):*
>
> *IT personnel (# S0011): As an IT personnel, my viewpoint is that our company does not merely become digitized, but it should also take action and become mobilized. First, we start with "digitizing all stores", which allows customers to enter the store and search information with the digital service platform, as well as provides market information to attain information transparency ... (the student then explains his new proposal ...)*

Taking the above discussion as an example, the student S0113 who played the sales representative mentioned several systems and their functions that he believed could be used for digital organization based on his own knowledge. However, the IT personnel (S0011) directly addressed his digital organization proposal without even analyzing or assessing sufficiently the information provided by the sales representative or other students (such as contemplating the evaluation of S0113's aforementioned systems or assessing their feasibility). Also, his new proposal did not specify the necessary steps to implement, nor did it conduct a feasibility assessment. This example reveals that students may jump to conclusions or decisions without undergoing a sufficient and complete cognitive process, or they may directly treat or quote online information as answers (e.g., Chang & McDaniel, 1995; Wallace & Kupperman, 1997).

On the other hand, we also explored the behavioral differences in the different categories of roles. The roles assigned to students were divided into two main categories, roles that involved taking on the managerial position with more responsibility and authority (such as department managers), and roles that involved taking subordinate positions (such as rookie sales representatives). We discovered in the qualitative analysis that students who play the managerial roles tend to give brief instructions, compile others' opinions, or devise thinking and planning approaches for subordinate employees. Such role-playing behavior can help students themselves in planning and integrating abilities, and at the same time, motivate other members in data analysis. On the other hand, students who played the subordinate roles focused more on practical experience in knowledge sharing and data collecting, discussing the topics in details. While previous studies have identified the behavioral categories of students' on-line collaborative learning process in role-playing (e.g., De Wever et al., 2008; Strijbos et al., 2004), the results of this study further clarify the characteristics of role-playing behavioral pattern in the activity of simulating real-life scenarios. The results show that a discussion activity specifying different simulated roles can help students achieve a certain degree of communication and cooperation, and may develop their communication skills (e.g., Chien et al., 2003). However, the task in this case study evidently demands extra effort from students to appropriately apply online resources in order to solve problems and evaluate each proposed proposal. Furthermore, in this study, students illustrated in the overall discussion an inadequacy in two cognitive skills: application and evaluation, and their analytical skills were

also very limited. Teachers and software developers may use above findings to determine the types of intervention needed to facilitate discussions that would promote completion of the cognitive process.

Conclusion and Suggestions

In this study, we attempted to use a method of analysis that integrates content and sequential analysis to explore the characteristics and limitations of a role-playing-based online discussion activity for the learning community.

As for the characteristics of a role-playing-based online discussion activity, our process analysis and discussion indicate that the students in our role-playing-based activity demonstrated a certain degree of cognitive content structure in their discussions, a certain degree of analysis of different opinions, as well as behavioral patterns of sustained concentration. These findings may suggest that the strategy of role-playing motivates learners (e.g., Wishart et al., 2007) and may develop and improve some argumentation skills, such as comparing and analysis of different opinions to propose their claims (Driver et al., 2000).

As for the limitations of a role-playing-based online discussion activity, we have discovered that the cognitive dimension of the discussion lacked the development of B3 (Applying) and B5 (Evaluating), both of which comprise the decision-making skills valued in role-playing activities (e.g., Bos & Shami, 2006; Pata et al., 2005). This indicates that the diversity of social knowledge construction is restricted. The gradual advancement of the cognitive process was also limited. Furthermore, while our analysis showed continuity (B4->B4), analysis (B4) was not sequentially correlated with other cognitive processes (e.g., B1->B4, B2->B4, etc.). Some students even jumped directly from memorized knowledge to creation (B1->B6), indicating that they may jump to conclusions without going through a sufficient and complete cognitive process.

Based on these limitations and the above discussion, we propose the following suggestions for teachers when guiding learners in a role-playing-based discussion activity:

1. To help learners develop better cognitive skills, teachers may review the limitations of the discussions we discovered in the dimension of cognition when teacher intervention does not introduce and focus on promoting the depth of learners' cognitive processes. For example, teachers may post messages to guide students to think about relevant applications (B3) (e.g., reminding the students that certain information gathered may be applied to solve a certain component of the issue of corporate reform or asking them to think about possible applications) or prompt them to evaluate different pieces of information and comments (B5: Evaluate) (e.g., reminding the learners to take note of the feasibility of certain plans and evaluate them) as a way to reinforce cognitive aspects that may neglected in the discussions. Teachers may also trigger connections between analysis (B4) and other cognitive aspects (e.g., triggering B2->B4, B3->B4, B4->B5) as a way to ensure a complete and in-depth cognitive process in the discussion.
2. To improve social knowledge construction, teachers may introduce more structured strategies to promote diversity in knowledge construction. For instance, they may divide the discussion activity into data-collecting, stating opinions, coordinating and reviewing each plan, and formulating decisions. These efforts increase the scope of discussions in a more structured and organized manner and promote interactive social knowledge skills such as negotiation (C3), the ability to apply past knowledge to the present, including reflection on and review of this practice (C4), and the capacity to organize creative thoughts generated by the group (C5).

Lastly, we have discovered that an analytical approach integrating interaction and cognition may allow in-depth analysis of the content structure and behavioral patterns of students' online discussion process under a certain instructional strategy. This finding could be adopted as an evaluation method in future studies of online discussion instructional strategies.

Moreover, one worthwhile study for developers of intelligent discussion-based teaching systems is the design of an automated mechanism that integrates sequential analysis into online discussion or general learning platforms and automatically detects the learning process (e.g., Hou et al., 2010). In contrast with post-event, batched behavioral analysis, this approach allows researchers and teachers to evaluate instantly the behavioral patterns in online learning and to guide the learning community in a timely fashion.

In designing the discussion activity, we recommend that teachers design a series of scenarios that offer students the opportunity to change roles in many different tasks. This design may help enhance knowledge construction and diversity of cognitive thinking. Such an approach awaits future empirical researches for further in-depth analysis. In addition, there is much to be examined in the domain of role-playing-based online learning, including how realistic the learning community's role-playing is, and how factors are correlated to learning motivation and learning performance.

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