

MULTIPLE CONTENT ANALYSIS MODELS FOR ANALYZING HIGHER ORDER THINKING DEVELOPMENT IN ONLINE FORUMS

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ABSTRACT

Literature on blending multiple coding methods to obtain a more nuanced understanding of the complexities of thinking remains limited. This article explores asynchronous transcripts from an action research study to determine whether or how multiple content analysis instruments can effectively assess the development of higher order thinking. The intervention design was based on ecological constructivism. The mediation provided drew upon sociocultural theory. The study included 16 Japanese high school students engaged in English-based online synchronous and asynchronous activities, supported by in-person, face-to-face sessions conducted in Japanese. Qualitative data were collected from asynchronous forums, a post-survey, and my observation notes. Participants' forum interactions were transformed into quantitative data using three content analysis instruments: the Interaction Analysis Model (IAM), the Cognitive Dimension of Revised Bloom's Taxonomy, and Krathwohl's Affective Domain. These were selected based on the definition of higher order thinking adopted in this study. It was concluded that it takes time to analyze data with multiple models. Researchers need to be trained to use each model properly. Nevertheless, this study indicated that the use of multiple content analysis models can facilitate the development of higher order thinking in online discussion forums by complementing each other and highlighting different aspects of thinking.

Keywords: Content analysis models, Interaction Analysis Model, Cognitive Dimension of Revised Bloom's Taxonomy, Krathwohl's Affective Domain, higher order thinking, online forums, action research

INTRODUCTION

Education is taxed to transform itself in response to various demographic, technological, economic, and sociocultural changes moving into the fourth industrial revolution (Ally & Wark, 2020; Keller, 2008). Therefore, a critical responsibility for educational institutions is to provide learning environments that foster the development of independent learners who possess such skills as critical thinking, problem-solving, and learning how to learn in order to function in this complex world (Ally & Wark, 2020; Collins, 2014; Gabriel, 2007; Glassman et al., 2022; Wark, 2018; World Economic Forum, 2023).

In the wake of the COVID-19 pandemic, some online learning programs still appear to replicate traditional self-study correspondence courses or traditional in-person face-to-face (F2F) classes following lecture-based formats (Hodges et al., 2020) and a knowledge transmission model. In contrast, the mainstream online learning model emerging in recent

decades is characterized by technology-mediated knowledge construction through interaction in collaborative learning communities (Garrison, 2016). Although synchronous interaction is recognized as being beneficial in online learning programs, the asynchronous forum remains a hallmark of quality online learning due to the power that reflection and writing have for fostering learners' higher order thinking (Conrad & Openo, 2018). For the purpose of this study, *higher order thinking* is defined as "cognitive mental functions of understanding, applying, analyzing, evaluating, and creating knowledge, which are voluntarily controlled and facilitated through interaction" (Miyashita, 2022, p. 7).

An effective method for asynchronous communication analysis widely employed in online learning is content analysis (De Wever et al., 2006). Data from participant interactions in asynchronous forums is captured, stored, and then analyzed to discover patterns of knowledge construction. Transcriptions of online discussions can serve as a rich data source for informative, actionable feedback to students, teachers, and researchers (Bienkowski et al., 2012). Historically, content analysis focused upon gathering quantitative data on levels of participation. Then it was adopted as a tool for understanding transcripts on a deeper level (De Wever et al., 2006). Generally-speaking, the goal of content analysis is to expose information that is not readily observable at a surface level in transcription. A popular method of content analysis is coding. *Coding* is the assignment of a categorizing label to each unit of data (Cohen et al., 2018).

The Interaction Analysis Model (IAM; Gunawardena et al., 1997) is an established model (defined as a categorical system readily applied in practice; Miyashita & Wark, 2024) for exploring the social construction of knowledge in forums (Hall, 2014; Lucas et al., 2014). Although the IAM identifies three types of interaction (i.e., learner-content, learner-instructor, and learner-learner), which facilitate deeper thinking in collaborative constructivist learning environments (Moore, 1989), IAM does not assess learner-content interaction (i.e., interaction with learning materials provided in the program, such as books or video clips). Nor is the IAM able to assess students' learning or their reflections on an individual level, even though reflection is believed to be a critical aspect of collaborative constructivist learning (Conrad & Openo, 2018; Garrison, 2016; Liu et al., 2023; Rose, 2013). Furthermore, the IAM does not capture the complexity of thinking, including higher order thinking. Therefore, researchers are encouraged to complement the IAM with other forms of analyses to provide a more holistic picture of learning when assessing forums.

In fact, the IAM has already been used with other kinds of analysis procedures in some research studies. To illustrate, IAM has been triangulated with quantitative data on degrees of participation, qualitative data gathered from interviews or questionnaires, and with graphs or maps to visualize forum contributions (Hall, 2014; Lucas et al., 2014). The IAM has also been merged with other content analysis models, such as Newman et al.'s (1997) in Marra et al.'s (2004) work, Salmon's (2000) and Tuckman's (1965) in Brace-Govan's (2003) study, and Veerman and Veldhuis-Diermanse's (2001) in Schellens and Valcke's (2005) research. Still, content analysis tends to adopt the IAM as the sole model.

Content analysis is not a universally-applicable method; moreover, the concept of thinking is exceedingly complex. Thus, researchers are encouraged to identify content analysis models that suit the purpose of their study (Braun & Clarke, 2021; St. Pierre & Jackson, 2014). A review of literature indicates that, while there is a wealth of resources on how to better merge coding with other qualitative methods (Cohen et al., 2018), literature on how to blend multiple coding methods to obtain a more nuanced understanding of the complexities of thinking remains limited. To address this gap, this article explores asynchronous transcripts from an action research study to discover whether or how the use of multiple content analysis instruments can effectively access the development of higher order thinking. The research questions guiding this exploration are: (1) What are the

advantages and disadvantages in using multiple content analysis models to understand participants' thinking, if any? and (2) How can effective combinations of multiple content analysis models be determined?

METHOD

Action research

This study employed an action research methodology. Generally-speaking action research is "a small-scale intervention in the functioning of the 'real' world and a systematic, close examination, monitoring and review of the effects of such an intervention, combining action and reflection to improve practice" (Cohen et al., 2018, p. 441). There are two action research camps: the critical theorists' and the reflective practitioners' (Kemmis, 1997). The former considers action research within a larger agenda that is focused upon transforming education and society, whereas the latter engages action research to enhance professional practice at a local level. This study merges philosophies from both camps. Although generalizability of conclusions from this study is limited by the small number of participants learning within a specific context, detailed description of the course design, research site, and procedures enable transference to other settings.

Participants

This intervention was implemented in July-August, 2021, where I was employed at a public high school in Tokyo, Japan.

Enrolled in the second year (Grade 11 in the K-12 system) at this high school, all respondents voluntarily participated in the blended learning (BL) program that I designed. The number of potential participants was limited to 20; 18 were accepted. Data were excluded for two participants, as they only attended the synchronous portion of the program. Thus, the results reported herein were collected from the remaining 16 participants, who attended the synchronous and asynchronous portions of the program.

Researchers' roles

At the time of the BL program intervention, I was a full-time EFL instructor at the study site. I worked as the researcher, program designer, and primary asynchronous instructor in the BL program during the study. Due to the multiplicity of my responsibilities during the design and implementation phases, I felt it was crucial to carefully consider stakeholders' feedback. I also focused on developing my skills as a self-critical practitioner during each step of the cyclical process of this action research study (McNiff, 2013). An adjunct professor, engaged by universities in U.S.A., was invited to join me as the primary synchronous session instructor.

Design of the intervention

The BL program was a supplementary course, which students voluntarily completed. Employing the use of English for instruction and communication, participants engaged in synchronous and asynchronous constructivist learning activities in this program. The program consisted of three online asynchronous forums (one practice and two main forums; each one running for five consecutive days), combined with two 90-minute synchronous sessions. Activities were reinforced with in-person F2F sessions, employing direct instruction in Japanese about program contents, procedures, activities, and technologies. Although the in-person F2F component was designed to include 90-minute meetings at the beginning, middle, and end of the program, only the initial meeting occurred. The optional second session was not attended, and the final session was cancelled due to the COVID-19 pandemic. An explicit reflection period concluded the

program. Figure 1 depicts the flow of this BL program.

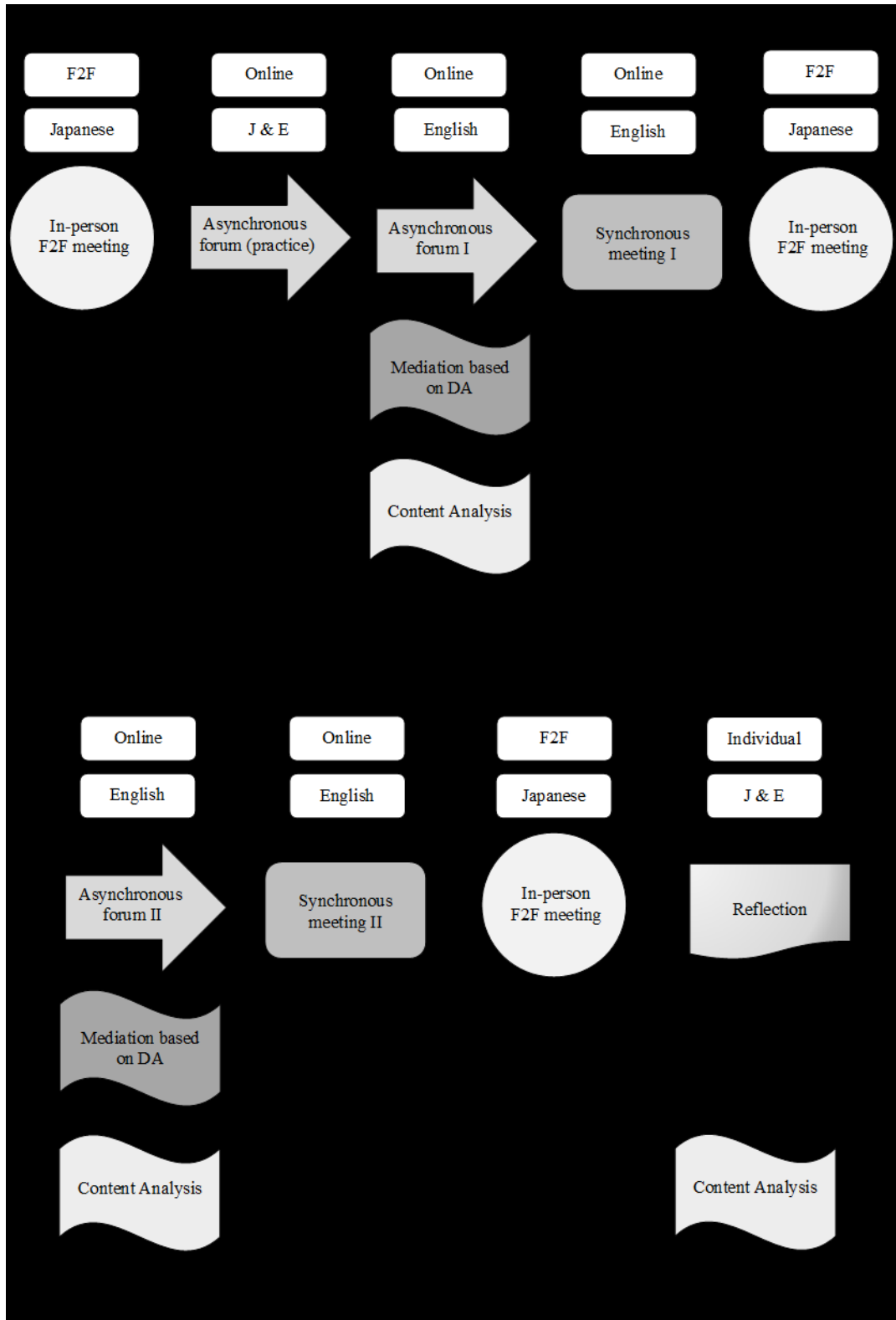


Figure 1. The flow of the blended learning program.

Theoretical foundation

The theoretical framework underlying the design of the BL program was constructivism. From within this broad framework, I drew upon the theory of social constructivism for student interactions, and ecological constructivism (Hoven & Palalas, 2016) for the connection between individual and collaborative learning, as well as for student reflections.

Instructional meditation in the asynchronous forums incorporated sociocultural theory (Lantolf et al., 2015) and dynamic assessment (Lantolf & Poehner, 2011) to promote greater systematic and learner-attuned mediation, and to enrich participants' higher order thinking (Lantolf & Poehner, 2004).

Instructional design

I wanted to move beyond teacher-led acquisition-oriented learning to adopt a more heutagogical (learner-determined) approach (Hase & Kenyon, 2013; Oktay & Yüzer, 2023), so I selected learner-centered inquiry-based instruction as the main instructional method for the BL program (Laurillard, 2012; Reigeluth & Carr-Chellman, 2009). As the primary instructor, I chose the theme and guiding questions. Participants explored the theme and related topics primarily through online discussion forums and reflection activities. As defined by Teaching English to Speakers of Other Languages (TESOL), the teaching method also included cooperative language learning and content-based instruction (Richards & Rodgers, 2001).

Course topic

Due to the current socio-political climate in Japan, students typically accept that English is essential for their future economic success. The course topic was purposefully constructed to encourage students to expand their metacognitive perspective on the value of English language learning. For instance, during the second synchronous session, participants designed individual presentations to address this question, "How can learning English be meaningful to me and to the world?" Two preceding asynchronous forums encouraged students to develop deeper thoughts on this question.

Data collection

The three data collection instruments included online discussion forums, a post-survey, and researcher observations. Artefact, inquiry, and observational data (Hendricks, 2013) were gathered. Artefacts consisted of asynchronous posting records from participants' interactions and contributions. Two initial asynchronous forums promoted student self-introductions and practice on the Google Classroom forum platform. I began interacting with students as the primary instructor/facilitator when they joined the two five-day forums (Forum 3 and 4). I did not mediate Forum 5, as it was intended for students to post individual, non-interactive reflections on the BL program. All participant forum posts were in English. Participants were invited to use English or Japanese to answer open-ended questions on their reflections about the program; all participants chose to respond in Japanese on the post-survey. I translated their responses into English for coding purposes. Final data were obtained from field notes that I recorded throughout the study process.

Data analysis and interpretation

I employed three data analysis procedures. First, I used content analysis (coding) to generate quantitative data. Second, I selected qualitative interpretive analysis to explore transcript, observational, and post-survey data. Finally, I triangulated the coded

quantitative data with the qualitative data, drawn from the qualitative interpretive analysis process, to yield a more comprehensive interpretation of the phenomena. Thus, this study exemplified a convergent parallel mixed methods design (Creswell, 2014).

Participants' asynchronous forum postings were transformed into quantitative data by employing the IAM (Gunawardena et al., 1997), Cognitive Dimension of Revised Bloom's Taxonomy (Cognitive Dimension; Anderson et al., 2001), and Krathwohl's Affective Domain (Affective Domain; Krathwohl et al., 1964).

The IAM consists of five phases with a number of sub-categories. The initial phase begins with lower mental functions, while subsequent phases progress towards increasingly higher mental functions, based upon Vygotsky's terms. Ordered from the initial to final phases, these phases are: (I) sharing/comparing of information, (II) discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements, (III) Negotiation of meaning/co-construction of knowledge, (IV) Testing and modification of proposed synthesis or co-construction, and (V) Agreement statements(s)/application of newly-constructed meaning (Gunawardena et al., 1997). The six major categories in the taxonomically-arranged Cognitive Dimension are: (1) Remember, (2) Understand, (3) Apply, (4) Analyze, (5) Evaluate, and (6) Create. These categories are ordered from simple/concrete to complex/abstract (Krathwohl, 2002). The Affective Domain is also organized as a hierarchical structure from simple to complex notions: (1) Receiving, (2) Responding, (3) Valuing, (4) Organizing, and (5) Characterizing. While the Affective Domain may not be synonymous with higher order thinking, it is bonded to the concept since the first two, Receiving and Responding, are linked to community building/social construction of knowledge, and the latter three, Valuing, Organizing, and Characterizing, are linked to higher cognitive functions/metacognition. The connection between the Cognitive Dimension, Affective Domain, and IAM are further explored in the Discussion section.

When coding qualitative data, it is prudent to select a unit of analysis that fits the purpose of a study (Rourke et al., 2001). Instructions included with the IAM instrument suggested that the unit of analysis should be the message, as the message represented the participant's understanding and offerings to collective knowledge construction in a forum (Gunawardena et al., 1997). The typical message and therefore, IAM coding unit, in this study consisted of one participant's post contributed to the forum at a specific moment during a given discussion. Cognitive Dimension and Affective Domain data were also coded using the message for the unit of analysis. Most often, a message was coded only once; however, occasionally a message was assigned to two or more codes. I employed a second coder to ensure a high level of coding reliability. Inter- and intra-coding reliability were not established as we coded all of the data together (Cohen et al., 2018).

Ethical requirements

In keeping with ethical standards (Cohen et al., 2018), I secured written permission from the study site's school principal prior to distributing a Letter of Information and Consent form to potential respondents (16- to 17-year-olds) and their parents/guardians. I discussed the aims, benefits, and risks of the program before students signed the form, ensuring that they understood their participation was voluntary and that they could leave the study at any time without risk of penalty.

RESULTS

Levels of participation: Quantitative data

On average, participants posted 2.3 messages in Forum 3 and 1.6 in Forum 4. These messages yielded an average of 121.8 words per post in Forum 3 and 121.4 words in Forum 4. Seven participants (43.8% of all participants) contributed posts in Forum 5 (the non-interactive reflective forum). Lastly, 12 participants (75.0%) finished the post-survey. As the primary instructor, I added a total number of 22 posts to Forum 3 and 24 to Forum 4, generating an average of 169.9 words per post in Forum 3 and 173.3 in Forum 4.

Participants' directional data (responses to prompts, other participants, or instructors) were also analyzed. Results indicated that 13 posts in Forum 3 (35.1% of all Forum 3 posts) and 14 posts in Forum 4 (56.0% of all Forum 4 posts) were generated from prompts. Coupled with the low number of participant posts in these forums, these results indicate that learner-learner and learner-instructor interaction was limited. Bullen (1997) identified two groups of forum messages: independent (responding to a discussion topic, without reference to other messages), and interactive (referencing other messages to advance a discussion). Applying Bullen's groupings indicates that most participants offered independent messages in response to prompts ($n=13$ in Forum 3; $n=14$ in Forum 4), while only seven messages in Forum 3 and four messages in Forum 4 were interactive in nature.

Forum 3: First main forum

Given the significant volume of data collected, only key results are reported here. Other results are available on request. Statistical data expressed in percent are rounded to the nearest tenth of a percent.

The IAM consisted of five parent codes, each represented one of the following phases: I: Share-Compare; II: Dissonate; III: Negotiate-Construct; IV: Test Construct; and V: New Knowledge. The Cognitive Dimension yielded six parent codes: (A) Remember, (B) Understand, (C) Apply, (D) Analyze, (E) Evaluate, and (F) Create. Lastly, the Affective Domain had five parent codes: (A) Receiving, (B) Responding, (C) Valuing, (D) Organizing, and (E) Characterizing.

In Forum 3, participants posted a total of 79 messages; eight messages were coded twice, and one was uncoded (it was a grammatical notation from the participant's previous post). Therefore, a total of 86 IAM units were coded from this forum. Seventy-two units (83.7% of all units coded to IAM) were coded to Phase I, two units (2.3%) to Phase II, 11 (12.8%) to Phase III, and one (1.2%) to Phase IV.

None of the the 79 Cognitive Dimension messages contributed by participants in Forum 3 were double-coded, while one was uncoded, producing a total of 78 units. Forty-seven (60.3% of all Cognitive Dimension units) were coded to (B) Understand, nine (11.5%) to (D) Analyze, and 22 (28.2%) to (E) Evaluate.

The Affective Domain produced a total of 78 units; 58 (74.4% of all Affective Domain units) belonged to (B) Responding, and 20 (25.6%) to (C) Valuing. Figure 2 illustrates the number of units by parent code for each instrument.

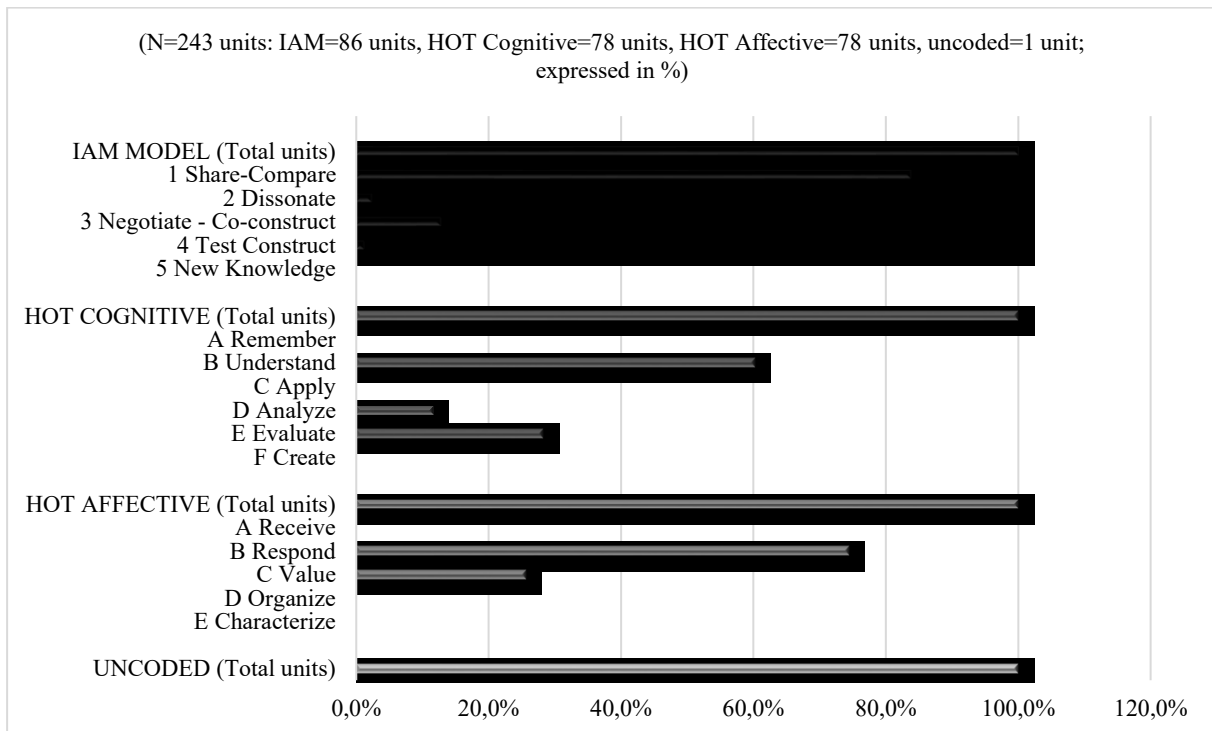


Figure 2. The proportion of coded units in forum 3: participants.

Forum 4: Second main forum

Forum 4 produced a total of 29 participant messages, generating a total of 29 units each for the IAM, Cognitive Dimension, and Affective Domain parent codes. Of these, 22 IAM units (or 75.9% of all IAM units) were sorted into Phase I: Share-Compare, six (20.7%) to Phase III: Negotiate-Construct, and one (3.4%) to Phase V: New Knowledge.

Thirteen of the 29 Cognitive Dimension units (or 44.8% of all Cognitive Dimension units) were allocated to (B) Understand, 10 (34.5%) to (D) Analyze, and six (20.7%) to (E) Evaluate.

Of the 29 Affective Domain units, 15 (or 51.7% of all Affective Domain units) were assigned to (B) Responding. The remaining 14 (48.3%) were assigned to (C) Valuing. Figure 3 graphically represents the proportion of coded units from participants' messages allocated to each instrument's parent code.

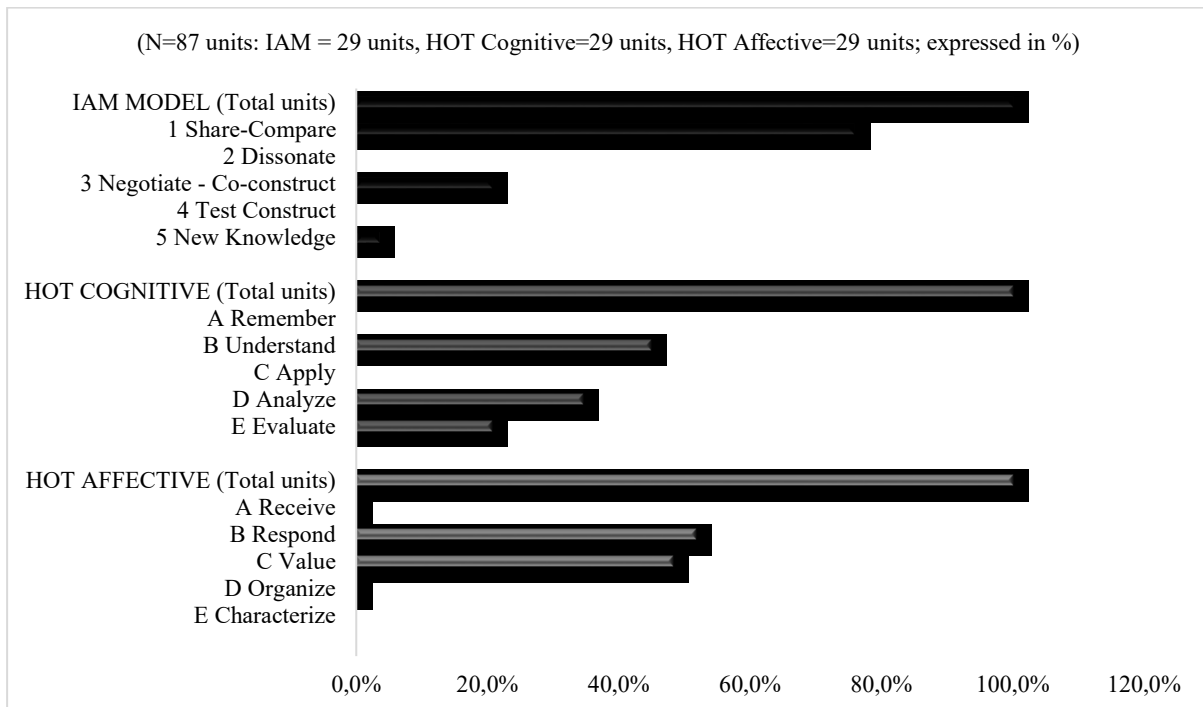


Figure 3. The proportion of coded units in forum 4: participants.

Forum 5: Reflection forum

Since Forum 5 asked participants to post their reflections on the course, rather than interact with each other or the instructor, the IAM instrument was not applied to this part of the analysis process. In total, seven units were allocated to each of the Cognitive Dimension and Affective Domain frameworks. Of the seven Cognitive Dimension units, one (or 14.3% of all Cognitive Dimension units) was allocated to (D) Analyze and six (85.7%) were allocated to (E) Evaluate. Of the seven Affective Domain units, five (or 71.4% of all Affective Domain) were assigned to (C) Value and two (28.6%) were assigned to (D) Organize. Figure 4 graphically represents the percentage of units assigned to the Cognitive Dimension and Affective Domain parent codes.

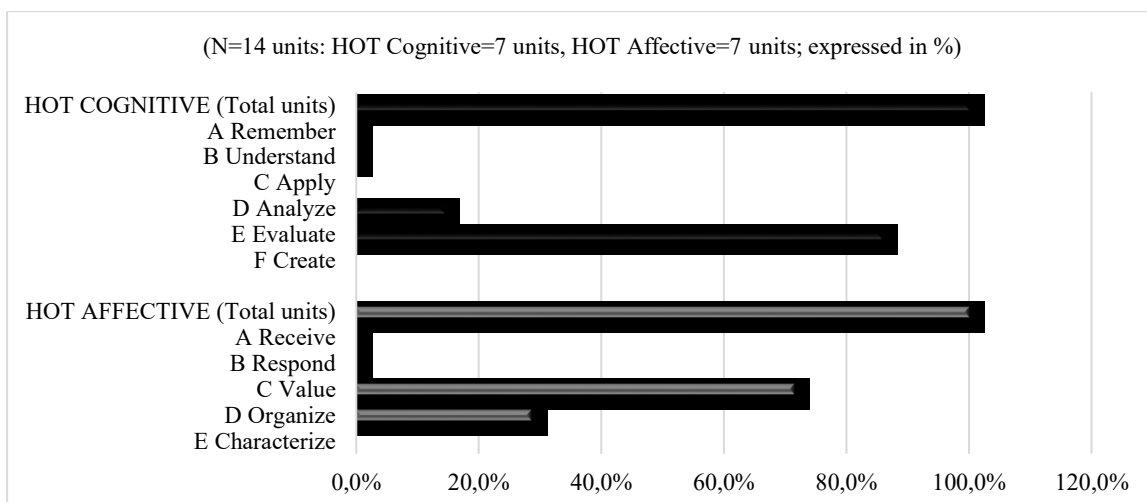


Figure 4. The proportion of coded units in forum 5: participants.

Inconsistencies between the IAM and the other two models

Phases I and II of the IAM are thought to be lower-level, while III to V are thought to be higher-level social construction of knowledge categories (Gunawardena et al., 1997). Likewise, categories A and B are thought to be lower, while C and above are higher levels of thinking in the Cognitive Dimension and Affective Domain (Tanujaya et al., 2017). Figure 5 illustrates how many units (or messages) from the lower and higher categories in the IAM in Forum 3 belonged to lower or higher categories in the Cognitive Dimension and Affective Domain respectively. Likewise, Figure 6 shows how many units that were sorted into lower and higher categories in the IAM in Forum 4 belonged to lower or higher categories in the Cognitive Dimension and Affective Domain.

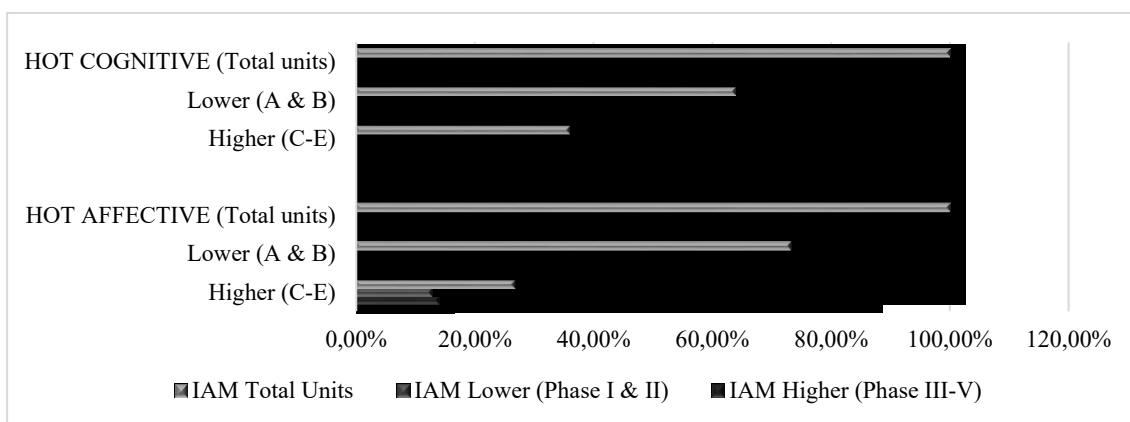


Figure 5. Forum 3 lower and higher order thinking: IAM vs Cognitive Dimension and Affective Domain.

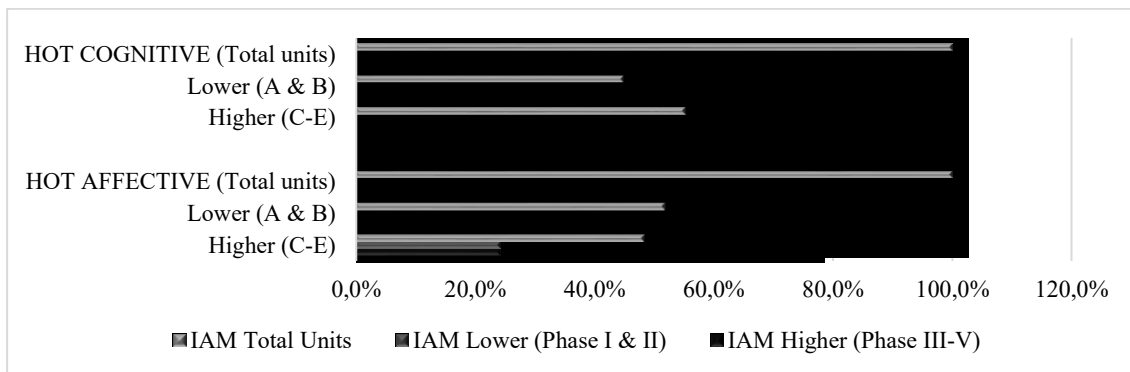


Figure 6. Forum 4 lower and higher order thinking: IAM vs Cognitive Dimension and Affective Domain.

Figure 7 compares the number of lower and higher level IAM units to the number of lower and higher level HOT (combined Cognitive Dimension and Affective Domain) units for Forum 3 and Forum 4. The IAM was not used in Forum 5 since participants were not asked to interact in this forum.

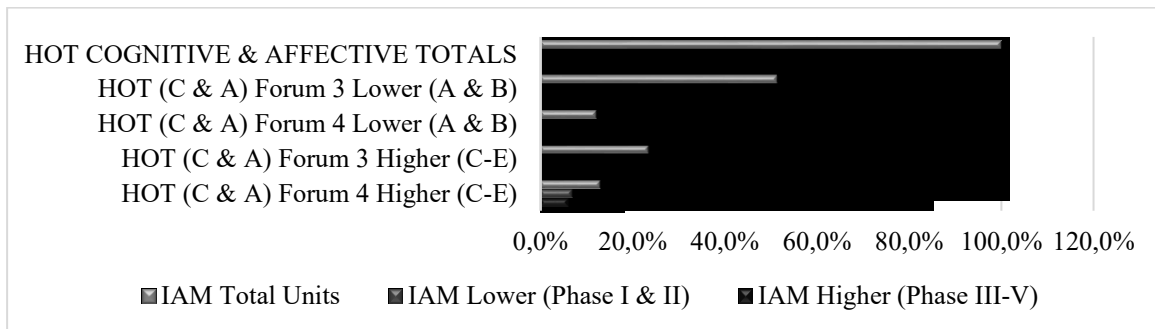


Figure 7. Forum 3 vs forum 4 lower and higher order thinking: IAM vs HOT (Cognitive Dimension and Affective Domain).

DISCUSSION

The most significant finding generated from the coding results indicated that learner-learner interaction in Forum 3 and 4 was minimal; nonetheless, participants demonstrated the development of higher order thinking through their engagement in this program. To illustrate, more messages in Forum 4 were coded into higher order thinking categories than in Forum 3 (Figure 7), suggesting that higher order thinking developed over time. Even though only seven participants contributed to Forum 5 (the individual-based reflection forum), all messages in this forum were coded to higher categories in the Cognitive Dimension and Affective Domain. Two participants stood out; they generated the most higher order thinking units coded to all analysis models in the three forums. These students actively interacted with other participants and the instructors, employing various facilitation strategies.

The following sections address the two research questions posed in this study, using coding results, a closer examination of participants' messages, the post-survey, and my observational journal juxtaposed with relevant literature.

Advantages of multiple content analysis models

The first research question was: What can be the advantages and disadvantages in using multiple content analysis instruments to understand participants' thinking, if any? Figures 5 and 6 in the Results section illustrated that messages sorted into higher categories in the IAM also belonged to higher categories in Cognitive Dimension and Affective Domain. In contrast, messages sorted into lower categories in the IAM might belong not only to lower but also higher categories in Cognitive Dimension and Affective Domain (Figure 7). The following three subsections explore why these inconsistencies may occur.

Sharing opinions with higher cognitive or affective functions

According to the IAM (Gunawardena et al., 1997), if a message is a statement of observation or opinion, the message has to stay in Phase I: sharing/comparing of information. In Forum 3 and 4, participants were required to answer two or three guiding questions in their first contribution to the forums after they read given articles and watching given video clips. Thus, all of the messages that responded to the guiding questions had to be sorted into Phase I in the IAM, because they were opinion statements. For example, in Forum 3, participants were asked if they agreed with the author after reading a short article that stated English was a global language. The following examples illustrate responding messages from Forum 3. (The coding results are inserted in square brackets after each unit of analysis.)

Phase I in the IAM and Lower Cognitive/Affective Categories

Example (a): I agree with this article. I think English will become more and more important by the time I work. [(B) Responding in Affective Domain; (B) Understand in Cognitive Dimension; Phase I in IAM]

Phase I in the IAM and Higher Categories in Cognitive/Affective

Example (b): I agree with this article. I feel more people need to learn English when I hear about my mother's and father's works. My father's company and American company will merge so he practice[s] speaking English online. My mother works in a nursery school, and takes care of some children whose mother or father is from other country. To make signs to them, she is trying to learn necessary sentence. But in my own case, these things cannot lead my motivation to study English hard because I am still a student so I cannot feel real sense of the necessity to lean English. [(C) Valuing in Affective Domain; (E) Evaluate in Cognitive Dimension; Phase I in IAM]

Example (c): Since people all over the world speak English as their first or second language, it can definitely be said that English is a global language, which is used in almost every field. Some people might say that English is just a language and people won't need it anymore because of the development of AI. However, I strongly agree with the author. Firstly, when I was studying in Australia, I noticed that the amount of information that came up when searching in English was much greater than when searching in Japanese. This means people use English to write articles with the aim of informing a wider audience. Secondly, I think you would probably talk to people in English when you go to a non-English-speaking country such as Russia, even though the Russian language is the fifth most spoken language in the world. That's probably because you would assume that they speak English to some extent. For these reasons, I believe that no one will deny it when they are told that English is the international language, which is used in countless spheres, education, business and science as such. [(C) Valuing in Affective Domain; (E) Evaluate in Cognitive Dimension; Phase I in IAM]

Example (a) was a reply to the guiding question with no affective commitment or higher cognitive functions. In contrast, Example (b) was also a reply to the guiding question, but this participant evaluated the importance of English as a global language by comparing the situation of her parents with her current feelings, showing some commitment to this issue. In Example (c), this participant also evaluated the importance of English as a global language by bringing in, and disagreeing, with the idea that people will not need to learn English with the development of artificial intelligence (AI).

Many of the forum 3 messages represented simple responses to the questions, which were readily sorted into lower categories in Cognitive Dimension and Affective Domain, yet some included higher cognitive or affective functions. Thus, even if participants do not interact with instructors or other participants, they can demonstrate higher order thinking in forums, which cannot be assessed by the IAM.

Negotiating, but with materials.

In the IAM, if a message demonstrates negotiation or co-construction of knowledge, the message can belong to a higher category, Phase III: Negotiation of meaning/co-construction of knowledge. However, the IAM was developed only for assessing collaborative co-construction of knowledge among participants and instructors; thus, this model cannot assess participants' interaction with content (i.e., learning materials, such as articles or video clips) provided in forums. One of the major advantages of adopting online

learning is its potential to increase interaction, which is divided into three categories: learner-content, learner-instructor, and learner-learner (Moore, 1989). It is common for participants to be given learning materials in forums; thus, this can be a drawback of the IAM if the purpose is to assess the development of thinking in forums.

In Forum 4, participants were required to answer whether they agreed with the author after reading a short article that described advantages and disadvantages of English as a global language, and by watching two video clips related to the theme of this article. Consider the following sample responses.

Phase I in IAM and Lower Cognitive/Affective Categories

Example (d): I agree with the author because we should communicate with people from different countries and know more about each other in the present day. Today we live in the globalization age. We learn a lot of things to make the world better than it is now. To communicate with many people, we can get a chance to discover a different viewpoint from us. I think that learning English makes us happy. Not only students but also adults should enjoy learning English and using English in various situations. When we will be adults in the future, I think it will be common to live with English as well as Japanese. [(B) Responding in Affective Domain; (B) Understand in Cognitive Dimension; Phase I in IAM]

Phase I in IAM and Higher Cognitive/Affective Categories

Example (e): In my opinion, I do agree with most of the pros and cons described in those two videos. However, I don't 100% agree with one of the cons. Many people spend hours, days, or even years pronouncing words and sentences trying to sound like "native speakers" which I think is useless since as Jay Walker said, English is a global language and is not a language that belongs to a particular region or country. Of course, speaking audible English is essential for making communications with others using that language. However, there is no such a thing as "Perfect English" and speaking in pronunciation which they fit into will, in my opinion, reflects their linguistic culture. As we are living in a diverse society, these differences in pronunciations should be respected and people should not be forced to "fix" their pronunciations to speak like the native speakers (people who speak English as their first language which in this situation, referring to the British or Americans). From what I mentioned above, the pronunciation of English is not a con that should be fixed but a pro that should be respected since it reflects our diverse society. [(C) Valuing in Affective Domain; (D) Analyze in Cognitive Dimension; Phase I in IAM]

Example (d) illustrates a respondent's generalization about the article being read. In contrast, the respondent in Example (e) negotiated with contents provided, arguing that there is no perfect English and diversity in English pronunciation should be respected. While many of forum 4 messages represented simple responses to the questions, which were readily sorted into lower categories in Cognitive Dimension and Affective Domain, some included higher cognitive or affective functions, negotiating with reading materials and/or video clips. This leads to the conclusion that, even if participants do not interact with instructors or other participants, they can develop higher order thinking by interacting with content provided in forums, which cannot be assessed by the IAM.

Negotiating, but within themselves (reflection/metacognition)

The IAM is also unable to assess learner interaction within themselves. The definition of *reflection*, an element of learning internal to individual learners, is not fixed, but inner interaction can be recognized as a form of reflection. Reflection is an important practice that can be incorporated in online discussion forums because asynchronous interaction

provides learners with the time necessary to critically reflect on views and to develop higher order thinking (Garrison & Anderson, 2003).

Metacognition is another important concept in higher order thinking. In the IAM, if a statement represents metacognition, the message can be sorted into the highest category, Phase V: Agreement statements(s)/application of newly-constructed meaning; however, metacognition that is recognized as Phase V in the IAM is limited to "Metacognitive statements by the participants illustrating their understanding that their knowledge or ways of thinking (cognitive schema) have changed as a result of the conference interaction" (Gunawardena et al., 1997, p. 14). Metacognition around a learner's self-motivation to learn, for example, cannot be counted as metacognition in the IAM. Considering the importance of reflection and metacognition in the facilitation of thinking, the lack of the ability to assess these two concepts can be a drawback of the IAM if the purpose of the analysis is to assess the development of thinking.

In Forum 3, participants were required to answer this question: Why do you study English? This question was designed to guide participants to deeper reflection, with the support of provided learning materials. While many messages represented simple responses to the question, which were sorted into lower Cognitive Dimension and Affective Domain categories, some included deep reflection or metacognition. The following are examples of both types of messages.

Phase I in the IAM and Lower Categories in Cognitive/Affective

Example (f): I have not decided what I do in the future. So why I learn English is unclear. But there is only one thing I can say. The reason why I learn English now is that it's cool if I can use English fluently. I want to get high scores in the English test such like regular school tests, Eiken, TOEIC, and so on. And I want to speak to foreigners with using English fluently when I go to travel abroad with my family or my friends. [(B) Responding in Affective Domain; (B) Understand in Cognitive Dimension; Phase I in IAM]

Example (g): I have two reasons why I learn English. First, I want to become friends with more people. If I can speak English, I will be able to travel in many countries and meet many people, join volunteer in other country, and help a person who comes to Japan from other country. It is happy to be able to communicate without translation because I can tell what I really want to say accurately. Second, I want to sing the songs in English. My favorite songs are "You Rise Me Up", "This Is Me", "Top Of the World" and so on. If you know [a] good one, please tell me. [(B) Responding in Affective Domain; (B) Understand in Cognitive Dimension; Phase I in IAM]

Phase I in the IAM and Higher Categories in Cognitive/Affective

Example (h): I've been using English for many years since I was a child. At first, I was just finding it interesting to communicate with people in English, but actually, the reason for studying English changed when I started to think about my future career. [(C) Valuing in Affective Domain; (D) Analyze in Cognitive Dimension; Phase I in IAM]

Example (i): I'm going to get in university in Australia to study business and accounting further to work in a global environment, so just being able to understand English doesn't mean anything, but I have to be able to MANIPULATE the language. I try to USE English all the time by speaking and writing. I believe that it's crucial for people who learn English not to be satisfied with just being able to understand it, because it will become the language that everyone should be able to use in the

future. [(C) Valuing in Affective Domain; (D) Analyze in Cognitive Dimension; Phase I in IAM]

The reasons expressed in Examples (f) and (g) were likely honest ones, but it was difficult to recognize elements of higher cognitive functions or respondents' commitment to this issue in these messages. In contrast, the participant who produced Example (h) exercised metacognition; observing the shift of his own motivation to learn English objectively. Also, in Example (i), the participant insisted that his own attitude toward learning English was different from many others' attitudes, thus exercising metacognition and reflection in his response.

The post-survey, closer examination of participants' transcripts, and my observations also suggested that messages sorted into lower categories in the IAM can belong to higher categories in Cognitive Dimension and Affective Domain. For example, one respondent made only one post in Forum 3, which consisted of three messages. Two of the three messages were sorted into lower categories in every model, but one of them was sorted into Phase I in the IAM, (C) Valuing in Affective Domain, and (E) Evaluate in Cognitive Dimension:

Example (j): I have two main motives to study English. First, I would like to find some interesting things of overseas for instance music, literature, and movies. There are also so many exciting things in Japan, but cultures using English have exciting things more. If I could use English better, I could enjoy there. Second, I'm afraid of that I can't use English. When something horrible happened in Japan, if I couldn't use English, I couldn't escape. This is useless worry, and I hope that. But, I sometimes feel that "It doesn't mean that Japan is perfectly safe." For example, when I saw or heard a news about nuclear powerplants, I feel that a little. If I could speak English, if I could believe that "I can escape anytime," I could live in Japan with more relief, I think. [(C) Valuing in Affective Domain; (E) Evaluate in Cognitive Dimension; Phase I in IAM]

In the post-survey, this participant stated, "After I made a post, the instructor sent me an article that was related to what I said in my post. By reading the article, I was pushed to think the matter more deeply. It was an interesting experience," and that "It was interesting to think why we learn English, using English. It was a good topic because I was very motivated to learn English." As the instructor, I offered a significant amount of feedback, including the introduction of new knowledge, presentation of different perspectives, and relevant learning resources in Forum 3 and 4. Although this participant was not actively engaged in forum discussions, his reply on the post-survey indicated that he likely exercised higher order thinking and found value in completing this program.

Examples in the above three sections demonstrate that adopting three tested models can increase the validity of content analysis. If only the IAM was employed for the analysis, the coding results would have shown that all of the example messages belonged to the lowest category of the IAM. On the other hand, these examples illustrate that the use of multiple content analysis models succeeded in capturing a more nuanced picture of the participants' higher order thinking development in forums.

Challenges of using multiple content models

There are a number of challenges to overcome when using multiple content analysis models. First, it takes time to analyze data with multiple models. Also, researchers need to be trained to be able to use each model properly.

Secondly, even if multiple content analysis models are adopted and qualitative analysis is combined with coding, there is a limit to measuring or understanding human thinking (St. Pierre & Jackson, 2014); what was captured in this study can only represent a part of the participants' actual thoughts. For example, it is difficult to assess if a participant fully exercised their potential or not in forums.

Moreover, it does not automatically mean that participants exercised their full potential even if many of their posts were coded to higher categories. Or, just because some participants contributed fewer posts, or posts that were sorted into lower categories, does not mean that they exercised their full potential either. For instance, one participant was highly active in discussions, especially in Forum 3. Most of his messages were sorted into higher categories on all analysis models. He expressed great appreciation for the program in Forum 5 and the post-survey. Yet, knowing how motivated to learn he was, and how proficient his English and communication skills were, it could be possible that he did not achieve his full potential in the program.

Conversely, a second participant contributed only six messages in Forum 3 and two in Forum 4; most of these messages were coded into the lower categories on all instruments. Yet, in the post-survey this participant wrote "When I saw a full screen of English, which seemed to be difficult to read, I had to hesitate to start reading," and "Reading opinions and questions from different perspectives than mine helped me think further." Reflecting upon her struggle to read and express her thoughts in English, coupled with minimal experience in publicly expressing her opinions, leads to the conclusion that she may have maximized her potential in this program, which could potentially lead to further breakthroughs.

Selecting appropriate models

The second research question was: How can effective combinations of multiple content analysis models be determined? Although developing new models in innovative research is encouraged, Rourke and Anderson (2004) recommended that researchers interested in content analysis should use suitable, existing models because creating new ones is extremely complicated, and requires exceptional research knowledge and experience. Therefore, one important factor to selecting appropriate content analysis models is the reliability and validity of the model. The three models that were selected in this study were well-tested.

Most importantly, how to select appropriate content analysis models depends on the purpose of the study and its definition of the subject of the analysis. Content analysis in this study was employed to identify the development of higher order thinking. Even though the concept of higher order thinking is popular and highly valued in education, a clear definition has been elusive. In this study, *higher order thinking* was defined as "cognitive mental functions of understanding, applying, analyzing, evaluating, and creating knowledge, which are voluntarily controlled and facilitated through interaction" (Miyashita, 2022, p. 7). This definition is based on the concept of ecological constructivism (Hoven & Palalas, 2016), wherein collaborative and individual learning through personal reflection are organically integrated. In addition, this definition drew on the Cognitive Dimension (Anderson et al., 2001), which is related to the individual's cognitive processes, the Affective Domain (Krathwohl et al., 1964), which is related to community building (receiving and responding) and metacognition (valuing, organizing, and characterizing), and Vygotsky's concept of lower mental functions and higher mental functions (Vygotsky & Rieber, 1997). Thus, the IAM, Cognitive Dimension, and Affective Domain were selected in this study to assess different aspects of higher order thinking as presented respectively in the proffered definition.

If the purpose of the study had been to explore only the social construction of knowledge, a sole model, such as the IAM, may have been enough. However, if the purpose of a study was to understand the development of thinking, and if thinking was defined as something multifaceted, multiple content analysis models may be required to assess multiple aspects of thinking.

Strict definitions of thinking or higher order thinking put aside, consensus should be that thinking can be developed socially and individually. If so, the combination of content analysis models that were used in this study illustrate one way to assess the development of thinking in forums or other learning environments.

CONCLUSION

The results in this study indicate that the use of multiple content analysis models can help to better understand the development of higher order thinking in online discussion forums. The IAM was created to assess social construction of knowledge resulting from interaction among instructors and other participants. This model cannot assess participants' interaction with learning materials or within themselves (i.e., reflection or metacognition). Also, this model does not assess affective or emotional aspects of learning. Cognitive Dimension and Affective Domain taxonomies complement the IAM by identifying aspects of thinking that the IAM was not designed to capture. Ultimately, the use of multiple content analysis models seems to have succeeded in painting a more nuanced picture of the participants' higher order thinking development in forums.

How to select appropriate content analysis models depends on the purpose of the study and how the study defines the subject of the analysis. If the purpose of a study is to understand the development of thinking, and if thinking is defined as something multifaceted, the combination of multiple content analysis models that fit the definition of thinking is encouraged. If thinking is defined as something that can be developed with three aspects—social, cognitive, and emotional presences—the combination of content analysis models that were used in this study can serve as a prototype to assess the development of thinking in online forums or other learning environments.

While advantages of adopting multiple content analysis models to understand the development of higher order thinking were recognized in this study, methodological challenges were also identified. It takes time to analyze data with multiple models, and researchers need to be trained to be able to use each model properly. Even if multiple content analysis models are adopted, and qualitative analysis is combined with coding, there is a limit to assessing the complexities of human thinking. While methods to explore thinking should be further refined, this limitation should be acknowledged in research that explores human thinking.

Developing higher order thinking in collaborative constructivist learning environments can contribute to nurturing active and critical citizens who help to shape tolerant, diverse, and inclusive communities (Campbell & Schwier, 2014). To further refine programs that include online discussion forums, future research may: 1) explore the development of higher order thinking in forums implemented in different contexts with the same IAM/Cognitive Domain/Affective Dimension analyses model that was used in this study, and 2) explore the development of thinking with different combinations of content analysis models, carefully selecting two or more models that fit the purposes of the study.

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