
Practice-Oriented Paper

Evaluating the Higher-Order Thinking Skills Used Within a Student-Made Reading Quiz Exchange

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Question-making within L2 language coursework is an effective springboard for L2 learners to practice L2 form construction and engage in higher-order thinking skills. Such inquiry and critical thinking can be guided through a taxonomy for learning, which crossed six revised levels of cognitive processing from Bloom's Taxonomy and the four levels of Webb's Depth-of-Knowledge. This paper outlines two stages where a group of learners assessed and created reading comprehension questions under this framework. The preliminary awareness-raising stage had classmates work together to identify the cognitive processes and knowledge dimensions of comprehension and discussion questions from a critical reading textbook. Then, the main project had learners create their own reading quizzes using news articles of interests accessed from a level-appropriate website for L2 English learners. The analysis was on the range of questions produced by the students and their reflections about their ability to do so. Students reported benefits to their L2 reading and increased awareness of the thinking skills needed for question-making. The results suggested that this student-made quiz exchange can serve as a reference to help teachers engage students in higher-order forms of inquiry.

Interpreting and formulating questions in a second language (L2) involves both syntactic and semantic processing that can pose challenges to L2 learners' success in achieving communicative aims. Language teachers can craft student-centered, motivating language coursework to develop learners' capacity to handle forms of inquiry, both in regard to constructions of grammar (Larsen-Freeman et al., 2016) and the higher-order thinking skills called upon by them. Broadly adopted within educational psychology, the revised taxonomy of educational objectives

by Anderson and Krathwohl (2001) is a framework for assessing and exercising a range of higher-order cognition by students. This framework crossed six revised levels of cognitive processing from Bloom's Taxonomy (1956) and the four levels of Webb's Depth-of-Knowledge (1997, 1999) to create a matrix for delineating learning objectives. These categories of cognizing are *remembering*, *understanding*, *applying*, *analyzing*, *evaluating*, and *creating*. The objects of these actions are forms of knowledge categorized as *factual*, *conceptual*, *procedural*, and *metacognitive*. This framework of twenty-four combinations can guide L2 learners to notice the cognitive actions and objects of knowledge that range within a rigorous set of questions that they may encounter or create.

This paper outlines an attempt to use this framework with a group of L2 learners of English. The aim was to learn about the range and rigor of the questions these students could create. The procedure was in two stages. First, an initial awareness-raising stage had students assess questions from a reading textbook in terms of cognition and knowledge. In the second stage, the students created, revised, and exchanged reading quizzes in a multistep process. The design aimed to meet the learners' innate need for learner autonomy, reward for competency, and interpersonal relatedness (Deci & Ryan, 1985). The resulting student-centered process yielded a range of inquiry between the students. The findings of this paper centered on the tallying of these qualities from across the quizzes they created. The rigor of thinking required by the students' questions are presented in a density plot similar to that of Hess et al. (2009). The results present a snapshot of the rigor entailed in the student-made quizzes and indicate the directions teachers can take to broaden students' engagement in higher-order thinking.

For L2 learning, organizing questions along levels of complexity can form a guide for learners to explore expanding levels of inquiry. The framework proposed in 1956 by Bloom and colleagues was developed to provide this organization for such learning objectives within education. The development of Bloom's taxonomy began from 1948 when test makers aimed to facilitate a categorical system for creating and comparing multiple-choice items for comprehensive examinations. From question items to lesson plans and curriculum standards,

the original taxonomy and its revision by Anderson and Krathwohl (2001) have since been applied extensively throughout the fields of education. Their work cited Bloom's call for possible revisions to the taxonomy as ideas about education evolve. The revised taxonomy has since received empirical support regarding both question item development in assessment and standards development within educational policy (Näsström, 2009). In this paper, Anderson and Krathwohl's revision of Bloom's taxonomy is applied again to the development of question-making. This application is student-centered and the educational objective is to develop L2 learners' ability to read L2 texts and to formulate a range of thoughtful questions.

The Cognitive Process and Knowledge Dimensions

Anderson and Krathwohl's (2001) framework consists of actions of thought that include *remembering, understanding, applying, analyzing, evaluating, and creating*. This concise list of verbs represents a continuum of increasing complex actions theorized to form a cognitive process dimension. For instance, the continuum ranges from *recognizing* and *recalling* (under *remembering*) to *hypothesizing* and *constructing* (under *creating*) (Anderson & Krathwohl, 2001). The objects acted upon under this framework were categories of "knowledge that students are expected to acquire or construct" (2001, pp. 4–5). These four levels were the *factual, conceptual, procedural, and metacognitive*. Of note, this distinction between knowledge types was formulated earlier as depth-of-knowledge by Webb (1997, 1999) within the field of mathematics education. The resulting matrix of the cognitive dimension and the knowledge dimension can describe the intention of questions in ways such as *recalling a fact, inferring a procedure, or critiquing a concept*. Anderson and Krathwohl (2001) acknowledged that distinctions along the two dimensions are not always clear-cut, but that the general hierarchy begins with lower-order categories which are subsumed by, and provide the foundation for, higher-order thinking skills.

Text Difficulty and Student Choice

An appropriate grading of reading texts helps ensure that students can focus on the texts' content and the making of reading comprehension questions. Nassaji

(2003) found the lower-level process of word recognition and the relation of texts to personal schema to be the determining barrier to effective reading by less-skilled L2 readers. Furthermore, L2 readers can maintain a focus on meaning while reading, uninhibited by vocabulary knowledge, if an estimated 98% of a text's lexis is known (Hu & Nation, 2000; Schmitt et al., 2011). Thus, using level-appropriate texts is ideal for L2 learners if they are to focus on meaning and engage well in a quiz-making project among peers. Nonetheless, there are trade-offs between accuracy and feasibility when estimating L2 readers' vocabulary knowledge (Gyllstad et al., 2020). For this collaborative lower-stakes classroom procedure, learner choice among acceptable material was prioritized to ensure student-centered learning.

To help ensure reasonably appropriate text difficulty and student choice, students can freely browse news articles of interest on Breaking News English (www.breakingnewsenglish.com), which is a free online resource that lists current news stories at different lexical grades meant for L2 readers. Users of the website typically have three levels of lexical difficulty to choose from for each news article. This choice of difficulty and topic can foster student engagement and be a reasonable way for appropriate text difficulty to be self-adjusting.

Facilitating Interaction

Having students make and exchange quizzes upends the teacher's central role of assessor and allows students to take on this empowering role. To spark intrinsic motivation and perseverance to develop L2 reading skills, student exchange can aim to tap language learners' innate need for learner autonomy, reward for competency, and interpersonal relatedness (Deci & Ryan, 1985). These aspects of motivation are also key to L2 reading (Komiya & McMorris, 2017). Regarding Japanese EFL learners, Kikuchi and Sakai (2009) found that they can fail to accept the value of a task when there is little or no interaction or choice provided by a teacher. Furthermore, Agawa (2020) also outlined how students felt more capable when they helped each other complete tasks. Tanaka and Hiromori (2007) found satisfaction in group work among peers but also that students who are typically less motivated can particularly benefit from a sense of

belonging. Thus, quiz development can be done within groups in a class while the quiz exchange can be between individual classmates from other groups. Additionally, anonymity of exchange of the final quizzes puts all participants on the same footing on the day of exchange, which can lessen social pressure (Cheng & Tsai, 2012).

Teachers can set a questioning format that is approachable and challenging. The rigor of thought needed to create questions is often different to the rigor of answering them. For instance, multiple-choice questioning eases the task of completing and grading quizzes, but it raises the challenge of quiz creation. In such a case, students must understand their text, create their questions, and create compelling distractor options. In the field of reading comprehension, Day and Park (2005) presented six types of comprehension questioning from *literal* to *personal response* with formats including open-ended and multiple-choice questions. It would be troublesome for students to mark open-ended questions and the most felicitous quiz method would involve multiple-choice quizzes automatically marked via a web-based quizzing platform. Additionally, selecting the multiple-choice question format reduces complexity of procedure for students. It allows them to focus on higher-order questioning for their chosen news articles within a common framework where they make individual choices regarding content. In sum, design choices by teachers can provide for students an understandable, peer-supported, and student-centered procedure that provides unique challenges to each student.

The Present Study

This study aims to critically evaluate the range of higher-order thinking skills evoked by the reading comprehension questions created by a group of L2 learners. The main project was a student-made reading quiz exchange that spanned weeks of an English course focused on reading skills and fluency. The primary focus of the study is on tallying the evaluations of the questions in the way Hess et al. (2009) tallied the learning objectives of classroom activities. This analysis is on how the students' questions aligned along the revised levels of Bloom's taxonomy (the cognitive process dimension) and Webb's depth-of-knowledge (the

knowledge dimension). Interest was also in what students reported about their reading and question-making abilities. The study sought to answer the following research questions:

1. To what extent will the questions on each student's quiz range the higher levels of the cognitive process and knowledge dimensions of Anderson and Krathwohl's (2001) revised taxonomy?
2. What realizations or instances of learning will the students self-report after completing the project?

Method

Participants

Twenty L2 learners of English from a university in the Kanto region of Japan participated in this project. These L2 learners comprised an intact group of students taking a language course with a focus on L2 reading skills. Seventeen of the participants spoke Japanese as a first language; two spoke Chinese and one spoke Korean as a first language. The proficiency level among the students in this course was representative of the students in the language program, largely CEFR A1 to A2 (TOEIC scores generally between 200 and 400) with a few individuals approaching CEFR B1 level (TOEIC scores around 550). The reading course was conducted online via Zoom, a peer-to-peer software used for synchronous online education. I was the teacher of this intact group of students.

Materials and Platforms

The initial stage made use of the textbook *Asian Issues 1: Practice in Critical Readings* (Graham-Marr, 2018). This textbook provides varied forms of comprehension and critical thinking questions for a selection of reading passages related to topics from within a number of Asian cultures. The main project made use of Google Forms, a web-based survey and quiz administration application. Google Forms was enabled as part of each student's university Gmail account. The students accessed *www.breakingnewsenglish.com* (Banville, 2021) and selected their individual news articles about which they made their reading quizzes. Typically, three levels of word difficulty were available for each article.

The students were to make six multiple choice questions and at least one question each needed to be of the following four types outlined in Table 1. These question forms were informed by research in the field, such as Day and Park (2005). The set is simplified to four types for the sake of the L2 learners so as not to overcomplicate the procedure. The setting of four question types also helped ensure a base level of variety in their question making.

Procedure

The students engaged in an initial awareness-raising stage and then the main quiz exchange project stage. The first stage introduced the idea that there are differences in mental rigor entailed by different questions. The class of students as a whole and in groups discussed the placement of questions from several units in the critical reading textbook. The sample of questions in the Appendix gives an idea of how the textbook was related to the cognitive processes and knowledge dimensions of the taxonomy. This practice in the first stage was introduced gradually over the initial weeks of the course. It was done collaboratively to stimulate class discussion, group work, and independent thought about the topic of questioning and higher-order thinking skills.

The main project, the 2nd stage, followed a formal sequence over the latter six weeks of the term (one session per week). Each student had some weeks prior to settle on a news article chosen on the Breaking News English website. They also chose the vocabulary difficulty level of their articles from the website's options. From the start of the main project, the students were assigned to groups of four

Table 1

Description of required question types

Types of expectations	
Type 1 – Detail question	Providing a detail directly mentioned in the passage
Type 2 – Vocabulary question	Deriving the meaning of a word based on surrounding context
Type 3 – Inference question	Making inference about the content based on details
Type 4 – NOT question	Distinguishing which option is NOT true or NOT relevant

people who worked together each week over the six weeks. During Session 1 and for homework, students worked independently and with groupmates to initially craft questions for their individual news article. Students were instructed on how to utilize keywords from their chosen texts. They were also reminded of the inference and critical thinking that had been covered in the course textbook.

Session 2 was for discussion and revision. The researcher came to each group to discuss what levels of high-order thinking were being called upon by the questions they were crafting. To maintain a student-centered focus, the researcher did not overly direct the students to change their questions to attend to different levels of Anderson and Krathwohl's (2001) framework. The exception was when questions were merely about recalling factual information or when distractor options needed clarification. The emphasis was on letting the student create their own questions and to keep the role of assessor centered among the students. The instructor gave some help with grammatical constructions, but groups were encouraged to settle on corrections through group discussion.

Session 3 was for setting up their quizzes on Google Forms. A template Google Form was provided, the students each created their own copy, and subsequently they set the basic settings for their quiz. Each student then sent the researcher an editor link. The researcher organized and viewed all 20 quizzes, and then provided feedback to individual students. Time for formatting and content revisions continued on their Google Forms on Session 4 and after. Before Session 6, the students finalized their quizzes, and the researcher arranged the allotments of Google Form links to be distributed to students in the class. Classmates were to take quizzes via these shared links. Names were removed from the quizzes. Session 6 was exchange day and each student received eight links to quizzes made by students from other groups. They did not receive links to their own quiz or quizzes made by their group mates. Within an 80-minute period of Session 6, each student completed their eight quizzes. Additional quiz links were available to students who finished with time to spare.

Following exchange day, students wrote their reflections about the project via a Google Form. Questions on this form included, "What was your impression about this quiz-making and exchange process?" "What do you think

you learned?”, and “Was anything a surprise to you?” Given that this project was one of many activities in this reading course, this collection of qualitative data sufficed given the time restrictions.

Analysis

The primary focus of this study was to evaluate the rigor of the questions produced by the L2 learners within this quiz-exchange project. The secondary focus was on instances of learning by students self-reported at the end of the project. Each article and set of questions from each student-made quiz was read and evaluated against the crossing of levels for cognitive processing and depth-of-knowledge. This evaluation process mirrored the textbook work shown in the Appendix. The evaluation was done directly by the researcher and one other English teacher who was familiar with the project. This analysis of the quizzes was done as a team where each question was discussed and assessed. Because the group of learners was small, and as Anderson and Krathwohl (2001) note, the distinctions along the two dimensions are not always clear-cut, it was most feasible to rely on this teamed approach for question evaluation.

The findings of this paper centered on the tallying of these qualities from across the quizzes made by the group of 20 students. The rigor of thinking required by the students’ questions were presented using a density plot, a graphical technique used in Hess et al. (2009). The resulting diagram illustrates the general *center of gravity* of questioning within the two-dimensional matrix. Additional graphic features were added to the presentation, such as the weight point of each student’s quiz and a general trend line of those data points. Qualitative data consisted of the students’ self-reported reflections about the project.

Results and Discussion

All students completed the steps of the process on time and all 20 students participated in the exchange. On the exchange day, a number of students requested and received links to more quizzes after completing their eight assigned quizzes. During this quiz-making and exchange project and upon its completion,

it was clear to the researcher that this approach was well-received by the group of students.

Questions along the cognitive process and knowledge dimensions

In answering RQ1, the students' questions were largely judged to entail *remembering facts* and *understanding concepts* along the taxonomy (see Figure 1). Regarding the cognitive process dimension, 36.8% and 57.0% of questions were attributed to the actions of *remembering* and *understanding*. Regarding the knowledge dimension, 47.4% and 46.5% of questions were attributed to *factual* and *conceptual* objects of knowledge. A smaller percentage of questions were considered to be more rigorous and a selection is presented here. For example, an article about a prison with a mice problem described how many staff and prisoners were relocated. The question, "How many people were moved from the prison?" asked the test-taker to *apply factual information* by recalling two facts and carrying out the action of combining them into one figure. While seemingly not too difficult, more is built into this question than merely recalling a single point of fact. From another quiz, the question, "What is the most relevant word?," had test-takers ascribe a single word to encompass the whole article. This was judged to be *analyzing concepts* of the article by way of *differentiating* and *finding coherence*, both higher-order actions of thought than understanding alone. These related verbs are outlined in Anderson and Krathwohl (2001).

The extent that higher-order thinking skills were used appeared to be similar to the degree found among the lesson plans researched by Hess et al. (2009). Their results can provide a reference point and help frame expectations for students more generally. However, deeper comparisons to Hess et al. (2009) are not made since it was a study of the learning objectives of lesson plan designs for younger learners studying language arts and mathematics. Nonetheless, their informative use of density plots was utilized for this study (Figure 1). Additionally, the *centers of gravity* of the students are overlaid on the two-dimensional matrix along with the general trendline. The purpose of this graphical presentation is to easily grasp the range of thinking skills built into the students' questions. The small

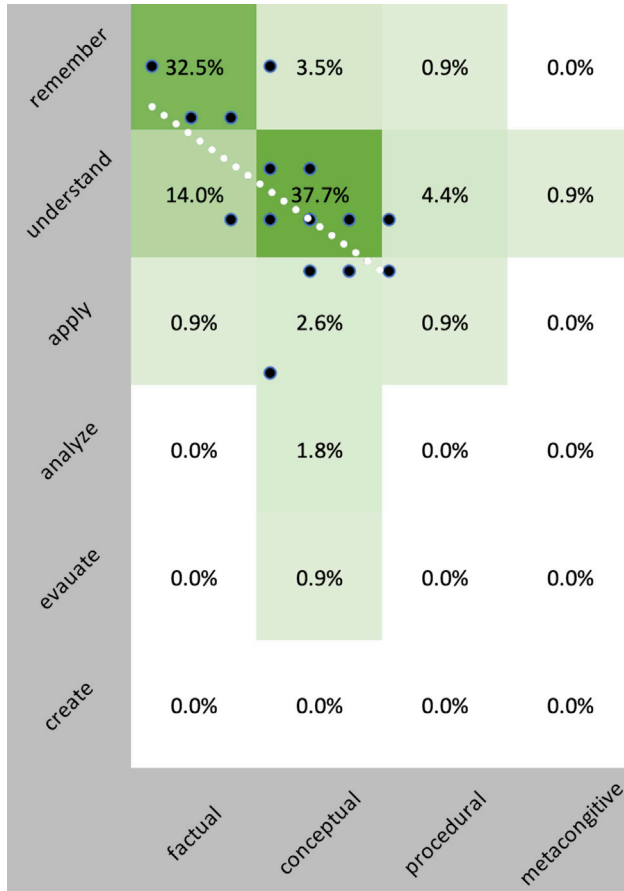


Figure 1. Density plot.

Note. This density plot indicates the range of the cognitive rigor of the students' question-making. The blue dots indicate the averaged position of a quiz's questions made by each individual student. Some dots overlap. The white dotted line represents a simple trendline centered for the group of students. Percentages do not always sum to 100% due to rounding error.

sample size is not sufficient for statistical analysis, but as a descriptive analysis, the general baseline levels for the cognitive process and knowledge dimensions for the 20 students could be ascertained.

Student learning

Concerning RQ2, many students reported learning how to better comprehend and more effectively make inferences when reading, and they referenced terminology and strategies covered with the critical reading textbook. Regarding the main quiz-making and exchange project, students reported how the practice of effective reading was necessitated by the process of making quiz questions for their chosen texts. Examples of this outcome were evident within the students' written feedback. One student mentioned the importance of keywording.

“I felt it was important to look for keywords when reading articles and to use skimming when reading sentences. Especially when I was making a quiz, I noticed that if I knew the keywords, the sentences would be easier to read.”

Another student discussed the challenges of creating questions that call on readers to infer answers and use higher-order thinking skills.

“Types 1, 2 and 4 are not hard to make but Type 3 is so hard to make. Because Type 3 need you to guess the thought of writer before you read the whole text and give the real answer. The answer is not wrote in the text and I am not the writer, so I may give the wrong correct answer.”

Another student said that the process of making a quiz was challenging but the process helped develop the ability to use test-taking strategies.

“I thought about the questions by referring to the questions in the class. It was a little difficult for me to make the quiz. But I had a good time working on it. I learned that there are some patterns in the quiz. I was able to solve other questions more easily.”

This feedback suggested that the project was successful in helping students to actively engage in reading texts. Moreover, the students' attention was brought to the grammatical construction and word choice of questioning. Many students took on this linguistic challenge and made many well-formulated and interesting questions. These findings form a reference point for language teachers to guide

students in their L2 reading and to engage them in higher levels of question-making.

Future considerations

The abilities of these students to make reading quizzes was captured in this study, but some limitations were identified. The reading units from the textbook included questions that covered the higher ranges of Anderson and Krathwohl's (2001) taxonomy. But the textbook contained open and closed questions, and the open questions tended to more flexibly tap the highest ranges by calling for in-depth answers. Nonetheless, allowing students to make open-ended questions within this quiz-exchange design could invite three potential problems: overly simplistic question-making, prolonged administration of the quiz exchange, and an infeasible structure for quizzes to be consistently constructed and marked. Using multiple-choice questions made it feasible to run the project, but additional practice in explicitly relating higher-order open questioning of the textbook to the multiple-choice question format could be beneficial. Nonetheless, there is a balance to keep by teachers between giving too much instruction and maintaining a student-centered learning environment.

Making multiple-choice questions with appropriate distracter options for high-stakes testing is a challenging specialty (see Eckes, 2015; McNamara, 1996), but such a level of multiple-choice question-making was not needed in such a project. The student-centered environment was maintained by prioritizing learner autonomy to choose texts and make questions. A sense of relatedness was intended by placing students in groups to support each other. Anonymity during the final quiz exchange was intended to help students rely on group mates without worry of critique from the whole class. Work in the course textbook and the choosing of reading difficulty for their news articles was aimed to help students feel competent. The outcomes of these intentions can serve as an example to reference by teachers designing similar classroom tasks.

Conclusion

A group of L2 learners engaged with comprehension and discussion questions from a critical reading textbook in relation to a cognitive processing and knowledge

dimension framework. The students' main objective was to create their own reading quizzes for news articles of their choice from a news website appropriate for L2 English learners. The students' quiz questions called upon a modest range of higher-order thinking skills. Moreover, the student's written reflections indicated improved awareness of reading strategies as well as the ability to make distinctions between the thinking skills outlined by the framework. The majority of their quiz questions required actions of thought more demanding than merely recalling facts. Questions about understanding concepts were common and some questions called for analysis. Increasing this higher range of thinking skills may be reached by providing more extensive examples of the multiple-choice question format but to an extent that would not detract from a student-centered learning environment. From the descriptive figures and the written reflections, in sum, the outcomes of this study indicated that a student-centered quiz-making and exchange procedure like this can be a fruitful part of an L2 language course.

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Appendix

For Stage 1, a sampling of questions from one unit in Asian Issues 1, plus their categorization

Understanding the Story Section (one of the three questions in this subsection)

#1. What is the best title for this article? [D]

(A) Four Seasons (B) Five Seasons (C) Hot and Humid (D) The Rainy Season

Critical Reading Section (two selected questions from this subsection)

Cause → effects

#2. [cold air meeting warm air] → the rainy season

#3. rainy season brings water → [rice grows]

Critical Thinking Section (two selected questions from this subsection)

Which are facts and which are opinions? Write F for fact, O for opinion.

#4. [F] The rainy season lasts for a month or more.

#5. [O] The four seasons are an important part of the Japanese character.

Representation of analysis of questions resulting from class discussions.

		Knowledge Dimension (objects of learning)			
		factual	conceptual	procedural	metacognitive
Cognitive Process Dimension (actions of thought)	remember				
	understand		#1	#2, #3	
	apply				
	analyze	#4	#5		
	evaluate				
	create				

Note: This sampling of questions is from subsections of “Plum Rain – Rainy Season” in Unit 3. When Stage 1 was actually done, a majority of the questions from a given unit were discussed and assessed. For this sample of questions, the correct answers are presented in brackets for reference.