Empirical Research on Learners' Perceptions: Interaction Equivalency Theorem in Blended Learning

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Abstract

This paper reports on an empirical research on the Interaction Equivalency Theorem posited by Anderson (2003a), consisting of the three elements of teacher-student-content interaction. Using an author-developed survey, the paper reports the priority order of interaction elements to assure learning quality with two parameters of learning modes and subject orientations. The inventory was tested in four universities with a total of 236 students. The results revealed that student-teacher interaction for face-to-face (F2F) and language-oriented course, and student-content for online and knowledge-oriented course were prioritized in students' perceptions to obtain higher satisfaction. In addition, the experience of increased asynchronous online written interaction with peers in the blended course design produced a change in the students' perceptions towards the necessary interaction elements. The research therefore adds empirical validity of the Theorem. Further research directions regarding the Theorem are also provided.

Keywords

Interaction Equivalency Theorem, blended learning, learning effectiveness

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Introduction

Interaction is a key to foster, support and engage learning (Anderson, 2003b). However, much is still unknown about the detailed mechanism as to why and how some interactions work more effectively and some do not. The fields of online and distance learning are unique because of the necessity to bridge the physical distance between educational providers and learners; hence, conscious efforts to plan and realize the interaction between the two parties are constantly demanded. In his seminal book on the theory and practice in distance education, Keegan (1996) posits three categories of theories, that is, independence and autonomy, industrialization of teaching, and interaction and communication, assigning a full chapter to each topic category, the last being the focus of this paper.

Key interaction theories

There are at least three major interaction theories that serve as the base for the current research: guided didactic conversation by Holmberg (1989), the Three Part Model of Interaction by Moore (1989), and the Interaction Equivalency Theorem by Anderson (2003a).

Guided didactic conversation by Holmberg (1983)

Holmberg conceptualized interaction between the instructor and the students in the early days of distance education when interaction was mostly in text form and mediated by postal services. Holmberg thought that, similar to the process of thinking aloud or internalized conversation, for learners to appropriate the course content, the interaction between the instructor and the students in writing should have a conversation-like quality. This special feature of conversational intercourse has been considered to function to overcome the "transactional distance" (Moore, 1993, pp.22-23) - a psychological and pedagogical separation between teachers and learners.

At this stage, the emphasis is more on the special *nature* of interaction, which is *guided* and *didactic* to foster individual learning, rather than the social elements involved in this two-way communication. However, the theory is notable because of its particular emphasis on establishing a type of mediated relationship between the instructor and the students, which is different from the directional transmission model used in broadcast or mass media (Keegan, 1996).

Three part model of interaction posited by Moore (1989)

Moore's 1989 model is said to have been the first to define the concept of *interaction* in distance education systematically. The paper articulates a typology of three types of interaction: learner-content, learner-instructor, and learner-learner (p.1).

Learner-content interaction is the learner interacting with content that results in "changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (p.2). Moore himself notes on page two of this paper that this idea refers to Holmberg (1986), who calls it the "internal didactic conversation" when learners "talk to themselves" about the information encountered in the

learning materials. Learner-instructor interaction is the learner interacting with an expert of the subject matter to gain support, including motivation, self-direction, presentation of information, and evaluation. Although the influence of this type of interaction is considered to increase in accordance with its frequency and intensity, the instructor personalizes instruction by engaging in a mediated dialogue with each learner. Learner-learner interaction was regarded as a rather "new dimension" and a "challenge" in distance education given the time the paper was written (p.4). However the subsequent development of virtual classrooms, immersive environments, social networking sites and other web 2.0 tools demonstrates the attraction and power of student-student interaction. Moore considered that the utility of this type of interaction is in identifying group leadership and membership for younger learners, but its importance lessens with older learners who have mastery of self-directed learning.

Current network technology and learning contexts now demonstrate the "frequency and intensity" of learner-learner interaction to the extent that it is becoming first among the three. As Garrison and Anderson note (2003), all forms of education can be defined by a combination of interaction among teachers, students, and content, including distance education. Although different terminology is used, this is also true for blended learning when Garrison and Shale (1990) posit the concept of *convergence*, which predicts "the blurring of the boundaries between distance education and conventional education" (p.131).

Interaction Equivalency Theorem by Anderson (2003a)

In extending Moore's model, Anderson developed his own interaction theory to clarify the different economies in distance education between independent-oriented and interactive-oriented learning strategies and activities. He stressed the importance of cost and sustainability as well as pedagogical value in choosing appropriate mixes of interaction. Taking the definition by Wagner (1994), interactions are first defined as "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence each other" (p.8) and focuses more on the side of "learning events" than "media" of interaction (p.6).

Anderson and Garrison (1998) also expanded the types of interaction to include all possible forms including teacher-teacher, teacher-content and content-content interaction (Figure 1) In its conception, teacher-content interaction refers to the process the teacher undergoes while developing and apply the learning content in education; teacher-teacher interaction is the opportunity to participate in professional and social networking; and content-content interaction refers to the ability of intelligent learning resources to interact, update and improve without the direct intervention of humans. Although these dyads may not be directly visible and felt by the students, they are interactions operating behind the scenes of education to support its higher quality.
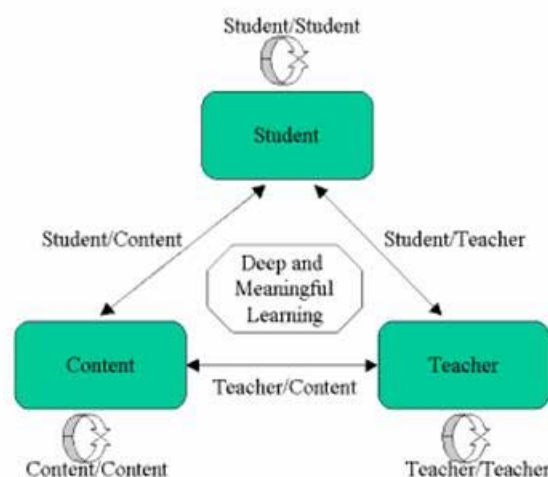

Figure 1. The interaction theory typology (Garrison & Anderson, 2003, p.43).

Anderson later developed an Interaction Equivalency Theorem that was designed to help educators select the most effective and efficient type of interaction. It states:

> Thesis 1: Deep and meaningful formal learning is supported as long as one of the three forms of interaction (student-teacher; student-student; student-content) is at a high level. The other two may be offered at minimal levels, or even eliminated, without degrading the educational experience.

> Thesis 2: High levels of more than one of these three modes will likely provide a more satisfying educational experience, though these experiences may not be as cost or time effective as less interactive learning sequences.

This is the antithesis of the traditional approach frequently applied in the field and in education in general. We tend to think the best way to achieve the highest learning outcomes and learner satisfaction is to have the most frequent interaction (usually between humans) with high intensity. However, Anderson's research and observations show that learners' needs vary and that higher interaction is not always the most appreciated or cost or learning effective (p.6).

A significant difference of Moore's interaction model to that of Anderson's is that the latter allows us to look at educational phenomena from multi-perspectives. In Moore's model, interaction is conceptualized in combination with the student, that is, from the learner's point of view. Garrison and Anderson's model allows us to perceive teaching and learning in their entirety not only from the student's perspective, but from the teacher's and the content's as well. In other words, a comparison of the Moore and the Garrison-Anderson models presents a shift from the learner per se to the entire distance education system in general.

Further, the Theorem was re-conceptualized to consist of two core theses of quality and quantity (Miyazoe & Anderson, 2010). The figure below is the visual expression of the concept.

| Thesis 1: Quality | **Figure 2.** Interaction Equivalency Theorem typology. | Thesis 2: Quantity |

That is, Thesis 1 questions the conditions under which certain limitations exist in providing interaction: under this condition, it asks if one of the interactions, namely, student-content, student-teacher, or student-student, is sufficient to provide a satisfactory learning environment. On the contrary, Thesis 2 questions whether or not we could provide more and more interaction, as well as spend more time and money if possible, in order to raise the quality level of interaction.

These are the core concepts behind the current paper's understanding of the Interaction Equivalency Theorem which became the base for the research that follows.

Research Questions

Relying on the equivalency theorem hypotheses, the research in this paper tries to answer the following questions:

1. Is it possible to quantify the preferred interaction element of teacher- student-content?
2. Does the preferred interaction element differ depending on the learners?
3. Does the preferred interaction element differ depending on the learning modes?
4. Does the preferred interaction element t differ depending on the content orientations?

Thus this research aims to see if the Theorem is applicable to the real practice and if so, in what ways and to what extent, conforming to the criterion for a solid theory noted by Holmberg (1997) that describes a useful theory as having:

- a systematic ordering of ideas about the phenomenon of our field of inquiry

and

- an overarching logical structure of reasoned suppositions which can generate intersubjectively testable hypotheses (p.31).

Methods and procedures

Participants

The data collection covered four universities, three in Tokyo (hereafter, University A, B, and, C) and one in Taipei (University D), with a total of 236 valid samples for analysis (255 participants). The valid sample number signifies the total number of questionnaires that were fully completed.

The total Japanese and Taiwanese samples were 200 and 36 students, respectively, which were analyzed separately and synthetically. The ratio between male and female students was 64%: 36% as a whole group, which approximately reflects the gender ratio profile in each educational context. The students' age was mainly from 18 to 23 years old with slightly older students found in University D samples.

Course design

Noting the historical debate of methods vs. media by Clark (1994) and Kozma (1994), the research design of the present paper tried its best to keep the same instructional method and medium possible for a clear research focus and rational for comparison. The context could be described as a blended learning as in all four contexts face-to-face classroom interaction was blended with significant online activities. The three universities shared the following core components: 1) using a learning management system (LMS) to support learning, 2) constant implementation of threaded discussion activities throughout the course period, and 3) the courses each dealt with foreign language instruction. Blog writing was also included for other comparative research but only with a data set from one of the Japanese universities (n = 54). The students shared the same physical classrooms for the face-to-face (F2F) teaching sessions. In comparison, they accessed the systems outside the classrooms at a distance from each other for the online portions of assignments.

Contextual difference

The length of each course was 15 weeks with University A, 30 weeks with University B, 10 weeks with University C, and 18 weeks with University D. The students had occasions to use the LMS in other courses, though no other courses that used it as an essential part for interaction were reported by the students.

Pre-course English proficiency test (Oxford University Press, 2003) and results of the Test of English as a Foreign Language (TOEFL) test provided by University C found that the language skills differed among the three universities as a school body, in the order of University C, B, and A, with C having the highest proficiency. In this regard, even though all research fields were taken from a common language education, it is possible that the focus of the course could change from skill-oriented to knowledge-oriented the higher the language proficiency of the students. It is also notable that students able to write in a foreign language for discussion in the threaded discussion are assumed to have a relatively high language proficiency level, although their levels varied, in this study.

The four instructors were included as a cross-over research design to see possible effects of the combination of native vs. non-native instructors to the target language, with the premise that a native speaker instructor may induce higher perceived value of student-teacher interaction. Universities A and B were taught by Instructor A: a Japanese instructor teaching English to Japanese; University C by Instructor C: a British instructor teaching English to Japanese; and University D by two Instructors D1 and D2: Japanese instructors teaching Japanese to Taiwanese.

Instruments

Following the Interaction Equivalency Theorem concept, an inventory that tests the priority order of interaction elements to assure learning quality perceived by the students was developed by Miyazoe (Appendix). The inventory configuration was conceived to test Anderson's two theses above examined; that is, it hypothesized that 1) if one of interaction is valued over the others, students could rank the three interaction elements, having one to be the most valued that the other two, and 2) if the results successfully detect the key elements to let students choose that order, customizing a course design of varied focus fitting to the priority order could produce higher levels of learning. The distinction between skills vs. knowledge underlies the subject orientation in the two data collecting contexts where skill-oriented course

design demands higher level of students' engagement through activities and simulations whereas knowledge-oriented course design often implies a big lecture room where a hundred of students listen to a lecturer, passively taking notes.

Following these, the survey results were used to determine the priority order depending on two parameters of the learning modes and subject orientation as follows: 1) general perceptions, 2) comparison between face-to-face vs. online modes, 3) language vs. general education (underlying skill-oriented vs. knowledge-oriented), 4) specific perceptions to the course they were taking in this study, and 5) open-ended question to ask about interaction elements other than teacher-student-content, if any.

Actual implementation was made using the original Japanese version to the Japanese context and the translated Chinese version to the Taiwanese. The inventory was part of a survey questionnaire including additional demographic questions and questions for other purposes. The final survey contained a total of approximately 70 questions estimated to take 10 to 15 minutes to answer.

Implementation

The inventory was given in fall 2007, winter 2007, and spring 2008 towards the end of each institution's course period to ensure maximum exposure to online interaction activities. Fall 2007, having a smaller sample size, served as a pilot study to investigate the inventory's functionality for later execution with larger samples.

Analysis method

A conversion procedure of the answers to the question items was established to codify the priority order of the three interaction elements of teacher-student-content into the following six patterns (Table 1):

Table 1. Six patterns of priority order of equivalency theorem

Pattern	Rank 1	Rank 2	Rank 3
1	teacher	students	content
2		content	students
3	students	teacher	content
4		content	teacher
5	content	teacher	students
6		students	teacher

Following this conversion matrix, the students' answers were coded into statistical package for the social sciences (SPSS) for further analysis.

Results

The same graphical representations are used to aid the understanding of the results visually. In the tables following, the numbers (1, 2, 3, etc.) on the bottom X axis refer to the pattern categories in Table 1 above. The left Y axis shows the percent of students who marked as the first rank (that is, most important) a certain interaction pattern in the Table.

General expectations

The general expectations of the students regarding learning quality were diverse, showing no recognizable pattern. This confirmed the research hypothesis that no priority order is the best solution for all students in all situations.

Face-to-face vs. online

A clear difference in expectations by the students was observed between the different instruction modes of F2F and online (Figure 3). Regardless of differences in contexts, overall, the students expect the interaction with the instructor (Patterns 1 & 2) to be the primary factor element in assuring learning quality in the case of the F2F interaction, whereas content is given first priority for the online mode (Patterns 5 & 6).

	F2F course	Online course	
Percent of students			University A B C D
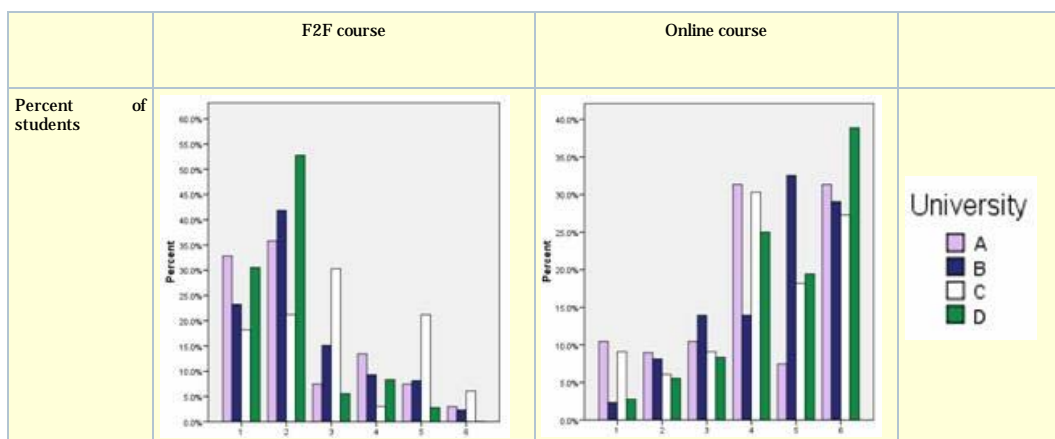
| | Pattern (n = 236) | |

Figure 3. F2F versus online.

Skill-oriented vs. knowledge-oriented courses

The different expectations of the students between the skill-oriented courses and the knowledge-oriented courses were observed (Figure 4).For language classes, students believe the instructor is the key to their learning. However, for general education classes, the students' expectations show no unified tendency as it was for the general perception result above: This may reflect the ambiguity of the concept of "general education" in the questionnaire because some general education courses can be more knowledge-oriented and others more skill-oriented. Moreover, the division between the placing of the instructor as the primary factor in language courses and content as the primary factor in general education courses is especially clear at University C.
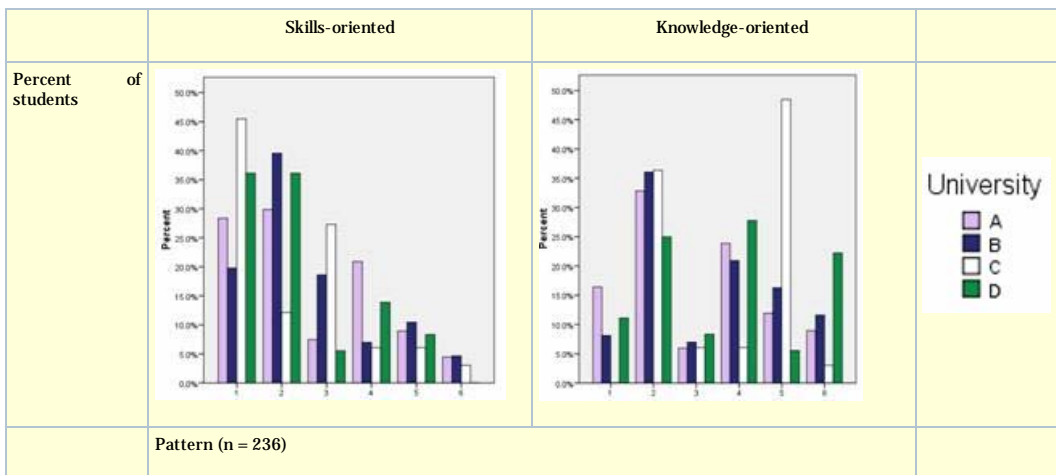
	Skills-oriented	Knowledge-oriented	
Percent of students			
	Pattern (n = 236)		

Figure 4. Skills-oriented versus Knowledge-oriented.

Traditional vs. current courses

Between general perceptions for language courses and those in this research in the blended course design, visible differences were observed (Figure 5). To highlight the difference, the six categories are simplified into three groups having the teacher as the first priority (Categories 1 and 2 into Teacher, Categories 3 and 4 into Student, and Categories 5 and 6 into Content). Although the students rated the instructor to be the most important when asked about traditional language courses in general that have been held in a physical classroom with one instructor being a knowledge provider and skills setter, the emphasis shifted to student interaction in all four university cases. This shift was most visible with the Taiwanese University D group.
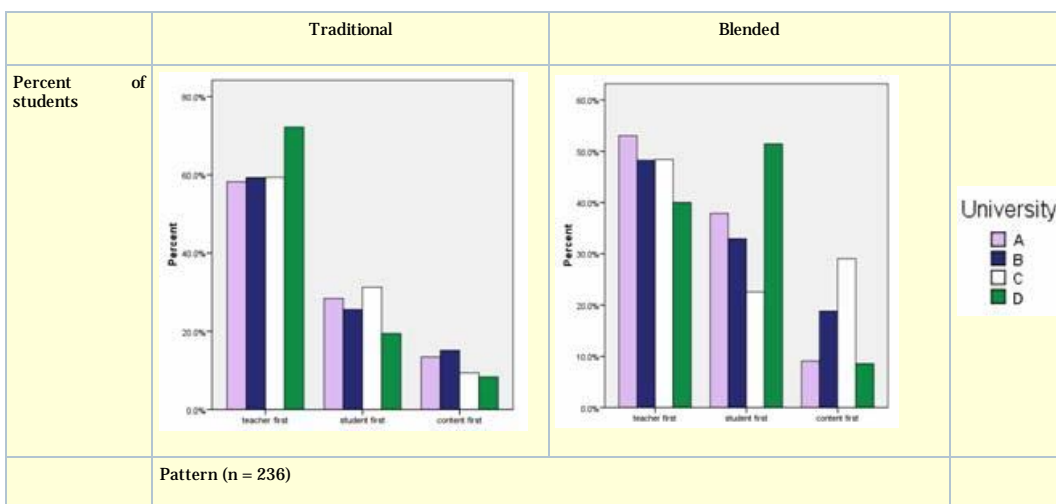
	Traditional	Blended	
Percent of students			
	Pattern (n = 236)		

Figure 5. Traditional language course versus the given blended course.

Native vs. non-native contrast

To examine the effects of the native or non-native instructor variable to the target language, the three subcategories' analysis was given, dividing D1 and D2 instructors (Figure 6). The native instructor cases were Universities C and D, whereas the non-native instructor cases were Universities A and B. It reveals that the overall findings so far made more or less applied to all five cases taught by four different instructors and that, unexpectedly, the native or non-native instructor variable was a minor factor in students' perceptions of quality interaction in this study.

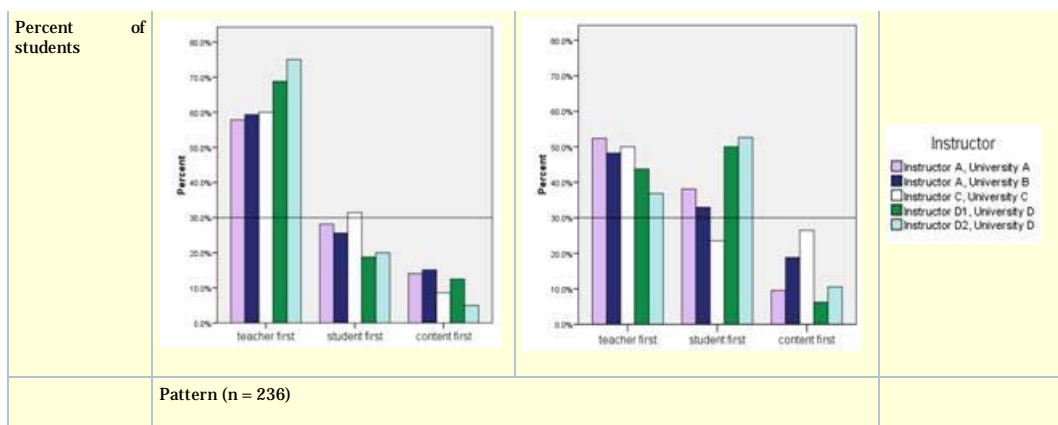|	Traditional	Blended	

Figure 6. Traditional Language course versus the given blended course by instructor.

Interaction priority and age

The same data was further examined to find any relation between preferred interaction element and age (n = 191): age in this study underlies approximately the length of the students' study experience in higher education (Figure 7). University D samples were particular in that it included students over the age of 20 who were largely lacking in other university samples in this study. Although data were available (from the Taiwan samples) in the age range of 23 to 27, these were excluded from the analysis due to the small sample size.
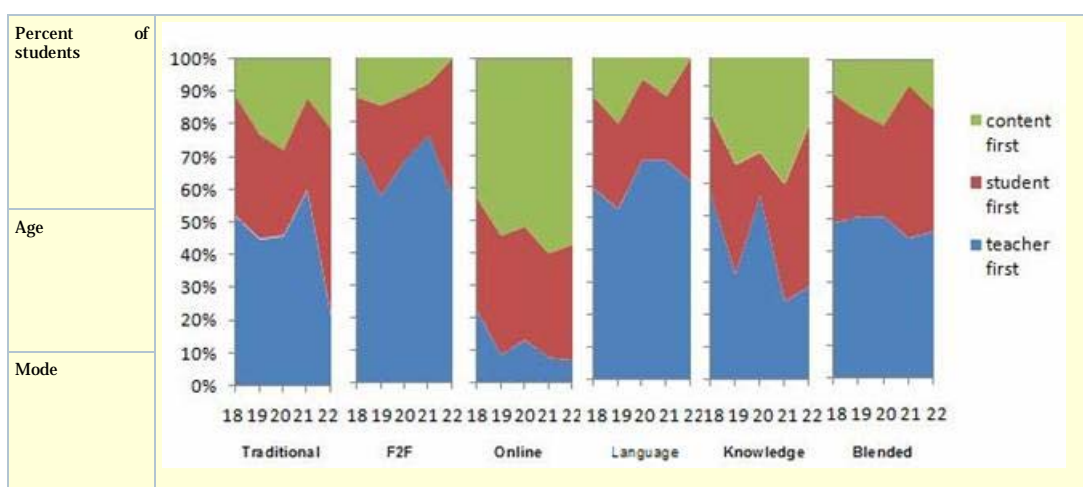

Figure 7. Interaction priority and age.

Figure 7 is interpreted by noting if the lines in each diagram are more or less flat. When there is an up-and-down trend, the figure indicates differences occurring with different age groups.

Overall, the interaction priority order of students' expectation shows similar pattern as it was observed above regardless of age. To the traditional learning and blended learning show similar weight of each of interaction components – that is, large portion of teacher, followed by student, and small portion of content interaction whereas F2F and language/skills-oriented learning, much larger expectation is placed on teacher, followed by student and quite small portion for the content interaction.

On the other hand, it is noteworthy that in online learning, the importance of teacher and student interaction, as indicated by the blue and red bands, decreases as they get older. This may predict the tendency that mature students acquire higher skills of self-direction than the younger ones so that they are able to concentrate more on the content interaction. Also, in contrast to this, in F2F and language learning, the priority of content interaction seems to decrease as they get older, even to the level of zero percent at the age group of 22. These may suggest that as the learners get older, they develop ability to distinguish the merits of different instruction modes and can control their own learning depending on the provided/chosen situation.

It should be remembered that the 21 and 22 age groups include a large portion of Taiwanese students, thus the results could be different with much larger samples primarily taken from students in either of the two countries. However, a further study on the changes in students' expectations of quality assurance interaction element as they mature would lead towards a course design that better fits the learners' variables, regardless of whether they are F2F, online, or blended learning.

Implications and conclusion

The research results so far seem to confirm Thesis 1 regarding quality aspects of the Interaction Equivalency Theorem. This is because the students in this study could answer without any hesitation the type of interaction pair that is most important to them. There is a clear criterion when choosing the most preferred interaction. This study confirmed Thesis 2 because, not only can the students name the best interaction, they can also rank the three kinds of interaction. Moreover, this ranking likely changes depending on the learning modes and learning subjects as far as the results of this study suggests.

The present research admits several limitations. First, although a sample of more than 200 is not insignificant, a bigger sample size could claim for higher statistic validity. Second, unexpectedly, not much difference was observed between Japanese and Taiwan samples in the research. It is not clear if this is accidental, or if it captures the general features of the two countries. Third, although it was ensured that all of the respondents experienced more than 10 weeks of blended learning, the study cannot be conclusive without testing a more longitudinal perspective. And finally, though the current study focused on F2F,

online, and blended learning modes, there may also be other factors that need to be included in the examination. In particular there may be cultural differences that relate to the perceived value of each of the modes of interaction, which might produce different results in different cultures.

Originally born in distance education, the research reported in this paper shows that Interaction Equivalency Theorem has validity in the much wider contexts of three different learning modes: face-to-face, online, and blended learning.

Although simple, the Interaction Equivalency Theorem inventory developed in this paper showed its effectiveness for diverse purposes by changing the concepts for specific contexts and needs. Using the same inventory, with varied contrasting pair questions to accommodate it to specific research questions, more varied age groups, different institutional and cultural contexts, and different instructional activities, will further clarify the expectations and preferences of learners in terms of necessary interaction for their learning.

Blended learning is merging the traditionally separated spheres of face-to-face and distance learning. When the two spheres meet, with research data and frameworks born and developed largely on the experiences gained by the learners of traditional school age and the other distance models informed by those mature and part time learners, it will be necessary to re-examine the base on which each has been established. Although much can be learned from both, there is both risk and opportunity to apply the theories and practices of one sphere to the other.

The fact that there was a certain shift in prioritized interaction elements by the students in this study, after enough exposure to the blended learning with increased online interaction with their peers, may suggest that there may be a lack in experience of increased peer interactions in traditional course designs. If this is the case, further correlational analysis with the prior learning experiences of the students and their perceptions of learning quality assurance interaction elements will be able to measure this using a modified inventory design.

For further research schemes, it would be possible to further quantify the interaction dyads of teacher-teacher, teacher-content, and content-content. Teacher-teacher interaction is not always evident for students in the usual educational settings; however, the recent movement to foster faculty or professional development to update our teaching practice with and among teachers can be seen as a common example, and the field is certainly having access to more data allowing researchers to obtain an analysis from the interaction perspective. The efforts of teachers to improve instructional materials and improve their knowledge about teaching content may also provide data under the concept of material developments and instructional design. As for the content-content interaction, huge potential is found in the numerical data provided in the online space where intelligent programs are working even while we sleep. Incorporating all these perspectives will lead to a fuller vision and scope of our teaching and learning in a new way.

If European and North American countries have been developing theories nascent to the experiences of their homelands, what is now needed in the field is to synthesize these to seek for a higher level of theory where local identities can be met and integrated, still keeping the originality of each. In this sense, the Interaction Equivalency Theorem may lead us to these higher levels, extracting the essence of theories from different contexts.

The advent of online learning may now make the concept of *distance* more psychological and pedagogical than physical. The perspective of looking at education from interaction and blended learning will give us a chance to synthesize various educational events so far separated to explore their potential to improve formal learning in all contexts.

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Appendix

Interaction Equivalency Theorem Indicator (based on Anderson, 2003a)

Below are the questions about "learning of high quality."

For you, if you are forced to choose one, which element is the most important for "interaction" to construct "learning of high quality"? Interaction with the teacher, interaction with the students (including yourself), or interaction with the course content?

Ex.1:		Ex.2:	
teacher	1	teacher	3
students	2	students	2
content	3	content	1

Please rank the three options 1, 2, 3, with 1 being the most important. Use all three ranks. Do not leave any blanks.

1. For you, generally speaking, the "interaction" elements that realize "learning of high quality" are, in order of importance:

Generally:	
teacher	
students	
content	

2. For you, when comparing face-to-face class (during the class) and online class (the class developed on Moodle), the "interaction" elements that are important are, in order of importance:

Face-to-face class:		Online class (on Moodle):	
teacher		teacher	
students		students	
content		content	

3. For you, when comparing language focused course and other content focused general courses, the "interaction" elements that are important are, in order of importance:

Language courses:		General Education courses:	
teacher		teacher	
students		students	
content		content	

4. For you, when considering (course name) taught by (instructor's name), the "interaction" elements that were important to support learning quality were, in order of importance:

(course name) by (instructor's name):

teacher	
students	
content	

5. Besides the three elements listed above, what interaction elements were particularly important <u>for you</u> to realize "learning of high quality," if any?

Note. Japanese and Chinese translated versions are available upon request to Terumi Miyazoe.