The Interaction Equivalency Theorem:  
Research Potential and Its Application to Teaching

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Introduction

This paper aims to overview the Interaction Equivalency Theorem posited by Terry Anderson (2003). It clarifies the position of the theorem in distance education and provides a definition that includes its essential composites. Two research studies are introduced: a meta-analysis on the theorem to show its validity and an empirical research study using the theorem to demonstrate an application of the theorem in teaching and designing. The theorem is useful when analyzing the existing instructional design(s) of a specific learning context and deciding on the optimal interaction design that meets the needs and limitations of the learning context. This paper is an update of two 2010 journal papers by the same authors (Miyazoe & Anderson, 2010a; 2010b).

Background

Location in the Distance Education History

In this paper, interaction is defined as “reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence each other” (Wagner, 1994, p. 8). This definition is the one used by Terry Anderson because of its simplicity and inclusiveness (Anderson, 2003). Historically, the “Three Types of Interaction” model (Moore, 1989) is regarded as the first systematic definition of interaction. This model defines critical interaction in educational contexts as having three essential components: learner–content, learner–instructor, and learner–learner interaction. The third element of learner–learner interaction may not appear new to present-day readers. However, at the time when Moore configured this model, online information delivery was not as developed in primary independent study modes of distance education and learner–learner interaction was a “new dimension” and a “challenge” (Moore, p. 4).

The Modes of Interaction

In their extension of Moore’s interaction model, Anderson and Garrison (1998) advanced an interaction framework called the Modes of Interaction. Aside from the three interaction dyads proposed by Moore, the three dyads of teacher–teacher, teacher–content, and content–content interaction were also conceptualized as indispensable components to support deep and meaningful learning in online and distance education. This extension is propelled by the transition from the traditional distance education delivery system to the currently available, digitally networked learning environment, in which networks afford and can realize a much greater degree of interaction. Digital resource sharing, teacher networks and teachers’ active involvement in making and sharing digital instructional materials are examples of teacher–teacher and teacher–content interaction. Another critical point is that Anderson considers both human and nonhuman interactions are integral components that help create a high-quality educational experience. This perspective highlights the new nature of student–content and even content–content interaction, in which students actively work online with artificial intelligence programs, the latter working together by transferring data multi-directionally to support online learning.

The Interaction Equivalency Theorem

The Interaction Equivalency Theorem posited by Anderson (2003) is the core of this paper. By extending the Modes of Interaction, the theorem aims to provide “a theoretical basis for judging the appropriate amounts of each of the various forms of possible interaction.” The main features of his theorem are condensed into the following two theses:

**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, although these experiences may not be as cost- or time-effective as less interactive learning sequences.
Figure 1 is a tentative visualization of the theorem conceptualization (Miyazoe & Anderson, 2010a). The first thesis refers to the equivalency of value, (i.e., the quality of the interaction). In the most extreme case, it proposes that only one of the interaction elements is necessary to ensure high-quality learning. For example, a student could achieve a high-quality learning experience via intense interactions with other course members (e.g., collaborative or cooperative learning) even if the teacher is unavailable, and the course content is inappropriate. Other examples of high levels of student–teacher and student–content that still support quality learning were also developed in the original 2004 paper. In contrast, the second thesis refers to the quantity of the interaction (i.e., there might be an educational situation in which a student engages in intense interactions with the course teacher, the course content, and/or other students). Such a course would likely provide a high quality of learning, but the cost of producing the content and the time commitments that would be required of the students and the teacher would likely create a course that is expensive and unsustainable.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Student-Content</td>
<td>Student-Teacher</td>
</tr>
<tr>
<td>Student-Teacher</td>
<td>Student-Student</td>
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</tbody>
</table>

One of them?

Increased interaction = Higher learning quality? but more costs and time

Research on the Interaction Equivalency Theorem

There have been increasing numbers of studies, including doctoral studies, focusing on the theorem and its applications. Here, two studies with different orientations are introduced to demonstrate the theorem’s scope. One is a meta-analysis on the theorem by Bernard et al. in 2009 designed to test the theorem’s validity, and the other is an empirical study on the theorem executed by the authors to provide a specific example of the theorem’s applications.

Meta-Analysis by Bernard et al. (2009)
The meta-analysis executed by Bernard et al. is the most recent comprehensive approach to test the validity of the theorem. To this end, it examined distance education research between January 1985 and December 2006. The total number studies examined for inclusion/exclusion was more than 6,000, and, out of 1,034 potential courses, a total of 77 satisfied all of the criteria (including treatment and control groups and measurable outcomes) for the final analysis. In this study, interaction was considered to be an intervention and is called the interaction treatment (IT). IT is defined as “the instructional and/or media conditions designed into DE [distance education] courses, which are intended to facilitate student–student (SS), student–teacher (ST) or student–content (SC) interactions” (p. 2) to codify the applied treatment into categories. The term value (or importance) for Thesis 1 and strength (or magnitude) for Thesis 2 were used for its conceptualization. Although the terminology appears different,
Bernard et al.’s interpretation seems highly consistent with the one articulated in this paper. In addition, the two categories of achievement and attitude are used as outcomes to calculate the effect size.

The basic findings are as follows: (1) Thesis 1 was supported, especially in relation to the SS and SC interaction treatments, which had higher values than ST for both achievement and attitude. (2) Not all of the combinations of the interaction treatments necessarily strengthen achievement and attitude, but (3) only SC contributes to higher achievement and attitudes. (4) Of the three possible combinations of SS+ST, ST+SC, and SS+SC, the combinations of SS+SC and ST+SC contribute to an increase in achievement. However, SS+ST and attitude did not support the thesis regarding increased effectiveness. In summary, the meta-analysis supports both Theses 1 and 2.

Bernard et al.’s meta-analysis revealed that combinations of different interaction dyads have not always assured higher levels of achievement and attitude. In particular, the combinations of student–student and student–teacher interaction might not increase the level of either achievement or attitude. This signifies that, although more efforts have recently been made to increase the level of interaction in online and distance learning in the hope of bridging the physical and psychological gap between students and teachers, this may not be the appropriate or lead directly to the type of gains expected and enhanced achievement or attitude. Furthermore, the meta-analysis suggests the importance of focusing on the interaction dyads paired with content elements. (In the tests of both Theses 1 and 2, increases in student–content interaction had a stronger effect than student–teacher or student–student.) In other words, it seems that if we can only ensure increases in one type of interaction, ensuring student–content interaction may be the most efficient and effective solution, followed by student–student interaction (as opposed to student–teacher interaction. This implication is contrary to earlier studies and perceptions of many teachers and students that teacher–student interaction is mostly highly valued and arguably most influential in a variety of outcomes—for example, see a review by Lamport (1993).

**Empirical Application by Miyazoe and Anderson (2010b)**

The purpose of this study was to test the validity and functionality of Anderson’s two core theses using the author-made survey inventory. The research was conducted at four universities with undergraduate students (N = 236). The inventory asked the respondents to rank the interaction dyads in the order of the most to least critical to ensure a high-quality learning experience. The six patterns of the interaction dyads are listed in Table 1. For example, if you think that, of the choices of teacher, student, and content, content is the least negotiable element to ensure a high-quality learning experience and is followed by teacher and then by student, your priority order for high-quality learning is Pattern 5: content–teacher–student. This configuration is sustained by the hypotheses that, if Anderson’s theses were valid, (a) respondents would be able to value one interaction over the others, and (b) they could rank the three interaction elements in order from most to least important.

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Rank 1</th>
<th>Rank 2</th>
<th>Rank 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teacher</td>
<td>students</td>
<td>content</td>
</tr>
<tr>
<td>2</td>
<td>Teacher</td>
<td>content</td>
<td>students</td>
</tr>
<tr>
<td>3</td>
<td>Students</td>
<td>teacher</td>
<td>content</td>
</tr>
<tr>
<td>4</td>
<td>Students</td>
<td>content</td>
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<tr>
<td>5</td>
<td>Content</td>
<td>teacher</td>
<td>students</td>
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<tr>
<td>6</td>
<td>Content</td>
<td>students</td>
<td>teacher</td>
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</table>

Aside from investigating general perceptions about the priority order, the survey questioned the respondents to compare their learning mode parameters and subject orientations (i.e., face-to-face vs. online vs. blended learning modes and skill-oriented vs. knowledge-oriented subject orientations). The premise for these subcategories is that, if the results successfully detect the most optimal interaction order in a specific situation, customizing a course design fitting to the specific focus or context of the course program could produce higher levels of learning.

The results confirmed the validity of both Theses 1 and 2. Thesis 1 is confirmed because the students in this study could pinpoint, with no hesitation, the type of interaction that was the most important to them. This result suggests that each student has clear criteria for choosing his or her most preferred interaction. Thesis 2 is confirmed because they could also rank the three kinds of interaction in the order that it was the most suitable for their own learning. In addition, this study suggests that this ranking likely changes depending on differences in the learning modes and learning subjects. In addition, in online learning, the students ranked student–content, student–student, and student–teacher interaction in this order of
importance, which is consistent with Bernard et al.’s meta-analysis results from distance education research.

Discussion

This paper has provided background needed to understand Anderson’s Interaction Equivalency Theorem (2003). It clarified its historical position with respect to online and distance education, provided the conceptual articulation of the two core theses, and overviewed the research evidence that supports its validity. This section introduces several topics for further research and practice using implications of the theorem.

Perspective Shifting

Thus far, research has only covered the three dyads of student–content, student–teacher, and student–student interaction (i.e., those seen from only the students’ perspective). This is understandable for many practical reasons, such as the relative ease of executing survey research that asks students about diverse aspects of their learning experiences. It is more difficult to determine how to quantify and evaluate the other three dyads of teacher–teacher, teacher–content, and content–content interaction. The extension of Anderson’s two core theses to include perspectives that take into account the roles of teachers and course content is useful for further exploring and quantifying the learning effectiveness and efficiency of online and distance education. That is we can expand the theory to include two new theses:

**Thesis 3**: Deep and meaningful formal teaching is supported as long as one of the three forms of interaction (teacher–student; teacher–content; teacher–teacher) is at a high level. The other two may be offered at minimal levels, or even eliminated, without degrading the educational experience.

**Thesis 4**: Deep and meaningful formal teaching and learning are supported as long as one of the three forms of interaction (content–student; content–teacher; content–content) is at a high level. The other two may be offered at minimal levels, or even eliminated, without degrading the educational experience.

Theses 3 and 4 demand a shift in perspective from a student-centered approach to a teacher- and content-centered approach. The personification of content is consistent with Anderson and Garrison’s decision to add the three more dyads of interaction and the increasing capacity of “smart content” to update itself, communicate with other non-human entities and benefit from semantic web type inferences. Furthermore, developing ways to quantify these new dimensions of education will lead to more analytical and evaluative attitudes toward online teaching and learning.

Learning Design

Research by Miyazoe and Anderson (2010b) suggested that various teaching and learning contexts may demand different interaction dyads to realize a high-quality learning experience. Of the various factors that need to be taken into account when creating an instructional design, differences in teaching and learning modes (face-to-face, online, and blended learning) and in subject orientations (knowledge vs. skill-oriented) were tentatively tested, and the study suggested that these two parameters are helpful for enabling finer analysis and decision-making regarding the optimal interactions for instructional design. The importance of this study lies in its exploration of the interaction design and its application based on the appropriate assessment of each teaching and learning context. With the articulation of the two learning mode and subject orientation variables, we can determine the most effective and efficient interaction for various teaching and learning contexts. Finally, the results from Miyazoe and Anderson (2010b) also point to the perhaps obvious implication that different type of disciplinary knowledge may set constraints and expectations on types of interaction both needed and expected by students and teachers.

Further Research

Thus far, this research has not examined Thesis 2 in terms of the parameters of cost and time. This direction is important because if, in reality, doubling or tripling the interaction dyads brings little or no improvement in the quality of learning, it would be much wiser to concentrate on pursuing the mechanism of Thesis 1. It would be helpful if we had a table that could tell us how much money and time would be needed to increase the level of interaction for each dyad. The necessary cost and time may vary depending on the specific economies of various countries (i.e., in some countries, human factors may cost less than content factors). We may be able to further determine which interaction element is the most effective and efficient in terms of learning, cost and time. In this regard, testing Thesis 1 may eventually result in the most efficient and effective instruction with the least time and cost.
Due to the limits of space and time, this paper could only introduce two studies dealing with the general and specific aspects of the theorem. However, more research studies on the theorem are being executed as doctoral dissertation research, such as the works of Rhode (2008, 2009) and Byers (2010). There are countless research studies that do not explicitly mention the theorem but, in effect, use the hypotheses of the theorem. The reason that more studies on the application of the theorem are now being produced is certainly related to the recent development of new technologies that fully support the interaction dimension that Anderson predicted. As a researcher, it is exciting to participate in the long research tradition examining interaction in online and distance learning. As five years have passed since Bernard et al.’s 2006 meta-analysis, another sampling of the theorem dealing with the years 2007-2011 may be necessary to highlight the outcomes that recent developments in technology have brought to interaction design in distance education.

**Resource-Sharing**

For now, we have a Website course that collects relevant references and resources for the study of the theorem on a Moodle (http://miyazoe.info/moodle/). We welcome people who have a serious interest in research regarding the theorem. We would be happy if you contact us for further information sharing and collaborative research projects regarding the development of the theorem.

**References**


Byers, A. S. (2010). Examining learner-content interaction importance and efficacy in online, self-directed electronic professional development in science for elementary educators in grades three – six. (Doctoral Dissertation). The Faculty of the Virginia Polytechnic Institute and State University, Virginia, US.


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