Interaction Equivalency Theorem: The 64-Interaction Design Model and Its Significance to Online Teaching

Terumi Miyazoe[1] Terry Anderson[2]
[1] Engineering Department, Tokyo Denki University,
2-2 Senjyu-Asahi-Cho Adachi-Ku Tokyo 120-8551, Japan
t.miyazoe@mail.dendai.ac.jp
[2] Center of Distance Education, Athabasca University,
1 University Drive, Athabasca ABT9S 3A3, Canada
terrya@athabascau.ca

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***Abstract**: This paper provides an overview and update of the Interaction Equivalency Theorem (hereafter, EQuiv) posited by Terry Anderson (2003). The EQuiv concerns the optimal and most cost-effective interaction designs in distance education/e-learning. Historically, Moore (1989) first clarified the three interaction axes of learner–content, learner–teacher, and learner–learner. The EQuiv is an extension of Moore's interaction theory and consists of two core theses that conceptualize quality and quantity dimensions of interaction design. Since its articulation in 2003, research has examined potentiality and applicability of the EQuiv in various disciplines for online learning environments worldwide. Research focusing on interaction abounds in the field. Therefore, tentative guidelines for EQuiv research are introduced in this paper. The most recent extension developed from the EQuiv, the 64-interaction design model, is described. This model provides all of the possible patterns of interaction design based on the EQuiv premises to identify the optimal interaction design for a specific teaching and learning context. The significance of EQuiv research lies in its clarification and conceptualization of the cost/time economy in interaction design, which has not been explicitly discussed or examined in educational fields. The paper concludes with suggestions for further research directions regarding the EQuiv in distance education/e-learning. EQuiv research has received funding from the Japan Society for the Promotion of Science (JSPS) for 2012–2014. As part of the project, the EQuiv website (http://equivalencytheorem.info/) was established to serve as an information-sharing space for further information on EQuiv research and activities.*

The Interaction Equivalency Theorem

The Interaction Equivalency Theorem (hereafter, the EQuiv) consists of two theses that refer to the optimal interaction design in terms of quality and quantity to achieve the most efficient and effective learning in distance education/e-learning. The EQuiv is the propositional extension of the three interaction axes of Moore (1989): the learner–content, learner–teacher, and learner–learner dimensions. The EQuiv is also a conceptual extension of two frameworks developed by Anderson, the Community of Inquiry (Anderson & Garrison, 1998) and the Modes of Interaction (Anderson, 2003), whose detailed relationship and historical implications in the field of distance education/e-learning are found in Miyazoe and Anderson (2011) and Miyazoe (2012).

The main features of the EQuiv 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, or 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 are likely to provide a more satisfying educational experience, although these experiences may not be as cost- or time-effective as less interactive learning sequences.

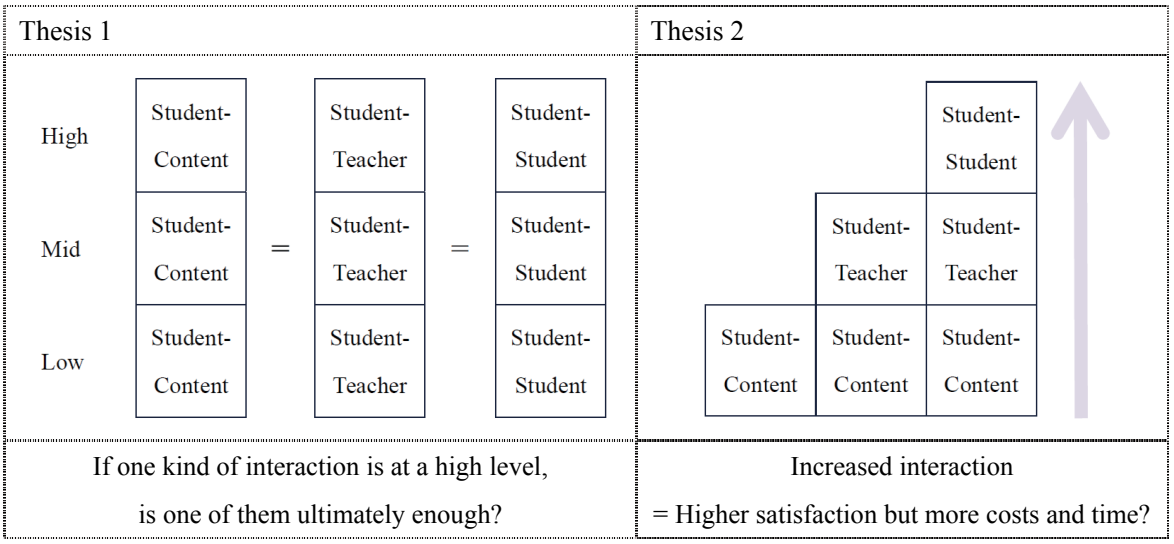


Fig. 1. Interaction Equivalency Theorem

Figure 1 presents the differences in the nature of the two theses. Thesis 1 refers to the

quality of interaction design, whereas Thesis 2 refers to the *quantity*. High-Mid-Low on the left corresponds to the amount of interaction planned/realized in a course design. In short, Thesis 1 says that one kind of high level of interaction may be enough to sustain meaningful learning (referring to effectiveness), whereas Thesis 2 says that more than one kind of interaction may be more satisfactory but also more costly (referring to efficiency).

The model is intended to conceptualize interaction, which is actually invisible. Therefore, an objective measurement of the amount of interaction may not be easily achieved. However, course designers or teachers make some estimations about the amount of interaction, however intuitively, and implement them in our teaching and learning. In this sense, the EQuiv theses are regarded as working hypotheses for the advancement of research and practice. The EQuiv is significant and useful in that it provides a means to conceptualize interaction, which is a critical element in realizing learning so that we can think of it in a more tangible and systematic manner in the field.

A Review of EQuiv Research

Since its official publication in 2003, research on the EQuiv has been conducted gradually and consistently. Some studies are publically available, and others are written as part of research toward masters' and doctoral degrees.

The study by Bernard et al. (2009) in Canada is probably the most comprehensive work on the EQuiv so far. This meta-analysis of interaction research in light of the EQuiv covered empirical studies in distance education from 1985 to 2006. The study supported the validity of the two theses. The doctoral study by Rhode (2009) in Canada examined the EQuiv in a self-paced online course for teachers' professional development. Another doctoral study by Byers (2010) in the US tested the validity of the EQuiv in a self-paced online course for adult students. The empirical study by Miyazoe and Anderson (2010) attempted to apply the EQuiv to a blended learning context with Japanese university students. Miyazoe and Anderson (2011), referenced in the above section, articulated the EQuiv concepts in a sharable manner. Cabral (2012) is completing a doctoral study examining the validity and functionality of Thesis 1 in self-paced online teacher education courses in Portugal. Two masters' studies by Markewitz (2007) in Canada and Hao (2011) in Taiwan, both available from their schools' online library databases, analyzed online distance courses and math courses using the EQuiv framework.

As a general trend, EQuiv research began by examining the validity and functionality of the EQuiv. This research is now moving toward its second stage:

finding useful ways of applying the EQuiv for specific purposes, such as differences in subjects, contexts, and learning modes. It is notable that multi-national studies on the EQuiv are spreading around the globe. This is reasonable given the nature of the EQuiv, which is relevant to the general issue of quality and interaction design in educational endeavors.

Guidelines for the EQuiv Theorem Research

Since the conceptualization of interaction by Moore (1989), the founder of distance education in the US, the field has abounded with research that relies partially or entirely on these three axes of interaction. In the past, more research examined human-centered interactions, especially those between learners and teachers. The focus on learner–learner interactions is more recent and was initiated by the advent of new technology that allows multi-directional interaction among learners. These studies are not regarded as EQuiv research per se but rather as general interaction studies. In addition to its focus on interaction, the following perspectives are found in EQuiv research:

1) All three axes (learner–content, learner–teacher, and learner–learner) constitute the research core for the analysis.
2) Research speculates on quality and/or quantity issues in the optimal dose/balance of interaction.
3) Research speculates on the outcomes of learning experiences, such as meaningfulness, satisfaction, and cost/time issues.

Such research does not necessarily reference the EQuiv, but its importance is in the concept/hypothesis that supports the analytical perspective of interaction. As far as these three criteria are satisfied, the research is comparable to other EQuiv research and to further syntheses of the governing theory of the EQuiv.

The 64-Interaction Design Model

In an extension of the EQuiv and its research worldwide, the 64-interaction design model was developed by Miyazoe and Anderson (2012) as the most recent outcome of EQuiv research (see the Appendix for a graphical representation). The model provides all possible combinations in terms of the quantity and quality of interaction to identify the optimal interaction design for a specific purpose in a specific learning context.

The 64-interaction design model is composed of all possible combinations of the three interaction axes (learner–content, learner–teacher, learner–learner dimensions) and

the amount of interaction (high, middle, low, and zero levels). The 64 interactions represent the hypothetical total number of designs from the calculation of 4x4x4.

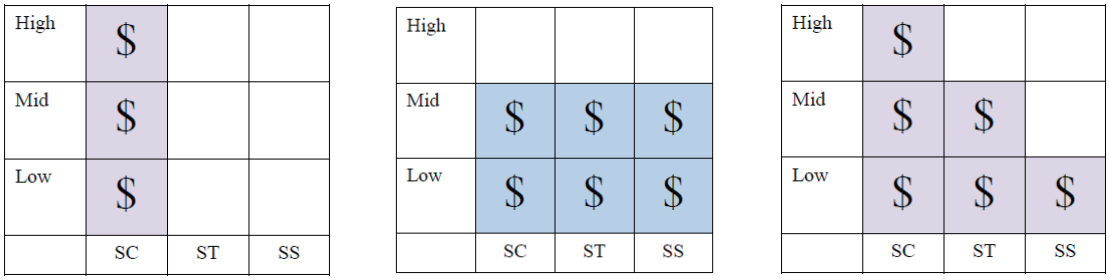
The interaction designs of Thesis 1 situations are located with two sub-categories in the right-most column. The six designs in blue are the interaction situations at the "minimal" level, and those in green are at the "elimination" Level. The remaining 57 designs refer to situations in which different levels of the amount of each interaction dimension are combined differently. The ultimate case at the bottom, with zero levels for all three interaction dimensions, is a case in which, before any action on the part of learner, the course was cancelled or withdrawn, so interaction did not occur.

The use of the interaction design survey instrument developed by the authors (Miyazoe & Anderson, 2010), which is a data collecting instrument that identifies the optimal interaction design and allows conversion of perceptional interaction to numerical interaction, facilitates the identification of the optimal interaction design for a specific purpose in a specific educational/socio-cultural context.

EQuiv Interaction Design and Cost Issues

The identification of the optimal interaction design is critical when we consider the costs incurred by the amount of interaction implemented in a specific course design. When we plan more interaction in a course, such as a higher frequency of Q&A between the teacher and students using an online forum or a higher frequency of socialization between students using SNS space, it is inevitable that extra costs will be incurred. These extra "costs" include invisible costs, such as the teacher or students' time.

Figure 2 helps to visually explain the utility of the EQuiv consideration from cost/time perspectives. Suppose ID (Interaction Design): A is the most effective and efficient design (the highest learning with the lowest cost/time), and ID: C is equally effective (the highest learning) and more satisfactory (because of the variation in interaction) for a specific purpose in a specific context. In reality, the ID implemented is likely to be ID: B, in which a moderate level of all three interaction types is implemented in the hope that the ID will be satisfactory for the largest number of course takers. The EQuiv consideration of the ID suggests that locating the optimal ID, which will be different in each case, would serve the large cost/time economy for all stakeholders, including tutors, students, and institutions.



*SC: Student-Content, ST: Student-Teacher, SS: Student-Student

Fig. 2. Cost Issues in Interaction Design

Further Research Directions

The EQuiv research by the authors is funded by JSPS 2012-2014, which is a Japan-based research project with six international collaborators located in different countries. The project aims to identify critical elements, in addition to the previously detected subject orientations and learning modes, which identify the optimal interaction among the 64-interaction designs.

The viable factor elements to be tested in the project include culture, language, learning styles, teaching styles, and possible differences in need among various levels of learning (such as BA, MA, and PhD programs). A "gap" may exist between the intention of the learning designer (or teacher) and the perceptions of the participants (or students). These variables are critical in interaction design because, theoretically speaking, the "gap" between the optimal situation and reality may involve the extra cost/time elements that could be eliminated in an alternative use of the EQuiv consideration.

The aim of the EQuiv is not only to reduce costs. The EQuiv aims to address the necessity of reducing the "fat" in any educational system in terms of interaction design so that each stakeholder—teachers, students, and institutions—can make better use of cost/time in healthier and more productive ways.

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Appendix:

64 possible interaction designs in terms of quality/quantity

	Quality/Quantity of each interaction type			
1	High SC	High ST	High SS	
2			Middle SS	
3			Low SS	
4			No SS	
5		Middle ST	High SS	
6			Middle SS	
7			Low SS	
8			No SS	
9		Low ST	High SS	
10			Middle SS	
11			Low SS	Thesis 1 situation
12			No SS	
13		No ST	High SS	
14			Middle SS	
15			Low SS	
16			No SS	Thesis 1 situation
17	Middle SC	High ST	High SS	
18			Middle SS	
19			Low SS	
20			No SS	
21		Middle ST	High SS	
22			Middle SS	
23			Low SS	
24			No SS	
25		Low ST	High SS	
26			Middle SS	
27			Low SS	
28			No SS	
29		No ST	High SS	
30			Middle SS	
31			Low SS	
32			No SS	

33	Low SC	High ST	High SS	
34			Middle SS	
35			Low SS	Thesis 1 situation
36			No SS	
37		Middle ST	High SS	
38			Middle SS	
39			Low SS	
40			No SS	
41		Low ST	High SS	Thesis 1 situation
42			Middle SS	
43			Low SS	
44			No SS	
45		No ST	High SS	
46			Middle SS	
47			Low SS	
48			No SS	
49	No SC	High ST	High SS	
50			Middle SS	
51			Low SS	
52			No SS	Thesis 1 situation
53		Middle ST	High SS	
54			Middle SS	
55			Low SS	
56			No SS	
57		Low ST	High SS	
58			Middle SS	
59			Low SS	
60			No SS	
61		No ST	High SS	Thesis 1 situation
62			Middle SS	
63			Low SS	
64			No SS	

*SC: Student-Content interaction, ST: Student-Teacher interaction, SS: Student-Student interaction