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Applying the Interaction Equivalency Theorem to Online Courses in a Large Organization

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Abstract

Finding effective ways of designing online courses is a priority for corporate organizations. The interaction equivalency theorem states that meaningful learning can be achieved as long as courses are designed with at least a high level of one of three types of interactions (learner-content, learner-teacher or learner-learner). This study aimed to establish whether the interaction equivalency theorem applies to online learning in the corporate sector. The research was conducted in a large Mexican commercial organization, and involved 147 learners (sales supervisors), 30 teachers (sales managers and directors) and 3 academic assistants (course designers, or education support staff). Three courses of an existing Leadership Program (Situational Leadership, Empowering Beliefs and Effective Performance) were redesigned and developed to test three course designs, each emphasizing a different type of interaction (learner-content, learner-teacher or learner-learner). Data were collected through surveys (for diagnostic and evaluation purposes) and exams. All courses yielded high levels of effectiveness, in terms of satisfaction, learning, perceived readiness for knowledge transfer and return on expectations. This suggests that the interaction equivalency theorem not only applies in a business setting but might also include other indicators of course effectiveness, such as satisfaction, learning transfer and return on expectations. Further research is needed to explore the possible expansion of the theorem.

In 2004, the International Labor Organization actively encouraged the use of information and communication technologies in workplace learning (ILO, 2004). Increased adoption of online and blended education has followed (Kim, Bonk & Teng, 2009; Kim, Bonk & Zeng, 2005; Scott-Jackson, Edney & Rushent, 2008; Skillsoft, 2007). However, online learning platforms are often used as content repositories (e.g., Armellini et al., 2012). Web-based courses sometimes replicate face-to-face teaching methods or consist of uploaded digital materials, offering little or no advantage in the use of technology (Cotton & Gresty, 2007). A number of managers still hesitate to accept online education as an adequate means to obtain professional

credentials such as an academic degree (Adams, 2008; Udegbe, 2012). Yet, online learning is currently becoming more of a fixed reality than a choice, and designing effective courses remains an important challenge (Woo & Reeves, 2008) and a priority for organizations.

Studies conducted in academic settings (Chang & Smith, 2008; DeWitt, Alias, Siraj & Zakaria, 2014; Su, Bonk, Magjuka, Liu & Lee, 2005) have emphasized the importance of communications between people (i.e., social interactions) to build knowledge and foster learning. Accordingly, different proposals to understand online social interactions have emerged, such as Jung's taxonomy of interactions (2001) and the community of inquiry framework (Garrison, Anderson & Archer, 2000).

In business contexts, however, it is not always possible to generate interpersonal exchanges in online courses, even if employees consider these contacts important (e.g., Becker, Newton & Sawang, 2013; Vaughan & MacVicar, 2004). This may be due to the lack of focus on successful pedagogical design models (Macpherson, Elliot, Harris & Homan, 2004) or just-in-time, just-for-me demands (i.e., a single person requiring training at a given time). It is common for organizations to have programs with limited opportunities for social interactions (Padilla Rodriguez & Armellini, 2013; Padilla Rodriguez & Fernandez Cardenas, 2012; Welsh, Wanberg, Brown & Simmering, 2003).

Is an online course with no embedded social interactions effective in a corporate setting? The first thesis of the interaction equivalency theorem (Anderson, 2003) suggests an answer by claiming that meaningful learning can be supported as long as the course is designed with a high level of one of three types of interactions (learner-content, learner-teacher or learner-learner). The other two forms can be offered in a minimal degree, or omitted, without decreasing the quality of learning. This thesis represents an attractive idea for organizations that wish to expand and improve their offering of online programs, as it addresses limitations in social interactions by suggesting that meaningful learning will occur if another type of interaction can be maximized (Rhode, 2009). If shown to be well supported by evidence, the first thesis could guide effective course designs (Padilla Rodriguez & Armellini, 2013).

Empirical research is still needed, as very few studies have addressed or framed their results within Anderson's theorem. Research with online learners shows that they do not consider different interaction types to be equivalent or interchangeable (Padilla Rodriguez & Armellini, 2013; Rhode, 2009). Nonetheless, perceptions may be different from actual behaviors and results (e.g., Caliskan, 2009; Picciano, 2002). Bernard et al. (2009) reviewed 74 studies with different interaction treatments (learner-content, learner-teacher and learner-learner), defined as conditions designed to encourage interactive behaviors. They reported that all three are important for students' academic achievement, and that high and moderate levels of treatment strength were better than low levels. This finding is consistent with the notion that high levels of one type of interaction support meaningful learning.

Further support for the theorem can be found in two empirical studies that compared online course designs emphasizing different types of interactions. One of the studies (Russell, Kleiman, Carey & Douglas, 2009) used four groups. Group 1 had a high level of learner-teacher and learner-learner interactions. Group 2 focused on learner-learner interactions. Group 3 had a teacher but no embedded means for communications between students. Learner-teacher interactions happened via email. Group 4 was self-paced, with no discussion forums and minimum human support available (i.e., a high level of learner-content interactions). As Anderson (2003) predicted, outcomes were comparable across all four course variations. Participants rated the quality of all courses highly and achieved the expected objectives. A

second study (Tomkin & Charlevoix, 2014) divided participants of a massive open online course into two groups, one with a high level of learner-teacher interactions and one without (but with high levels of learner-learner interactions). As in the research by Russell et al. (2009), completion and participation rates were similar across both groups, as well as students' perceptions on the course.

While these previous studies are encouraging, they focus on academic settings and thus leave aside other indicators of course effectiveness relevant in business contexts. Several questions remain unanswered: How do employees at an organization interact online with course content, teachers and peers? Is the interaction equivalency theorem applicable to online learning and training in the corporate sector? In other words, do online corporate courses with designs emphasizing different types of interaction yield similar learning results? Could the theorem incorporate other indicators of course effectiveness, such as learner satisfaction, readiness to transfer learning to the workplace and return on expectations? This research contributes to answering these questions by comparing the effectiveness of three online corporate courses, each designed to emphasize a different type of interaction (learner-content, learner-teacher or learner-learner).

Methodology

A large commercial Mexican company (6000+ employees) with 30 food distribution centers and offices in the country participated in this study. Since 2004, its course designers had developed a face-to-face Leadership Program, which was composed of eight five-hour courses, or modules. After jointly evaluating the topics covered in each course, the materials available and the potential advantages and disadvantages of the medium for participants, the organization and the researchers selected three courses to be redesigned and delivered online:

1. Situational Leadership
2. Empowering Beliefs
3. Effective Performance

Online Courses

The topic and desired outcomes of each course (see Table 1) provided a rationale for the specific course design used, each emphasizing a different type of interactions (see Figure 1).

Table 1
Course design rationale

Course Topic	Predominant Interactions	Rationale
Situational Leadership	Learner-content (LC)	This course was suitable for independent study because it focused on theoretical concepts, and aimed to foster the competencies of planning and self-development.
Empowering Beliefs	Learner-teacher (LT)	The objective of this course was to encourage sales supervisors to believe in their own potential and *feel* like leaders. The organization wanted teachers, who were also students' line managers, to motivate and provide emotional support in this area.
Effective Performance	Learner-learner (LL)	This course focused on generating strategies to improve the performance of retailers, who were subordinates of sales supervisors (students of this course). Peer exchanges were expected to help learners obtain practical ideas and specific context-based suggestions.

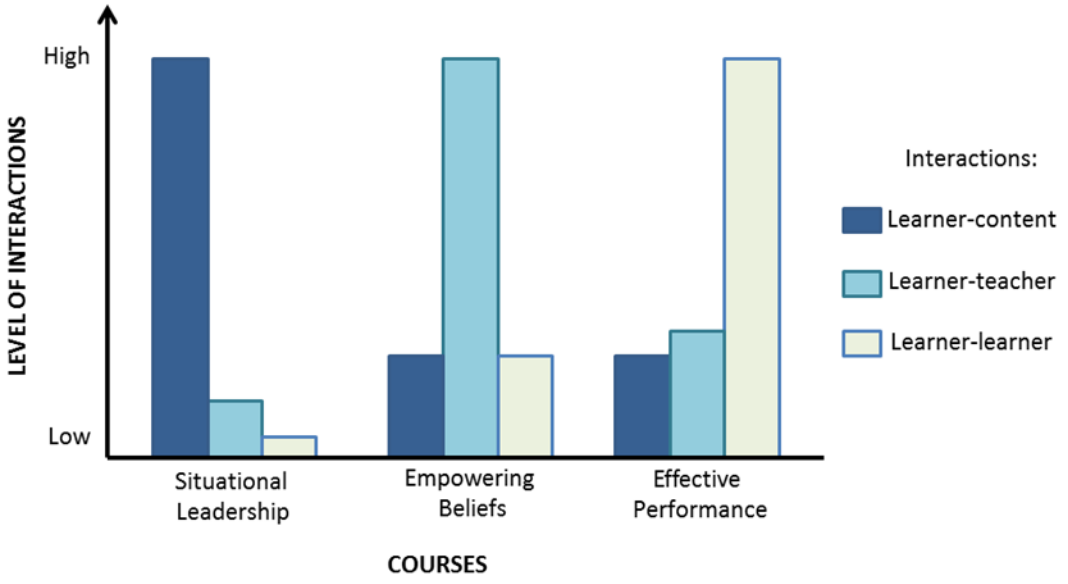

Figure 1. Levels of different types of interactions designed into online courses.

Each course required approximately five study hours. The course design incorporated five non-assessed activities and a non-assessed final project that fostered a particular type of interactions (learner-content, learner-teacher or learner-learner). To test the first thesis of the interaction equivalency theorem (Anderson, 2003), in each online course the researchers attempted to design high levels of only one type of interaction and low levels of the rest, as shown in Figure 1. In some cases it was not possible to completely omit the other types of interactions. For example, courses with social interactions included reading texts that enable learner-content interactions.

All courses had a general discussion forum available as an open space for questions and comments, monitored by a staff member of the education department at the organization. Course designers (also education staff) at the organization validated materials. The researchers prepared a teacher manual with a description of the role of teachers and specific examples of how to respond to the different activities. This manual was available for all courses. The specific characteristics of each course are described next.

Situational Leadership: Learner-content interactions.

The Situational Leadership course (see Figure 2) emphasized learner-content interactions. Its activities required explicit, observable responses from the students (e.g., providing an answer to a question instead of reflecting internally on a topic). Its non-assessed final project focused on the application of knowledge in the workplace. Besides the general discussion forum, there were no other embedded communication tools. While the course had a teacher assigned, their role was to monitor student progress without directly intervening. If required, teachers could use the general discussion forum to answer questions and clarify tasks.

Figure 2. Outline (in the original Spanish) of the Situational Leadership course. On a single screen, participants could see all materials and activities, thus obtaining an overview of the course structure. Main topics are in bold letters.

The design and development of this course required a high time investment. Since sources of human support would be kept to a minimum to avoid encouraging social interactions (thus increasing their level in the course), the content needed to be self-explanatory. The researchers tried to think of all the possible questions students could have when navigating through the course and to provide answers. Education staff at the organization helped improve resources by identifying where more clarity was needed.

Internet connection issues were anticipated (as in Macdonald, Bullen & Kozak, 2010). Media and applications requiring high bandwidth (e.g., videos and audio) were used with caution and always with a text alternative (i.e., transcript). To add a human touch, a two-minute podcast (Nie, Armellini, Harrington, Barklamb & Randall, 2010) and four brief videos (<1 minute long), with their respective transcripts, were made available.

Other online tools included two personal wikis, which served only as a space for students to write their reflections and were chosen over other tools because of their easy access (blogs were blocked); multiple-choice questions with automated feedback for both correct and incorrect answers; and three polls, which allowed students to see the responses of the group. There were also eight reading texts which incorporated hyperlinks to glossary definitions, images and self-reflection questions (e.g., *Think about three of your collaborators and their main tasks. How*

would you describe them? What is their maturity level? [One of the concepts students had to learn was "maturity level"]).

Empowering Beliefs: Learner-teacher interactions.

The Empowering Beliefs course fostered learner-teacher interactions. Its activities followed Salmon's (2002) e-tivity framework (see Figure 3) and had a clarifying example of expected responses. Online tools included three discussion forums and three wikis. There were also six text-only reading materials, with no multimedia.

A risk when designing the Empowering Beliefs course was inadvertently fostering peer exchanges, which could change the emphasis on learner-teacher to learner-learner interactions. In an attempt to prevent this situation, activity instructions referred specifically to teacher feedback. Sometimes teachers were asked to reply to each student (see Figure 3), and at other times they would address the whole group by summarizing the contributions. The minimum requirements of expected teacher behaviors were specified in the teacher manual, which also included research-based suggestions on key practices, such as maintaining contact and having a regular presence in online discussions (Dennen, Darabi & Smith, 2007). Teachers were expected to be an active part of the course, moderating online learning and providing guidance for students.

Activity 2.2 My story

Objective: To acknowledge your own achievements.

Task: Check the text 2.2 Empowering Beliefs. Now share your story. Post a message in which you describe an achievement you feel proud of. It can be personal, social, work-related, or family-related. What happened? What did you do? What did you achieve?

Response: Read your teacher's feedback. How do you feel? Share your reflections in a message (you have to click on "reply" in your teacher's message).

Figure 3. Example (translated from the original Spanish version) of activity fostering learner-teacher interactions.

Effective Performance: Learner-learner interactions.

The Effective Performance course fostered learner-learner interactions. Its activities followed Salmon's (2002) e-tivity framework (see Figure 4), and had a discussion forum and a clarifying example. Participants were expected to post at least two messages in each activity, one with their solution to the task and a second one replying to others' contributions. There were also nine brief reading materials, with only text (no multimedia). While this course had teachers available, the teacher manual advised them to moderate by exception. Teachers were expected to stand back and let students interact among themselves.

Activity 3.1 SMART Objectives

Objective: To practice elaborating objectives using the SMART methodology.

Task: Consider the text 3.1 SMART goals. Write three objectives you have in one of the following areas:

- Sales
- Execution standards
- Work environment
- Employee turnover

These objectives may be ones that you have established for a previous activity. Remember to use the formula:

Active verb + area of the objective + achievement level + commitment date

Post a message with this information.

Response: Check the objectives of a course mate. Verify that they meet the SMART criteria (specific, measurable, attainable, relevant and time-bound). Post a message in which you indicate the results of your evaluation (i.e., which criteria are met). If not all the criteria are met, include a suggestion to meet them.

Figure 4. Example (translated from the original Spanish version) of activity fostering learner-learner interactions.

Participants

Sales supervisors (n = 147) participated as students of the three online courses. Their ages ranged from 25 to 57 with a mean of 38 years. On average, they had worked at the organization for five years. Their average time in their current job was four years. Most of them (≈62%) had some university studies. Others (≈31%) had only completed high school (9-12 years of formal education). Few (≈7%) had only secondary education (6-9 years).

In their daily jobs, sales supervisors were usually out in the field, visiting supermarkets and convenience stores, negotiating sales and talking to retailers. Most of them were not used to office work. Nine months before the study, sales supervisors had received a netbook computer with internet access. They had weekly compulsory training to learn the basics of using this technology. Most learners (≈71%) had some knowledge of online education, having studied at least one web-based course.

Learners were divided into 18 groups of 5-16 participants and a median of 8. The average student-teacher ratio was 5:1. Sales managers and directors (n = 30, 2 women and 28 men) participated as teachers. They were selected for this role mainly due to their experience in and knowledge of the topic. The Education staff believed that the best people to teach how a leader should behave in the specific context of the organization were those with job positions that required managing teams and deploying effective leadership skills (i.e., managers and directors).

Teachers' age ranged from 27 to 55 with a mean of 41 years. Their average tenure with the organization was six years. Their average time in their current job was three years. All but

two of them had at least some university studies. Most of them (≈62%) had some knowledge of online education, having studied at least one course via the web.

Three Education staff members performed as academic assistants to the courses, monitoring activities and providing general support for participants.

Data Collection and Analysis

Different groups of students had access to the courses in six different sequences, as shown in Table 2. Learners had one week to finish each course, with a commitment of approximately five study hours. Course delivery took a month, three weeks for three courses, with a one-week break.

Table 2
Sequence of access to courses

Sequence 1	Sequence 2	Sequence 3	Sequence 4	Sequence 5	Sequence 6
LC	LC	LT	LT	LL	LL
LT	LL	LL	LC	LC	LT
LL	LT	LC	LL	LT	LC

Note. LC = Situational Leadership, learner-content interactions; LT = Empowering Beliefs, learner-teacher interactions; LL = Effective Performance, learner-learner interactions

At the beginning of each course, a diagnostic survey was available online. It consisted of closed questions that gauged students' initial course expectations, previous knowledge of the topic and their perceived competence in the skill to be developed by the course. Students' perceptions of their own knowledge and performance served as a reference point for comparison with learning and behaviors after the course.

To avoid their expectations becoming biased, students were not told which type of interaction was emphasized in each course. They had one week to review the resources and complete all the activities.

A final exam with ten multiple-choice, matching and true/false questions evaluated students' learning at the end of each course. After answering these questions, participants could check their grades and feedback. Average grades for each course exam were calculated.

An evaluation survey included closed questions (5-point Likert scales) about perceived engagement with the activities, interactions with content, teacher and peers, and students' evaluation of the course in terms of satisfaction, learning, workplace behaviors and expectations. Frequencies and percentages were calculated for each course. Open questions in the same survey explored the number of study hours spent, learners' perceived responsibility in relation to their own performance, their favorite aspect of the course and their suggestions to improve the course. Coding focused on references to the different types of interactions.

Results

Results are organized in terms of participants' interactions within the course, learning outcomes and other indicators of course effectiveness. For comparison purposes, data were grouped and labelled according to the type of interactions emphasized in each course:

- Learner-content: Situational Leadership
- Learner-teacher: Empowering Beliefs
- Learner-learner: Effective Performance

Interactions within the Online Courses

In all three courses, most learners spent nearly the full recommended study time of five hours. Most reported being engaged or very engaged with the activities, regardless of the type of interaction fostered. Students also rated the usefulness of the types of interactions available in their courses (i.e., in the course with no social exchanges, participants were only asked about their engagement with the content). Most expressed favorable reactions towards course activities (see Table 3).

Table 3
Percentage of student agreement with the usefulness of course interactions

	Predominant Interactions in Course		
	Learner-Content (n = 131)	Learner-Teacher (n = 136)	Learner-Learner (n = 139)
Learners reporting engagement with course activities	86%	87%	82%
Course content fostered my reflections on the topics of the course.	95%	97%	99%
The teacher helped me understand the topics of the course.	NA	78%	80%
In this course, I have shared valuable learning experiences with other students.	NA	NA	89%

Note. NA = Not applicable.

In the evaluation survey open questions, some participants referred to interactions that were not designed into the courses (see Table 4). One learner mentioned that his favorite aspect of the Situational Leadership course, which had no embedded communication tools except for a seldom used general discussion forum, was *the participation of other course mates*. Nine participants mentioned that their favorite aspect of the Empowering Beliefs course was exchanges with peers (e.g., *knowing about my course mates' experiences and talking about mine*), even though learner-learner interactions had not been intentionally embedded into this course.

Table 4
Favorite aspect of course

	Learner-Content (*n* = 131)	Learner-Teacher (*n* = 136)	Learner-Learner (*n* = 139)
Learner-content interactions	24	16	14
Learner-teacher interactions	0	4	0
Learner-learner interactions	1	9	30
Interactions in general (probably referring to social interactions)	2	1	0
Other (e.g., learning, experiencing an online course, etc.)	104	106	95

In all courses, about a quarter (23-24%) of suggestions for improvement related to having more and higher-quality interactions with the content, the teachers and other learners.

Learning Outcomes

Learning outcomes were positive in all courses. In the diagnosis survey, students self-assessed their own previous knowledge of the course topic, on a scale from 1 to 10. Average exam grades were over 9 (out of 10) in all courses. Almost all course participants (96-99%) reported having learned a lot or very much (see Table 5).

Table 5
Learning outcomes across different courses

	Learner-Content	Learner-Teacher	Learner-Learner
Average self-assessment of previous knowledge	6.8 (*n* = 140)	5.3 (*n* = 147)	7.3 (*n* = 145)
Average exam grades	9.3 (*n* = 133)	9.5 (*n* = 137)	9.3 (*n* = 139)
Students reporting having learned a lot or very much	98% (*n* = 131)	99% (*n* = 136)	96% (*n* = 139)

Other Indicators of Course Effectiveness

All courses, regardless of their design, yielded high levels of effectiveness. Comments were mostly positive, for example:

- *It is a very complete course*.
- *Everything [was] very good. Thank you and congratulations*.
- *I liked [the course] because it made me learn how I can perform [better and achieve] objectives and [improve] my relationship with my collaborators*.

Almost all participants (96-98%) were satisfied or very satisfied with the courses. Students' initial expectations were mostly to do with learning more about the courses' topics, improving their workplace performance and how to impact on business macro-level results, such as sales. After completing the activities, almost all students in each course (98-99%) claimed that

their expectations had been met. Also, they (96-98%) reported feeling prepared to apply the new knowledge in their workplace (see Table 6).

Table 6
Other indicators of course effectiveness

	Learner-Content (n = 131)	Learner-Teacher (n = 136)	Learner-Learner (n = 139)
Course satisfaction	98%	96%	96%
Perceived readiness to apply learned knowledge in the workplace	98%	96%	98%
Fulfillment of expectations	99%	99%	97%

Discussion

In all courses, students reported engaging in interactions that were not emphasized or included in the design. For example, the Situational Leadership course had no activities that enabled communications between participants. Yet, one student reported that his favorite aspect of the course was the participation of his course mates. Where did these communications happen? Could they have happened in other contexts, such as private messages or face-to-face conversations? Participants may have found value in communications with others as a resource to build knowledge (as in Chang & Smith, 2008; DeWitt et al., 2014; Su et al. 2005), and sought informal exchanges beyond course boundaries. This is an interesting finding because it shows that course design does not determine students' learning behaviors. While unplanned interactions may be 'invisible' to course designers and teachers, they may have a significant influence on the learning experience.

If students engage in educational interactions beyond course boundaries, how influential is course design for learning? Why did participants seek additional interactions? Were they trying to make the course more meaningful or were the designed interactions not enough? While these questions are beyond the scope of this study, it is clear that designers should incorporate sufficient opportunities for meaningful exchanges within the course boundaries, allow the possibility of informal interactions and ensure that support channels are available for learners.

The results of this study provide evidence of all three course designs being engaging, effective alternatives for online education in corporate settings. Regardless of the type of interaction present at a high level, participants achieved the desired learning outcomes in all courses. Their exam grades were higher than their self-assessed previous knowledge. All types of interaction can promote academic achievement (Bernard et al., 2009; Russell et al., 2009; Tomkin & Charlevoix, 2014). This implies supporting evidence for the first thesis of Anderson's (2003) interaction equivalency theorem: Deep learning is supported as long as one of three types of interaction (learner-content, learner-teacher or learner-learner) is present at a high level. Although these findings are limited to the context of the participating organization, the theorem could serve as general guidance to design effective online courses in similar corporate settings, but it must be used with caution. Students' engagement in informal interactions suggests that a focus on a single type of interactions may not be enough. Additional research is needed.

When considering other indicators of course effectiveness relevant in business settings, the first thesis of the interaction equivalency theorem (Anderson, 2003) remains applicable. All three online courses were equally effective in terms of satisfaction, perceived readiness to transfer knowledge to the workplace and return on expectations. These findings are particularly relevant for organizations that are more interested in the translation of course knowledge into business practices than the mere acquisition of knowledge.

This research is not without limitations. Participants' previous online learning experiences may have biased their satisfaction reports. If –as reported in other studies (Cotton & Gresty, 2007; Padilla Rodriguez & Armellini, 2013; Padilla Rodriguez & Fernandez Cardenas, 2012; Welsh et al., 2003)– their previous online courses consisted solely of content available for independent study, students might not know if they are missing something by having only one type of predominant interaction designed into their course. A second source of potential bias is found in socially desirable responses (i.e., socially or culturally acceptable replies). In most cases, teachers were the line managers of the students, which could compel learners to express themselves positively about their teachers' performance or to exaggerate the benefits of the online courses (even if they were ensured anonymity when answering).

The limited duration of the courses raises the question of whether longer ones would yield similar results. Further research may also be needed to assess course effectiveness through indicators other than student perceptions, such as measuring actual learning transfer instead of perceived readiness, and to expand the interaction equivalency theorem.

Conclusions

Course design does not dictate or constrain the type of interactions that students use. This emphasizes the role of informal interactions, which can be valuable for learning. Understanding these interactions could inform course design and delivery decisions. Additional research is needed to evaluate the specific relationship between engagement in different types of interactions and the achievement of learning outcomes.

In the context of the participating organization, online courses were effective in terms of satisfaction, learning, readiness for learning transfer, and return on expectations, as long as one of three types of interaction (learner-content, learner-teacher or learner-learner) featured prominently in the course design. This provides supporting evidence for the applicability of the interaction equivalency theorem (Anderson, 2003) in business contexts and suggests its potential expansion to incorporate different indicators of course effectiveness. However, findings also indicate that focusing exclusively on a single type of interaction during the design phase, with no or very limited attention to the other types, may not be desirable, as students can benefit from all three types as part of their learning process.

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