A Comparative Content Analysis of Student Interaction in Synchronous and Asynchronous Learning Networks

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Abstract

Interaction plays an important role to the success of distance learning. As most distance learning environments utilize mainly asynchronous Computer-Mediated Communication (CMC) systems, interaction research that focuses on synchronous CMC is largely ignored. This study scrutinize the patterns of learner-learner interaction in a distance-learning environment. Student interactions in synchronous and asynchronous CMC systems were both compared. Results of the research suggest that constructivist-based instructional activities, such as student-moderated discussion and small group cooperative learning, are conducive to interaction. Overall, a higher percentage of social-emotional interactions occurred in synchronous mode than occur in asynchronous mode. Students spent more time in task-oriented interaction in asynchronous discussions than in synchronous mode. In moderating online seminars, student moderators that followed the guideline of Student-Centered Discussions (SCD) could encourage full participation of online seminar. Recommendations on the design of instructional activities and interactive interfaces were also made for the improvement of distance-learning environments.

1. Introduction

Interaction is considered to be a key element for successful learning in distance education. On the one hand, the current state of interaction research discusses mostly theory but provides little empirical evidence. On the other hand, the research results are based mostly on laboratory experimental studies or surveys, which exclude the context of learning. As an increasing number of courses in various disciplines go online, a growing body of literature begins to point to the importance of online interaction. Research findings show that interaction is a critical indicator of learner satisfaction [6], higher levels of academic achievement [11, 16, 20] higher levels of motivation [15], and a positive attitude toward distance education [23].

The majority of research on learner interaction was conducted over asynchronous computer networks. It is partially due to the predominant use of asynchronous Computer-Mediated Communication (CMC) systems as indicated in the survey of distance-learning systems conducted by Lewis et al. [17]. Few studies have been done on learner interactions in a synchronous communication network and even fewer research projects have been designed to compare both synchronous and asynchronous communication. Factors such as difficulty in coordinating meeting time, high cost in good quality synchronous communication technology, and tool stability may explain the underutilization of synchronous CMC systems. Nevertheless, with the improvement in CMC technology and the availability of affordable tools, synchronous conferencing systems have become more common in distance-learning environments. It is critical to conduct research at every stage of technological transition so that the strengths and weaknesses of these systems can be better understood and utilized.

This study scrutinizes the different patterns of student interaction between synchronous and asynchronous learning environments based on learner-centered instructional design. This research investigates the factors that contribute to the different interaction patterns in different communication modes and make recommendations on the interface design of the CMC systems based on these factors.

2. Rationale

In the past few years, a multitude of studies of distance education have contributed to the broad understanding of distance instruction and learning. As observed by Maddux [18], there were more descriptive studies on computer-based instruction prior to 1980. During the 1980s, there were more lab experimental studies as an increasing number of educational software

and systems being developed. The cost-effectiveness of these programs became the focus of interests. During the 1990s, Maddux has noted a shift in trend that focused more on the improvement of the instructional systems. It indicates a need to improve human-computer interaction. Still, experimental studies dominate the research in educational media.

As pointed out by Hiltz et al. [14], pedagogy has direct impact on the results of learning in distance education. One cannot separate the effectiveness of a program from the theoretical grounding of the instructional design. There is also a need for more empirical studies that examine how the employment of theoretical-based instructional design can enhance interaction in distance learning networks and how the interface design of the learning networks can be improved to match with the objectives of the distance learning activities. When evaluating the effectiveness or impact of a learning program, one cannot ignore the instructional design of the particular program because the results can vary significantly.

An empirical study in a natural setting where the distance learning course is actually being conducted can provide detailed analysis and holistic understanding of the educational process. This study utilizes the method of content analysis to examine the patterns of student interaction in online environments and the factors that may influence online interaction. The data for this study were collected from a distance learning course over a period of ten weeks.

The research results can (a) help educators and researchers of distance education understand better the types of instructional design that match with the different modes of distance-learning systems, (b) provide recommendations to system developers on the improvement of the interface design of learning environments, and (c) further the understanding of distance learners' online behaviors.

3. Theoretical framework

Interaction is often emphasized in different contexts for different purposes, such as construction of knowledge [7] and student satisfaction [9]. Moore [19] contributed to the discussion of interaction by providing an important framework of three types of interaction: learner-content, learner-instructor, and learner-learner interaction. Moore pointed out that learner-content interaction is a "defining characteristics of education." As a result of learner-content interaction, learners achieve intellectual growth or changes in perspectives. The second type, learner-instructor interaction, highlights the important role of instructors. In addition to defining the learning objectives, activities, and materials, distance instructors are also responsible for revising teaching methods and providing evaluation as their students progress in the process of learning. The third type, learner-learner interaction, takes place between learner and other learners in real-time or delayed time and is not restricted to the presence of the instructor. This "inter-learner interaction" can foster learning through student collaboration and knowledge sharing. Although the strategies used to increase learner-learner interaction vary according to the characteristics and backgrounds of the learners, learner-learner interaction can significantly encourage the development of student expertise in different subject areas and promote community building.

Hillman et al. [13] added a fourth component on learner-interface interaction to the literature discussion. They defined learner-interface interaction as "a process of manipulating tools to accomplish a task" (p. 34). They stressed the importance of learner-interface interaction because the "learner must interact with the technological medium in order to interact with the content, instructor, or other learners" (p. 33). The learner must be empowered to profess the necessary skills to use the communication tools and feel comfortable with the learning environment. Good interface design can enhance interactivity and minimize technological barriers to online learning.

A framework of interaction provides the foundation for the design of interactive strategies that are critical to the success of online learning. Many researchers have also defined interaction for the purpose of operationalizing the construct in search of student experience in online interaction via CMC systems. Specifically, how does one measure interaction? Henri [12] used computer conferencing transcripts to examine online interaction. She evaluated the patterns of interaction by examining the trends in the interconnected messages, for example, the number of messages sent or received by conference participants. This type of interaction research may tell the reader the number of inquires or responses sent by a particular conference participant but the number does not account for the quality of the interaction or the intent of the interaction, for example, clarification of requirements or elaboration of concepts. Gunawardena et al. [8] proposed a different interaction analysis model, in which they defined interaction as "the process through which negotiation of meaning and co-creation of knowledge occurs in a constructivist learning environment" (p. 141). The Interaction Analysis Model was proposed to examine the process of social construction of knowledge. The model elucidates how participants in a constructivist learning environment can arrive at a higher level of critical thinking through different stages of interaction (debate) with peers. These stages are (a) sharing/comparing of information, (b) discovery of dissonance and inconsistency, (c) negotiation of meaning/co-construction of knowledge,

(d) testing and modification of proposed synthesis, and (e) agreement/application of newly constructed meaning. They also found evidence of knowledge construction as a result of the online debate.

To sum up, the framework and models of interaction demonstrate the interdisciplinary nature of interaction research that focuses on the interrelationship among learners, content, and technology. Two-way interaction is not an inherent part of technology and more carefully constructed instructional designs need to be incorporated to better the design of distance-learning environments. The results of learner interaction are tied closely to the instructional design and theoretical ground of a course. A course that is based on student-centered instruction might result in different interaction patterns than a course based on teacher-centered instruction. This research contributes to the understanding of interaction research with a focus on a learner-centered instructional design.

4. Research design and method

4.1. Course design

The course for this research is an upper level undergraduate course titled "Theories and Applications of Computer-Mediated Communication Systems" offered at the University of Hawaii. The main objective of the course is to enrich the understanding of CMC systems through discussions and efficient use of various CMC systems. The course design is based on the following theoretical principles:

Principle 1: Learner-centered instructional design: The course design considers student development, especially in the following areas: cognitive, meta-cognitive, motivational, affective, social, and individual differences. Students learn to monitor their own progress, manage the course content, and develop expertise in a sub-domain of CMC study. Specific examples of learner-centered instructional activities include the use of student reflection journals for the purpose of metacognition and student-centered discussion for motivating them to take control of the subject matter.

Principle 2: Constructivist activities: The emphasis is placed on student acquisition of knowledge via active involvement with the curriculum rather than via imitation or memorization of facts or course content. Specific instructional activities based on the constructivist principles include synchronous and asynchronous discussions for co-construction of knowledge and project-based learning for real-world application.

Principle 3: Small group cooperative learning: Students collaborate on tasks in small groups to accomplish a set of predefined learning objectives and to advance their knowledge in a domain. Emphases are placed on community building and knowledge sharing. They equally share the responsibilities of the assigned tasks and semester projects. At the end of each term, they demonstrate the ability to accomplish the task on an individual base.

The course for this study was conducted through a number of text-based, audio-video conferencing, and enhanced virtual systems. Students took turns to moderate seminars in three-member small groups each week. They followed the guidelines of Student-Centered Discussions (SCD) [3, 21] to participate in the online seminars. In general, students participated each online seminar by following the SCD principles such as respecting each other, generating ideas, listening tentatively, and referencing each other during conversation. Whereas, student moderators kept the discussion alive by observing rules such as greeting participants, devising warm-up activities, making an opening statement, using a step-by-step discussion process, asking questions, scripting the discussion, and preparing concluding remarks [3]. Detailed description of instructional design, course syllabus, and the CMC systems employed are described in the research by Chou [4, 5].

4.2. Research method

This research uses the content analysis method to analyze transcripts from both synchronous and asynchronous conference transcripts. The data was collected from the weekly computer conferences held on WebCT bulletin board and chat rooms.

The coding scheme for the content analysis is based on Bales's Interaction Process Analysis (IPA) [1] which was developed to study small group interaction (Table 1). Bales' analysis schema has been applied extensively to the study of small group interactions [10]. The analysis focuses on two areas: socioemotional (SE) area (category 1-3, 10-12) and task areas (category 4-9). Bales' IPA is the basis of content analysis for examining patterns of interaction for this study. The IPA is especially appropriate for comparing and contrasting the interaction patterns between synchronous and asynchronous communication. The transcripts from both modes of communication were analyzed separately. The results can then be used to answer research questions regarding learning activities, for example, how different the interaction patterns between synchronous and asynchronous communication were, or how different the interaction patterns between a conference moderator and a conference participant were.

Table 1: Bales' Interaction Process Analysis (Revised and Expanded)

Code	Category
Social emotional Area: Positive Reactions	
1	Shows solidarity, raises other's status, gives help, reward
2	Shows tension release, jokes, laughs, shows satisfaction
3	Agrees, shows passive acceptance, understands, concurs, complies
Task Area: Attempted Answers	
4	Gives suggestion, direction, implying autonomy for other
5	Gives opinion, evaluation, repeats, analysis, express feeling, wish
6	Gives orientation, information, repeats, clarifies, confirms
6.1	*Gives personal information (positive social-emotional)**
6.2	*Gives topic-related information**
6.3	*Gives technical information*
Task Area: Questions	
7	Asks for orientation, information, repetition, confirmation
7.1	*Asks technical information**
7.2	*Asks topic-related information**
7.3	*Asks personal information (positive social-emotional)**
8	Asks for opinion, evaluation, analysis, expression of feeling
9	Asks for suggestion, direction, possible ways of action
Social emotional Area: Negative Reactions	
10	Disagrees, shows passive rejection, formality, withholds help
11	Shows tension, asks for help, withdraws out of field
12	Shows antagonism, deflates other's status, defends or asserts self
* Categories in italics are additions to the original IPA.	

After the initial round of coding, the researcher found that the original categories 6 and 7 were too broad to reflect the actual online interaction patterns from the samples used for this study. Technical questions, topic-specific discussions, and personal information exchanges were frequently seen in the synchronous discussions and yet there were not equivalent categories in the IPA model. Thus, the researcher divided categories 6 and 7 into thee sub-categories. Category 6 was divided into "gives topic-related information" (task), "gives personal information" (SE), and "gives technical information" (task). Category 7 was divided into "asks topic-related information" (task), "asks personal information" (SE), and "asks technical information" (task).

For the purpose of content analysis, three seminar transcripts from the same week of asynchronous and synchronous discussions were chosen for content analysis. The unit of analysis is the sentence. A total of 4,977 sentences were coded. There were 2,519 sentences in asynchronous discussions and 2,458 sentences for synchronous seminars. For testing intercoder reliability, a total of 907 sentences out of 4,977 sentences were coded by two coders. Each coder received a clean copy of the plain texts imported into the NUD*IST[1], a software program for content analysis. The coding results were tabulated and imported into the Excel spreadsheet program. The data were later analyzed in the SPSS statistical computer program. The transcripts from the odd weeks (weeks 3, 5, and 8) were randomly chosen for content analysis. The intercorder reliability was measured by Cronbach's alpha. The results of reliability analysis between the two coders' are at the following alpha levels: .90 (week 3), .89 (week 5), and .88 (week 8), an indication of high intercoder reliability.

4.3. Research questions

Question 1. Task versus Social-Emotional-Oriented Interaction

Is there a significant difference in social-emotional-oriented content and task-oriented content between asynchronous and synchronous communication modes?

Opposing arguments on whether CMC can strengthen interpersonal relationship or alienate individual learners are frequently discussed in literature [2, 22]. An analysis on the pattern of interaction, especially comparing social-emotional versus task-oriented interaction, can help further the understanding. That is also the purpose of the first research question.

Question 2. Conference Moderation

Is there a significant association between the moderators and the participants in the online discussions?

The patterns of student interaction are contingent on the instructional design and pedagogical principles of a course. This course for this research emphasizes on learner-centered instructional design. Contrary to instructor-led discussion, students are encouraged to lead the online seminars and facilitate discussions. The interaction between the moderators and the participants also represent an important aspect of online interaction. The second question probes the relationship between moderators and participants.

Question 3. Gender

[1] NUD*IST stands for Non-numeric Unstructured Data Index Searching and Theorizing(http://www.qsr.com.au).

Is there a significant difference in the SE-oriented versus task-oriented contents between female and male participants?

Gender difference in online interaction has always been the subject of many research studies. This study investigates if there is a significant difference in both synchronous and asynchronous discussions between male and female participants.

5. Analyses and discussions

5.1. Patterns of student interaction

First, the total number of sentences in each mode and the percentages of SE versus task-oriented content distributed over the total number of messages in each mode in the selected weeks for this study are presented in Table 2. In asynchronous discussion, 8% of the discussions were devoted to SE content, with 92% to task-oriented content. In synchronous discussion, SE content accounted for 33% of the discussions and task-oriented contents for 67%. There was a higher percentage of task-oriented discussions in both communication modes. When examining the communication mode separately, there is a higher percentage of SE content in synchronous communication mode and a higher percentage of task-oriented content in asynchronous communication mode.

Table 2: Comparison of SE versus Task-Oriented Content: Percentage and Total Number of SE and Task-Oriented Messages Submitted Each Week

	SE	***%***	***Task***	***%***	***Subtotals***
Asynchronous					
wk3	92	13%	598	87%	690
wk5	34	5%	717	95%	751
Wk8	40	7%	508	93%	548
subtotals	166	**8%**	1823	**92%**	1989
Synchronous					
wk3	221	35%	417	65%	638
wk5	233	36%	411	64%	644
Wk8	239	29%	584	71%	823
Subtotals	693	**33%**	1412	**67%**	2105
Totals	859	**21%**	3235	**79%**	4094

When examining the weekly patterns of interaction in asynchronous mode, SE contents mildly went from 13% in week three to 7% in week eight in asynchronous mode. Likewise, SE contents also decreased from 35% to 29% in synchronous mode. The reduction in SE-oriented contents and the increase in task-oriented contents in both communication modes could be summarized by the following factors:

1. In the revised version of Bales' IPA (Table 1), the SE-oriented content consisted of interaction in both positive reactions (e.g., greeting, showing tensions, giving/asking personal information, etc.) and negative reactions (e.g., disagreeing, showing antagonism, disagreeing, etc.). As the course continued from week three to week eight, the students were already familiar with each other and the systems. They spent less time in the exchanges of interpersonal information or feeling less frustrated over the CMC systems. Therefore, there was less SE-oriented interaction.

2. As the semester continued, students became more familiar with the rules of participating in online discussion. Because each group was in charge of moderating one seminar, the group in charge had the responsibility to keep the discussion focus by asking more task-oriented questions.

3. The time constraint in restricting the synchronous seminar to one hour also limited the SE-oriented interaction. Students initiated the discussions as soon as the moderators opened the floor.

4. The seminar topics required students to support their arguments with facts and good reasoning, which usually left little room for SE content.

If all variables from Bale's IPA are grouped into only two categories—SE and Task variables, the multiple regression analysis shows that both variables significantly predict the interaction patterns in both communication modes, $F(2, 116) = 85.7$, $p < .0001$ (Table 3). The mean sentence per person in synchronous mode is 26.31 sentences and 51 sentences in asynchronous mode. Because $R = .77$ and $R^2 = 0.6$, 60% of the variance is accounted for by these independent variables. The analysis shows that there is a significantly higher amount of SE-oriented interaction in synchronous discussions and a significantly higher volume of task-oriented interaction in asynchronous discussions.

Generally speaking, in synchronous communication mode, there were more interactions in showing support and personal information exchanges; in asynchronous communication, the discussions remained in the form of expressing opinions and delivering topic-related information. The conversations in asynchronous communication were mostly one-way communication in which most students posted their questions and made comments that did not require further clarification or responses from the original senders. Most students did not post more than the required two postings in responding to classmate's postings. In the distribution of task-oriented interaction, the exchanges between asking for information (Task 7.1 - Task 9) and giving information (Task 4 - Task 6.3) were obviously uneven in asynchronous mode. Participants seemed inclined to ask fewer questions and give more information. The distribution is even more uneven in asynchronous mode when comparing the communication between Task 5 and Task 8. However,

there are more reciprocal interactions in the above mentioned pairs of categories in synchronous mode.

Table 3: Multiple Regression Analysis Predicting Interaction in Synchronous Versus Asynchronous Discussions

	Syn. Mean	*Syn. SD*	*Asyn. Mean*	*Asyn. SD*	*F*	
SE	8.66	8.12	4.26	4.72	-7.46	***
TASK	17.65	15.53	46.74	19.11	12.21	***
totals	26.31	22.01	51.00	20.76	5.85	***

****P* < .0001

In the synchronous communication mode, there was more spontaneous communication going back and forth. The communication processes between asking and answering questions are more equally distributed in synchronous communication, whereas in asynchronous communication, students tended to volunteer and to give more information than to ask questions.

The synchronous communication mode also made it easier to provide immediate feedback to information seekers. Some students were actively engaged in discussions while other students waited until they were asked to say something. The researcher observed that there was more equal participation in the discussions in three-member small groups than in large groups. In addition, in synchronous mode, participants asked more personal questions and revealed more about their frustration or need for help with less hesitation. Personal questions such as one's occupation, schooling history, and background of technical training were included more often in synchronous discussions.

5.2. Moderator versus participants

Students took turns moderating small group discussions in the weekly synchronous seminars. Every group was responsible for hosting one online seminar in the semester. Because there were thee members in each group, the seminar was usually divided into three small groups so that each member of the host group could moderate one group in the online seminar. The moderator's action is highly correlated with the performance of the conference participants. According to Table 4, when a moderator sent out more task-oriented content, the participants also responded with more task-oriented messages, $F(1, 163) = 36.58$, $p < .0001$. Likewise, when a moderator sent out more SE-oriented content, the participants responded with messages of the same nature, $F(1, 163) = 11.91$, $p < .001$. In addition, the total number of messages sent by the moderators also contributed positively to the total number of messages sent by the participants, $F(1, 163) = 28.85$, $p < .0001$. Overall, the moderator's functions are vital to the information exchanges in a small group discussion. The comparison of the mean sentences between moderator and participant indicates that in order to encourage active discussion, the moderator usually sent out two or three times more sentences than the participant.

Table 4: One-Way ANOVA Between the Mean Sentences Sent by Moderators and Participants

	Moderators	*Participants*	*F*	
SE Mean	9.05	3.5	11.91	**
Task Mean	24.15	6.29	36.58	***
Total Mean	33.19	9.78	28.85	***

****p* < .0001, ***p* < .001

In addition to sending out more messages to encourage member participation, student engagement in online discussions is also affected by a number of factors: the types of questions asked by moderators, moderators' styles in leading questions, the advance planning of the seminar, the background information provided to the class by the moderators, and the activities planned. The types of conference moderation used in this course for this research by the students are summarized as follows:

1. Same small group with the same moderator: Each small group stayed with the same moderator from the beginning to the end of one seminar session. The advantage in this type of conference moderation was that the students could engage in more in-depth discussions.

2. Same small group with different moderators: The moderators rotated from one group to another group every 20 minutes. The advantage in this type of conference moderation was that the students could benefit from the unique background knowledge that each moderator brings.

5.4. Gender Difference

In terms of gender differences, significant differences were found in synchronous mode in both SE-oriented and task-oriented interaction. In general, female participants sent out more sentences than the male participants in both synchronous and asynchronous communication modes; the female mean sentences are higher. Nevertheless, female participants sent out significantly higher number of messages in both SE-oriented and task-oriented areas as shown in Table 5. Although the SE-oriented interaction in asynchronous communication does not show significant difference

between female and male participants, it is close to a significant result. Overall, female participants consistently sent more SE-oriented messages in both communication modes.

Table 5: ANOVA on Mean Sentences Between Synchronous and Asynchronous Modes by Female and Male Participants

	Female Students		*Male Students*		*F*
Syn	Mean	SD	Mean	SD	
SE	5.92	8.74	3.05	5.55	6.68*
Task	11.197	6.13	6.80	12.04	4.01*
Sub-totals	17.12	23.83	9.85	16.85	5.28*
Asyn					
SE	4.94	6.26	2.85	2.96	2.27
Task	44.22	27.08	38.04	21.79	.72
Sub-totals	49.17	29.94	40.89	23.14	1.09

5.5. Discussions

The analyses on learning activities focus on interaction patterns between synchronous and asynchronous discussions as well as student moderation of online seminar.

1. Learner-learner interaction: In general, there were more interactive exchanges in synchronous communication. In addition to discussing the topic of the week, students also spent time in getting to know each other by sharing personal information. The immediacy of message exchanges encouraged more SE-oriented discussions in synchronous discussions than in asynchronous discussions**.** In contrast to the synchronous discussions, there was less two-way communication taking place in asynchronous discussions and the majority of the discussions were task-oriented. In addition, the exchanges in SE-oriented content gradually were reduced in both communication modes. After the initial stage of getting to know each other, students were able to concentrate more on tasks at hand. The one-hour time constraint set for each seminar also contributed to more task-oriented interaction in synchronous seminars.

In short, there was absolutely no interaction in asynchronous mode in the following categories: Asks personal information (SE, 7.3), Gives suggestion, direction, implying autonomy for other (Task, 4), Asks for suggestion, direction, possible ways of action (Task, 9), and Shows antagonism, deflates other's status, defends or asserts self (SE, 12). No moderator was assigned to host the discussions in asynchronous discussions. It might have made a difference in the interaction patterns if there were a moderator to facilitate the discussions. This will require further study.

2. Conference moderation: Student-moderated seminar proves to be a successful strategy in keeping online discussions alive. Students were given responsibilities in finding a topic of common interest for fellow students to discuss and debate during online seminars. They also had to research relevant literature to demonstrate their knowledge of a certain topic in order to conduct an in-depth discussion.

6. Conclusions

6.1. Interaction Factors

Based on the observable elements in this study, the following interaction factors are observed:

1. Learning activities: First, there were more SE-oriented interactions in the synchronous communication mode. Appropriate employment of the synchronous seminar enhanced interpersonal connections. Second, asynchronous peer review provided the opportunity for collaboration on building the knowledge base and sharing information. Third, a student-moderated conference based on the SCD Model allowed learners to take initiative for their learning and become efficient in computer-mediated communication as well as various CMC systems. Fourth, there was more one-way communication in the asynchronous mode. Students seemed to be more interested in expressing opinions than challenging each other's views; whereas in synchronous mode, there were more questions and answers. Students were more engaged in the synchronous discussions. There was a stronger sense of immediacy to respond to peer's questions in synchronous mode than in asynchronous mode.

2. Technology attributes: First, student perceptions of the communication characteristics of technologies may have affected their initial interaction online. Time played an important role in student adoption of new technology. Usually after the first two or three weeks, students were able to ignore some of the "obstacles" of a system and concentrate on the task at hand. Second, the selections of synchronous or asynchronous technologies contributed to the different interaction patterns. Students tended to spend more time in task-oriented discussions in the asynchronous mode. When online tasks are clearly defined and students pass the initial "get-to-know-each-other" stage, students were inclined to spend less time in SE-oriented interactions in both communication modes. Nevertheless, learners consistently spent more time in SE-oriented interaction in synchronous mode than in asynchronous mode.

3. Learner differences: First, female students contributed more to SE-oriented interaction than the

male students in both communication modes. Second, female students also sent an overall higher number of messages than the male participants in synchronous communication mode.

6.2. Recommendations

Based on the experience in conducting this research, recommendations are made as follows:

1. Instructional strategies and design: The use of SCD etiquette for online interaction is highly recommended. First, the learners have a common set of rules to follow so that they will be less confused with the procedures of the online seminar. Second, these rules encourage the active participation of the students. Third, SCD can also contribute positively to the affective aspect of discussion by using basic greetings and referencing in conversation.

2. Interface design: Moderators play a critical role in online seminar. The system can include the following features to make the moderation more effective: (a) time management: In many instances, the moderators haste to conclusions because of insufficient time left during online seminars. A timer with a reminder of the remaining time can help the moderator to set pace for the discussion; (b) participant list and number of messages posted; In order to encourage equal participation, the moderator can be better informed about member participation by browsing the numbers of messages posted by individual participants. The moderator can then direct questions to other participants who may not have the opportunity or who need to be encouraged to take full participation of the online seminars; and (c) emoticons: Students love to use various symbols to convey their emotions, e.g., exclamation, surprise, smile, encouragement, frustration, etc. A set of emoticons on the side bar can help participants to express their thought, feelings, and actions more effectively.

3.Future Study: Further analysis on how interaction enhances or impedes learning can provide more insights into the nature of online interactions. This study mainly focuses on the patterns of interactions and the contributing factors. How interaction can contribute to learning is also an important area of further study. Furthermore, there should be more careful examination of the influence of learner differences on interaction and learning.

Research in distance education covers a wide spectrum of issues. Although interaction is not the only key to successful distance education, the interaction factors are vital to the progress of learners, teachers, and the school as a whole. As Gunawardena et al. [7] has boldly put it: "No interaction, no education." This study advocates the integration of learner-centered instructional design and constructivism into the curriculum. The researcher hopes to break the myth that synchronous communication is impossible to manage. On the contrary, the appropriate incorporation of synchronous activities can enhance learning interests and interpersonal relationship. Although there is no lack of research in distance education since the 1980s, there is a need for more research on the pedagogical applications of emerging technology employed in distance education because the implications and applications also affect educational policy and management. This study is a small contribution to the understanding of the ever-changing technological ecology of distance education.

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