

## Influence of Structure and Interaction on Student Achievement and Satisfaction in Web-Based Distance Learning

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### ABSTRACT

This study examines the influence of instructional design and management style on student achievement and satisfaction in a web-based distance learning environment. From the literature review, two major instructional design and management styles in web-based distance education were conceptualized as structure and interpersonal interaction. To investigate the differences on learning output variables, two web-based instructional programs were developed as college level courses. One course was developed and implemented mainly with a resource-based highly structured self-learning mode with little interpersonal interaction, and the other course was developed and conducted mainly with interpersonal interaction without well-structured materials. Sixty seven and fifty six juniors were enrolled in each course at a cyber university for one semester. Questionnaires, achievement scores, satisfaction levels, and interview data were collected and analyzed. Findings indicated that self-learning with well-structured materials was not inferior to highly interactive instruction without well-structured materials in receptive learning achievement. This implicates that well-structured material can possibly replace a teacher's one to one interaction in receptive learning as early distance educators expected. However, students in the interactive course without well-structured materials, rather than in the well-structured course with little interaction, showed higher achievement in critical thinking learning. In terms of satisfaction, students in the structured course were more satisfied with structure, and students in the interactive course were more satisfied with interpersonal interaction. Implications of these findings and recommendations for further study are suggested.

### Keywords

Structure, Interaction, Distance learning, Instructional design, Instructional management, Web-based learning

### Introduction

Recent advancement in the web and multimedia technology is changing the way of teaching and learning. Because of the technologies' flexibility and diversity, distance learning programs using internet and multimedia contents also have proliferated (Menchaca & Bekele, 2008). In web-based distance instruction, one of the critical issues is how to design, develop and manage instructional programs to get effective, efficient learning that is attractive. For thousands of years, learning and teaching always took place in close proximity, and this has become firmly anchored in human consciousness. Learning and teaching at a distance is, therefore, regarded as something extraordinary and a kind of defect. Educators have tried to make every effort to get over this spatial separation. The first pedagogic approaches specific to distance education aimed at finding ways by which spatial distance could be bridged, reduced or even eliminated. The question was asked: what must be done to make distance equivalent to proximity in distance education? The pedagogics of distance education is derived basically from the efforts to answer to this question.

One answer to this question is making and managing the best learning materials as possible, which require little to no teacher's interaction. Educators at traditional distance universities have put forth the most effort and funds in the professional development and production of qualitatively excellent teaching materials for the purposes of self-study, which were distributed by post and then by web-based cyber instruction programs these days (Peters, 1998). They have tried to include the effect of teacher's interaction into well-structured course and material for self-learning. Moore (1993) conceptualized this as structure, because he regarded the main feature of making and managing programs as the structuring of the learning and teaching. Also many studies have presented elements and rationale for course/contents structure as well as instructional strategies for structuralization (Bischoff et al., 1996; Carr-Chellman & Duchastel, 2000; Chen, 2001a, 2001b; Chen & Willits, 1999; Lee, 2004a; Ostlund, 2008; Peters, 1998; Saba, 2005; Saba & Shearer, 1994). Researchers emphasizing structure in distance learning seem to believe that well-structured material can overcome the absence of teachers.

Others say, however, that it is not sufficient simply to enable students to study in isolation with the help of distance learning materials. Students must be able to discuss with their teachers and other students in order to learn, because this is the real foundation of academic teaching (Daniel and Marquis, 1979; Moore & Thompson, 1990; Morris, Mitchell, & Bell, 1999; Sewart, 1982; Verduin & Clark, 1989). They say that a person's grasp of the acquired and assimilated knowledge can only develop in discussion through interpersonal interaction (Garrison, 1993). But interpersonal interactions at a distance have not been easily achieved until the advent of the computer and network technology. Now educators' and developers' attention has turned to converting distance learning into a more interactive one than ever as computer and web technology become widely available. As a communication medium, the web discussion board presents many possibilities to effective interaction, which is not encountered in traditional instructional environments or in print publications. So many studies on interaction in web-based learning persist positive pedagogical effects of interaction and present various interaction strategies for better learning (Beuchot & Bullen, 2005; Dennen et al., 2007; Garrison & Cleveland-Innes, 2005; Kehrwald, 2008; Novitzki, 2005; Russo & Campbell, 2004; Tu & McIsaac, 2002; Weaver, 2008).

These two perspectives, structure and interaction, bring educational policy and priorities into conflict with each other; they are characteristics of distance education on the whole and are the source of many disputes as Lee (2004b) indicated. Moore (1993) has been theorized the relationship of these two perspectives. According to him, the more we structuralize a course and its materials, the less we need interpersonal interaction. When materials are not structured well enough, teachers need to provide more interaction for compensation. So the decision making on the extent – whether to focus on structuring course and materials or making interactive course, or how to combine each of the extreme – is critical, especially in distance education organization, as each (structure and interpersonal interaction) need a substantial budget to implement in a satisfactory manner. If the educational organization decides to focus on structuralization of programs, they need to hire expert contents designers and web programmers. If the organization wants to emphasize interpersonal interaction, they must have enough instructors or tutors to interact with the students. These two concepts are, in effect, contrary in relationship. According to Peters (1998), an interesting task for distance-teaching pedagogics might be to undergo a theoretical and experimental work to find whether and if so where the pedagogic optimum can be found between two extremes, with an extremely structured course at one end and extremely interactive course at the other end.

Unfortunately, however, studies about the rationale of each program's effect or the influence of the design and management style on learning output variables cannot be found easily. Although the majority of the literature on web-based distance education focuses on the effectiveness of web-based distance education or educational media, and emphasizes structure (converting existing, traditional course materials to a web-based format) or a teacher's interaction with students respectively, it doesn't reflect a scientific approach necessary to discern which – and why – is more effective, how learning outputs are different in each program, and whether – if so, how much – structure can be a substitute for interpersonal interaction.

Therefore, this research purposes to analyze and compare learning outputs, such as student achievement and satisfaction, in highly structured instruction with the least interaction and highly interactive instruction with the least structure, and to discuss two macroscopic instructional design and management styles and their influence. For this research, two different WBI (Web-Based Instruction) programs with different design and management styles, one with highly structured instruction and the other with highly interactive instruction, were developed. Quantitative and qualitative data were collected and analyzed to investigate the influence of design and management styles on learning output in web-based distance learning.

## **Theoretical Background**

### **Structure and interaction**

There is a physical separation of a teacher and a learner in distance education. One of the efforts in reducing the distance between teacher and students was taken when people started to interpret distance education as the simulation of a conversation between teacher and student. Distance educators recommend that the contents be displayed in the form of a written dialogue. When writing teaching text, teachers must imagine that they are speaking to someone, and this is supposed to make them use a natural spoken language in writing the text wherever possible (Holmberg, 1983). Many distance educators emphasize the importance of structure in developing text materials in distance education to make up the distance. Kearsley & Lynch (1996) contended that distance education courses

must have high structure to be successful, and William (2006) said that the more ID components incorporated into a distance education course, the greater the student achievement outcome. It is also reported that most critical factor in distance learning is structure and interaction, neither learners' characteristics such as their technical expertise nor course delivery format (Stein et al., 2005).

The term structure, defined by Moore (1993), is in contrast to dialogical learning. Structure refers to elements of the course's design, such as learning objectives, activities, assignments, evaluation, whereas interaction is the communication between the instructor and learners (Moore & Kearsley, 2005). Structuring of instruction is consistently planned on a targeted basis in small steps; its time is regimented and it is uniformly controlled and evaluated. The main instrument of this learning and teaching are printed materials or multimedia learning packages which contain carefully developed and optimized courses and set learning into motion. Moore (1993) used the example of a teaching film for television to show just how far this structuring could go: in the film literally every word, every action of the teacher, every minute of the available time and even the tiniest detail of the contents were laid down beforehand.

The structuring of learning and teaching is in fact nothing new and certainly not unique to distance education. Presenting knowledge through books has usually been broken down by means of components such as Foreword, Introduction, Chapters, Summary and Conclusion. And in the last two centuries, the articulation of instruction has been a central theme of pedagogics, especially in the field of instructional design or educational technology. This structure is seen most clearly and most densely in programmed instruction. It is the representative of instructional theories in which each word, each learning step, each teaching strategy is planned and developed with the greatest care in order to simplify learning and make teaching more successful. What is nevertheless new in Moore's suggested concept is not structuring in itself but the extreme extent of its application (Peters, 1998).

This structure discussed here, is about the elements in the course design and contents design. A course consists of such elements as learning objectives, content themes, information presentations, case studies, pictorial and other illustrations, exercises, projects and tests. All these should be very carefully composed and structured. In addition, we need to consider another type of structure especially in a web-based environment. That is, interface structure, which is not covered in Moore (1993)'s concept; he seems to consider the concept, structure, in a correspondence learning environment, not an e-learning context in recent days. Interface structure encompasses site structure, navigation structure, and screen design structure on the computer screen that students face directly (Lee, 2004b). Therefore, highly structured instruction in this research means that the extent of structuring is quite high in terms of course, contents, and interface structure for self learning with little to no teacher's interaction.

While structure is an issue about program design and development, interaction is an issue rather about implementation and management. Moore (1993) categorized interaction types into student-teacher, student-student, and student-contents interaction. Moore called student-teacher interaction dialogue, which was in contrast to his definition of structure. The concept of Moore's dialogue does not mean the written presentation of simulated letters or conversations, rather it means direct and indirect oral interaction between teachers and students, that is, an actual dialogue. The concept in the definition of dialogue that is in contrast to structure, however, needs to be redefined in this context because student-student interaction is more like student-teacher interaction, and it is essentially different from student-contents interaction which is self-learning with materials. So these two interactions (student-student, student-teacher) could be redefined as interpersonal interaction, which is beyond just dialogue (Lee, 2004b). Interpersonal interaction is certainly differentiated from intra-personal interaction of student-contents interaction that is rather included to structure because structuring materials is basically for effective intra-personal interaction between a student and contents. Meanwhile, we should consider electronic messages on the web board in written text as well as oral dialogue in web-based distance environment. This could be very attractive because it would mean that more personal communication and academic discourse – something that lacks in traditional distance education – might be combined with recent technology-based distance learning. So the interpersonal interaction in this research includes student-teacher and student-student interaction, mainly reflected the cyber space through web board or e-mails as posted messages in written text.

Interaction has been the most frequent research theme in web-based distance learning because of its pedagogic genesis. Many studies on interaction in web-based learning persist positive pedagogical effects of interaction and present various interaction strategies for better learning (Beuchot & Bullen, 2005; Dennen et al., 2007; Fulford, & Zhang, 1993; Garrison & Cleveland-Innes, 2005; Gunawardena & Zittle, 1997; Russo & Campbell, 2004; Tu & McIsaac, 2002). They persist no matter how the program is structuralized, learning cannot be completed without

interpersonal interaction. Moore & Thompson (1990) and Verduin & Clark (1989) found that distance education courses were most effective when student-student interactions were present and the instructor feedback was timely.

However, the belief of the more, the better in interaction is becoming to be criticized. It has been found that, although instructor-learner interaction is important, not all students are looking for high levels of interaction, such as a response to every discussion board posting (Su et al., 2005). Thus, instructor presence does not follow a more is better pattern. Various studies have shown the cases for it. Mazzolini & Madison (2003) found that increased instructors posting did not result in increased student participation. In fact, as the instructor became more involved, student messages became shorter and more infrequent. Dennen (2005) noted similar interactions in a course where the instructors wrote about one-half of all messages in the class in an attempt to respond to each individual student. Dennen et al.(2007) suggested that there is a threshold at which an instructor's heavy-handed or overwhelming amount of communication inhibits or discourages learner communication and participation. Besides, it is reported that some instructors may not know how to fluidly, efficiently, and effectively provide important information in an online setting. So structuring those elements is necessary to help instructors. Structuralization would make up for instructor's unpreparedness (Dennen et al., 2007).

*Table 1. Structuring elements*

Structure	Structural elements
Course structure	<ul style="list-style-type: none"> <li>Dosing</li> <li>Providing Course orientation: welcoming, characterizing the course contents, description of the required preliminary knowledge, indications of correlations to other areas of knowledge and possibly to job practice, description of rough learning and teaching objectives, naming advantages obtained by reaching and learning goals, etc.</li> <li>Scheduling</li> <li>Self-tests</li> <li>Peer evaluation</li> <li>Assignments and pre-scheduled deadline</li> <li>Systematic management of course pace and learning speed</li> <li>Strict grading according to notice announced in advance</li> </ul>
Contents structure	<ul style="list-style-type: none"> <li>Portioning</li> <li>Providing contents, lists</li> <li>Indication of learning and teaching aims</li> <li>Sequencing</li> <li>Stressing what is important</li> <li>Showing perspectives for further study</li> <li>Branching</li> <li>Providing cross-references</li> <li>Arrangement in blocks and characterization by marginal notes</li> <li>Providing summative map, structural site map, procedural map</li> <li>Providing concept map, concepts tree</li> <li>Providing comparison/contradiction</li> <li>Providing abstracts</li> <li>Providing index</li> <li>Providing various Instructional methods: questions for repetition, questions for training, simulated dialogue</li> <li>Writing contents with spoken language, like conversation style</li> </ul>
Interface structure	<ul style="list-style-type: none"> <li>Providing spatial layout to avoid cognitive overloading</li> <li>Providing search index function</li> <li>Emphasizing by spaced printing</li> <li>Providing marginal notes</li> <li>Visualization with graph, table, or figures</li> <li>Using frames, underlining, bold, italic print, decimal numbering</li> <li>Using comic characters like Avatar for students not to feel isolated</li> </ul>

*Note.* From previous studies (Bischoff et al., 1998; Chen & Willits, 1999; Lee, 2004a; Peters, 1998; Saba & Shearer, 1994)

Structure and interaction seem to be standing contrary on one hand, complementary on the other hand. According to Moore (1993), structure is a variable that determines to some degree the extent of dialogue (Gorsky & Caspi, 2005). Saba & Shearer (1994) assumed a systemic and dynamic relationship between structure and dialogue and observed that transactional distance varies by the rate of structure and dialogue. They found that as dialogue increases in a videoconferencing environment, structure decreases to keep the system stable. When structure increases, dialogue decreases. Moore & Kearsley (2005) noted that success in distance teaching is determined by the extent to which the instructor and the institution are able to provide appropriate structure and the appropriate quantity and quality of dialogue between instructor and learner. But the challenge here is that what is appropriate is left to the instructor to determine (Stein et al., 2005). Moore acknowledged that there are no ready-made answers to how much dialogue and structure is needed and desirable for effective learning. Although he recommends that instructors in doubt should err on the side of too much structure rather than too little (Moore, 2004), it is still challenging to find pedagogical optimum between two extremes. And before finding the optimum, a preliminary research on how these two extremes influence on learning respectively, how learning is differently influenced by each centered instruction, is necessarily to be studied.

### **Structuring elements**

Well-structured materials in this research are the learning contents which are designed and developed considering various structural elements (see Table 1), which were from previous literature (Bischoff et al., 1998; Chen & Willits, 1999; Lee, 2004a; Peters, 1998; Saba & Shearer, 1994). Non-structured materials are the learning contents which were not specifically considered those structural elements in design and development.

## **Research Method**

### **Program development**

In order to compare learning output variables in web-based instruction, two WBI (Web-based Instruction) programs were developed as college level courses. One course (called structured instruction in this paper) was developed and implemented mainly as a highly structured resource-based self-learning mode, and the other course (called interactive instruction in this paper) was developed and implemented to carry mainly interpersonal interaction with the least course/contents/interface structure. Elements and design/management factors of each instructional program, such as elements for course/contents/interface structuralization, or management tips for the interactive course, were shown in Table 1. Programs were designed and developed according to traditional ISD (Instructional Systems Development) model, considering these elements. Three WBI experts and practitioners verified these two different programs throughout the development process. Subject matters of both courses were same, which were about general social science. The development process for two instructional programs is as follows; Analysis and Planning (Learning contents, students, learning environments were analyzed first and research design was planned considering these analysis results) → First instructional design and draft storyboarding → Validation by three experts (Ph.Ds in the field) and developers → Second instructional design and storyboarding → Production of digital materials → Pilot implementation of course → Revision and redevelopment of program → Validation by three experts and completion of final instructional programs (The programs were also validated by students during the process of implementation and data collection; see Results).

### **Participants and setting**

Sixty seven and fifty six juniors at a cyber university in Korea, ages 20s to 50s, were randomly assigned and required to take each course respectively for one semester. There was a pre-test to know prior knowledge and the results showed no significant difference between two groups (Table 2). Same instructor and same contents were applied to both classes. In terms of student characteristics that might have influence on the results of this research, perceived learner characteristics were analyzed a week prior to each program's implementation. Students used a five-point Likert scale to analyze whether students were extrovert vs introvert, social (or outgoing) vs rather individual, active vs passive in class. As a result, students in the highly structured instruction were more extroverted ( $p < 0.05$ ) and more active in class ( $p < 0.01$ ) than the students in the interactive instruction were. However, the student factor doesn't

seem to be really influential in this context because students' characteristics were reversed in the previous pilot implementation and showed same results as this paper. That is, in the pilot implementation, students in the interactive instruction were more extroverted ( $p < 0.05$ ) and more active in class ( $p < 0.05$ ) than the students in the structured instruction were. But the results of the pilot implementation showed no significant difference from the result in this paper. Therefore, student's characteristics weren't a critical factor as much as instructional method in this research.

*Table 2.* Pre-test difference for students' prior knowledge between structured instruction and interactive instruction

Record	Class	N	Mean	St. Dev.	df	T
Overall record	Structured instruction	53	3.83	0.91	93	1.68
	Interactive instruction	42	3.50	0.99		

## Implementation

Two classes were homogeneous in terms of instructor and subject matter, since same instructor and same subject matter was assigned to both classes. Main difference was instructional design and management way (Table 3).

*Table 3.* Examples of course structure difference between the structured course and the interactive course

Course structuring elements	Structured instruction	Interactive instruction
Dosing	Highly structured contents were provided regularly every week	Most of the instruction is based on the interaction on the online board. Non-structured contents were provided irregularly.
Orientation	Implemented in detail	Very brief orientation provided
Grading	Strict grading according to notice announced in advance	Participation and peer evaluation included. (But these were not included in the result for comparison with structured instruction.)
Assignments	Assignments required every week. No feedback provided.	Immediate feedback provided to every assignments.
Deadline	Pre-scheduled deadline	Flexible deadline according to students' consensus
Course schedule	Systematic management of course pace and learning speed	Flexible management applied in regard of pace, speed, sequence, etc.

In the highly structured instruction, students were required to study highly structured web-based material and to undertake assignments given every week, usually alone. Instructor's feedback was provided as little as possible. Instead, most of the possible feedbacks by the instructor were structured into the web materials. For example, materials were written with natural oral language just like a simulation of conversation. And a teaching assistant cartoon character was used all along the learning process in the material. In addition, various structuring elements in Table 1 were reflected to the program and the web-based material. The instructor was trying to neither encourage nor discourage interactions among students. Meanwhile, in the highly interactive instruction, students were required to undertake assignments and to participate in team discussions assigned throughout the course. The instructor's immediate feedback to assignments and questions were provided, although well-structured materials were not provided. All interactions were recorded on an asynchronous web bulletin board. Table 3 shows some examples of course structure difference between two classes.

## Procedure

This research was done over a period between 2002 and 2004 from program development to data collection and analysis. Design and development of two different types of instructional programs were started from early 2002. The treatment was first operated with these programs as a pilot implementation at fall semester of 2002. After some revision, finally developed instructional programs were implemented in 2003 again. And then interview and analysis

of collected data was conducted until 2004. The results were found to be credible enough to be replicable since there was no difference between two implementations.

The students' cognitive achievement data was collected in two different ways. One was about receptive learning, which consisted of declarative knowledge, information, concepts, or theories that were mostly accepted without criticism; ex. Introducing concepts and definitions of the terminology related in the class. In receptive learning, students don't have to criticize what they learn, what they do is just understanding, memorizing, and recollecting. That is, reception in itself. The other was about critical thinking learning, which contained controversial issues requiring arguments, criticism and discussion; ex. Does distance education using high technology reproduce classes of society? Does it make the rich-get-richer and the poor-get-poorer?, or Is distance education cost-effective?

For evaluation reliability, three evaluators' gradings were correlated (Pearson  $r = 0.84^{**}$ ,  $p < 0.01$ ). In terms of satisfaction level, a satisfaction measurement tool which was developed and validated by Kim and Ryu (2000) was used after modification. Twenty students were interviewed at the end of each course to verify all quantitative data and to provide more detailed information regarding the factors of learning outputs.

Besides, questionnaires, achievement scores, satisfaction levels, online messages, interview data were collected and analyzed. Various statistical analysis methods such as correlation analysis, contents analysis, t-test, and frequency analysis, were applied to the data.

## Results and Interpretations

### Cognitive achievement

Students' cognitive achievement, shown in Table 4, was evaluated in terms of receptive learning and critical thinking learning. In cognitive achievement, the well-structured course was not inferior to the teacher's interaction in receptive learning. However, in critical thinking learning, students in interactive instruction showed higher achievement than those in structured instruction. In receptive learning, well-structured instructional program was provided for the structured course students, while simple text scripts and instructors' feedback was provided for the interactive course students. In critical thinking learning, a well-structured contents, including pros/cons on issues, was provided for the structured course students, while live discussions and arguments (mainly student-student interaction, instead of instructor-student interaction) occurred on the board in the interactive class.

Table 4. Student achievement differences between structured instruction and interactive instruction

Record	Class	N	Mean	St. Dev.	df	T
Overall record	Structured instruction	60	69.43	14.08	109	2.43*
	Interactive instruction	51	75.94	14.08		
Record in critical thinking learning	Structured instruction	60	16.38	5.82	109	3.28**
	Interactive instruction	51	20.49	7.35		
Record in receptive learning	Structured instruction	60	53.05	10.08	109	1.29
	Interactive instruction	51	55.45	9.34		

\* $p < 0.05$ , \*\* $p < 0.01$

Two groups' answers about influential factors on cognitive achievement were also different. Table 5 shows that students in the structured instruction considered web-based material as the most critical factor for cognitive learning, and assignment was considered as a subsequent critical factor. Meanwhile, students in the interactive class consider messages on the discussion board as the most critical achievement factor. Interviews conducted at the end of the semester also verified these findings;

*"...actually, studying is individual thing after all, isn't it? So the most critical thing in this kind of e-learning is course and contents structure. Interpersonal interaction is just additional, not essential, I think..."*

- From an interview with a student in the structured instruction.

“...the discussion in my class was fabulous! I think this kind of discussion and interaction is really necessary in distance learning. Otherwise, it would be hard to keep studying, not in face-to-face environment...”

- From an interview with a student in the interactive instruction.

Table 5. Frequency analysis results of students' perceived achievement factors

	Structured instruction	Interactive instruction
Perceived student achievement factors	1. Web-based material (67%) 2. Assignments (53%)	1. Messages on class web board (77%) 2. Assignments (51%)

## Satisfaction

A 26-item survey was used to measure participants' satisfaction toward their instructional program. This survey, modified from Kim and Ryu (2000)'s tool, consisted of three categories: structure (course, contents, interface), interpersonal interaction (instructor-student, student-student), and overall attractiveness of instruction. Respondents used a five-point Likert scale (5=very satisfied, 1=very dissatisfied) to rate their satisfaction level. The alpha reliability coefficient of the survey was .93. Table 6 shows t-test results of those students in the structured instruction who were satisfied more with the structure factor of the program whereas the students in the interactive instruction were satisfied more with interpersonal interaction factor of the program. There was no significant difference about the attractiveness of the program. This result was verified in Table 6.

Table 6. Students' satisfaction level differences between structured instruction and interactive instruction

Satisfaction level	Class	N	Mean	St. Dev.	df	T
Satisfaction level with structure	Structured instruction	53	4.04	0.46	93	2.09*
	Interactive instruction	42	3.83	0.52		
Satisfaction level with interaction	Structured instruction	53	3.70	0.58	93	2.26*
	Interactive instruction	42	3.97	0.55		
Satisfaction level with attractiveness of instruction	Structured instruction	53	3.86	0.66	93	0.96
	Interactive instruction	42	3.72	0.80		

\*p<0.05

Additionally students were asked to identify their perception of critical satisfaction factors by checking the most critical factor and the second critical factor. As a result, students in the structured instruction considered the design of web-based material as the most critical satisfaction factor. On the other hand, students in the interactive instruction answered instructor's feedback as the most critical satisfaction factor. Both of them considered the contents of the program as a secondary satisfaction factor (see Table 7). These findings implicate that instructional programs in this research were developed appropriately, along with design intention. Students were satisfied with the program more than at an average level, so an error from program dissatisfaction was avoided. Table 8 also supports two instructional programs were appropriately developed, since the perception of students in the structured course showed their course is highly structured while the perception of the students in the interactive course showed their course is highly interactive one. The instructional programs developed in this research were validated again by these results.

Table 7. Students' perceived satisfaction factors in structured instruction and interactive instruction

	Structured instruction	Interactive instruction
Satisfaction factors	1. Design of web-based materials (74%) 2. Contents of instruction (71%)	1. Instructor's feedback (80%) 2. Contents of instruction (53%)

Table 8. Students' perception of class between structured instruction and interactive instruction

Perception items	Class	N	Mean	St. Dev.	df	T
Contents material is well-designed enough for me to study well.	Structured instruction	55	4.14	0.72	92	4.05**
	Interactive instruction	48	3.56	0.85		
I can't understand easily when I study the	Structured instruction	55	2.64	0.95	90	6.59**

contents material at first.	Interactive instruction	48	3.56	0.87		
Course pace and requirement is quite structured.	Structured instruction	55	3.80	0.74	80	4.06**
	Interactive instruction	48	3.31	0.97		
I'm afraid I can't catch up the course without reading messages on the class board.	Structured instruction	55	2.75	0.46	93	2.88**
	Interactive instruction	48	3.68	0.52		
I learn a lot from the messages on the board.	Structured instruction	55	3.05	0.80	101	2.94**
	Interactive instruction	48	3.90	1.10		

\*\*p<0.01

## Discussion and Conclusion

The purpose of this study is to analyze the influence of instructional design and management style on student achievement and satisfaction in a web-based distance learning environment. Results indicate that program structure is possibly able to somewhat replace interpersonal interaction as early distance educators expected, especially when the contents have receptive characteristics like understanding, memorizing, and recollecting facts/concepts/principles without criticism. This is the contradictory empirical evidence to the general belief that the essential of learning is only from interpersonal interaction between teacher and student whatever the learning contents are. This research suggests that a well-structured instructional program can be provided as a substitute for teacher's interaction in receptive learning.

On the other hand, we need to focus more on the design of interpersonal interaction rather than structuring the program in critical thinking learning that pursues improving critical thinking ability. The result shows that cognitive achievement in interactive instruction is significantly higher than the achievement in structured instruction when the learning contents are to pursue critical thinking ability. But interpersonal interaction does not need to be the teacher-student interaction all the time. Student-student interaction was rather effective enough in this research. This gives us an important implication. One of the reasons that the teacher's interaction with students may not be implemented in the best way in reality is because the teachers feel overloading for interaction with the students (Lao, 2002). Since the interaction is labor-intensive and therefore expensive, distance universities may not be able to finance this type of instruction for all students. If it is come to be understood that the effect of student-student interaction is not inferior to the effect of student-teacher interaction, it could save a substantial budget for hiring instructors or tutors. In this regard, findings in this research implicate that interactions among students need to be designed elaborately to relieve teacher's overloading and to maximize learning effects at the same time.

Meanwhile, instructional method factor seems to have greater influence on student achievement than learner characteristics factor does. Perceived learner characteristics were analyzed a week prior to each program's implementation in this research as well as in the pilot implementation. And the results showed no difference regardless of learner's characteristics. It implies that a student's learning pattern would be more influenced by instructional methods or teacher factors rather than by learner characteristics. This means that between variable (instructional method, different in group between) is more critically influential than within variable (learners' characteristics, different within group) on student learning. Learning is, of course, influenced by the learner's cognitive, emotional, and social characteristics. But understanding teaching and learning situation needs to be approached comprehensively. In any case, it's impossible to instruct a perfectly homogenous group as there are students' differences all the time. In spite of the existence of individual's differences, some classes' average GPA does go up, and popular instructors and successful programs exist. This indicates that there are certain effective teaching methods in a context. This makes us aware of the importance of instructional design (ID) for effective teaching method.

In conclusion, this research provides us a significant implication for understanding theoretical framework in distance education. As reviewed in Theoretical Background, the contrary and complementary relationship between structure and interaction has been pervasive in academia. The idea of when structure increases, interaction decrease, and vice versa, implicates one can be a substitute for another. This research shows empirical evidence that structure can be a substitute in a certain case although it's not always the case. With regard to pedagogic optimum between two extremes, with an extremely structured course at one end and extremely interactive course at the other end, this paper suggests that the optimum should be located in structure side in receptive learning, whereas it should be moved a lot

toward interaction side in critical thinking learning. The practical implication of this is that we need to consider the characteristics of learning contents first, such as receptive learning or critical thinking learning, in web-based distance learning program development, because the learning outputs are influenced more by characteristics of the learning contents, especially in deciding the priority between self-study mode with highly structured program and interactive mode with highly interpersonal interactive program, or how to combine each mode.

Finally recommendations for further research are suggested as follows: first, this research does not consider each structuring elements' effect or influence on learning, although many structuring elements from previous literature were applied to structured instructional development. But there could be many different design types among structured instructional program. Analysis and comparison of each element's influence on learning would be a good theme for further research. Second, more objective analysis of learner's characteristics with verified measuring tools, including special characteristics such as learner autonomous, aptitude, or self-regulating ability, would give us more articulated implications. Third, further research might study on structuring of interaction. Stein et al.(2005) mentioned that the combination of learner-initiated interaction with instructor-initiated interaction built into the course explained more about satisfaction with perceived knowledge gained than satisfaction with structure alone. Thus, research on structuring of interaction will enhance our flexible understanding of two extreme concepts in distance education. Fourth, although basic principles of pedagogy is not easily changed, further study can explore if there is any difference in the results according to IT technology evolution which might have influence on the way of contents development and interaction than before. Finally, further research providing quantitative data from more cases with various learning contents could verify and generalize the findings of this research. Also research considering emotional or social evaluation as well as cognitive evaluation on various learning contents could be recommended for more comprehensive understanding in web-based distance education.

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