The Effects of Dynamic Image Schema on ESL Students' Systematic Improvement of Listening Comprehension: A Dynamic System Theory Perspective

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Abstract

From a dynamic system theory (DST) perspective, this study examines the effects of dynamic image schema (DIS) on ESL students' systematic improvement of listening comprehension. Forty ESL learners of two classes at an American university were invited to participate in the study. Data were collected through multiple procedures including listening comprehension scores of pre- and post-tests, students' class notes, and responses to survey questions. Both descriptive and inferential statistical analyses were performed. The results show that DIS did facilitate ESL learners' listening comprehension. On the one hand, the construction of DIS allowed ESL learners to organize listening materials in the basic frameworks for systematically information processing; on the other hand, DIS helped to enhance ESL learners' ability of refined sorting, categorizing, predicting, organizing, and analyzing information to reach meaningful re-configuration of knowledge and thus improve their listening comprehension. Important educational implications for second language acquisition practitioners are discussed.

Keywords

Dynamic image schema (DIS), Dynamic system theory (DST), Systematic information Processing, English-as-a-second-language (ESL) Listening comprehension

INTRODUCTION

The examination of factors that affect student systematic learning in the classroom is an important area of research in education (Slavin, 2008; van Merrienboer & Kirshner, 2007). A new Student Systematic Learning Theory is being initiated and developed by Al-Shammari and Yawkey (2009, 2011). According to Al-Shammari and Yawkey (2011), a student "systematically learns materials based on using prior, assimilated and accommodated learned experience" (p. 4). This theoretical principle suggests that when a student is actively learning in the classroom, he or she systematically builds up connections between his or her existing knowledge and the incoming information. In an English-as-a-second-language (ESL) listening classroom, in order to improve their listening comprehension, ESL students try to re-organize the listening materials systematically to achieve a dynamic interaction between their existing knowledge and the new information (Huang, 2004, 2005).

Listening comprehension is often difficult for ESL students for several reasons (Huang, 2005). For example, their difficulties can come from the English language itself. A new word, an unfamiliar pronunciation, or a complex sentence structure can cause comprehension challenges for them. Further, the new content and the unfamiliar background can cause listening comprehension challenges. Finally, the lack of appropriate and effective learning strategies or skills also contributes to their difficulties in listening comprehension. Therefore, the search for effective strategies to improve ESL students' listening comprehension systematically in the classroom has important educational implications.

In view of the difficulties in ESL listening comprehension, many researchers have examined how to integrate strategies such as meta-cognitive instruction, active interaction method and cultural background instruction to improve ESL learners' listening comprehension (Flowerdew & Miller, 2005; Huang, 2004, 2005). However, they failed to view listening comprehension as an extremely dynamic and complex process in which all the contributing factors interact with each other and each development in listening process is the result of dynamic integration between the existing knowledge and the incoming information. The dynamic image schema (DIS) under the dynamic system theory (DST) framework provides structural understanding of various experiences for better organizing and processing information (de Bot, Lowie, & Verspoor, 2006; Geert, 1994; Kozel, 2009). The purpose of this study, therefore, was to examine the effects DIS on ESL students' systematic improvement of listening comprehension.

LITERATURE REVIEW
DST: Definition and Characteristics

The DST was originally developed for biology and defined as a set of variables that mutually affect each other's change overtime (Geert, 1994). It seeks to explain complex systems where variables interact with each other and the system continually changes (Kozel, 2009). In a dynamic system, a small difference can lead to great effects. "A butterfly beating its wings over Peking causes a thunderstorm over New York" is a common DST interpretation, which illustrates the power of small changes and the interactive nature of a system.

The DST proposes that variables that determine changes are numerous, interacting, with small differences sometimes resulting in great effect (de Bot et al., 2006). A dynamic system perspective provides the mechanisms to describe and explain the interaction of the individual systems with its changing environment. The DST is a complex and nonlinear system, comprising many subsystems and open to modification (Guralnik, 2004; Newman & Newman, 2007).

DST Views SLA as a Dynamic Process

The DST is a relatively new theory for second language acquisition (SLA) and it views SLA as a dynamic process (Santibnez, 2002). SLA can be seen as a dynamic system with a set of variables interacting over time. It can also be seen as a dynamic process because SLA shows some of the core characteristics of a dynamic system, e.g., sensitive dependence on initial conditions, complete interconnectedness of subsystems, the emergence of attractor states in development over time, and variation both in and among individuals (Santibnez, 2002). The DST lays out a complex and multidimensional framework for explaining both variability and patterns or order in the SLA system (de Bot et al., 2006).

DIS: Definition and Background

The DIS under the DST framework provides a dynamic conceptual structure for ESL listening comprehension (de Bot et al., 2006; Santibnez, 2002). Specifically, it provides a highly complex and systematic framework for better understanding and processing of the new information based on the existing knowledge in the listening process (Diller, 1981).

The origin of image schema theory in the current sense is most frequently attributed to the British psychologist Frederick Bartlett, who argued that a schema consists of an active organization of past experiences. Bartlett and Kant (1932) described image schema as stereotypical mental scripts or scenarios of situations and events, built up from numerous experiences of similar events. In philosophy, the word "schema" is seen as a frame that organizes knowledge about certain properties of objects, events, and action, which typically belongs together (Dijk, 1997). According to Anderson (1984), schema theory has been defined more specifically as an abstract framework that organizes knowledge in memory by putting information into the correct "slots", each of which contains related parts. Oller (2006) believes that without these dynamic schemata, nothing in life would be predictable; and if nothing were predictable, it would be impossible to learn. The world would appear chaotic.

DIS and Language Learning and Listening Comprehension

Pichert (2002) pointed out that comprehension is an interactive process between the material and the learner. The importance of schema theory and the activation of prior knowledge as it relates to language learning can be seen in the functions of a schema, which affect both the learning and the remembering of textual information. Similarly, Luke (1985) argued that, when learners process aural and visual input, their prior knowledge structures in existing image schema interact with new information in incoming image schema. Language learning is also such an active process that entails learners' self construction of meaning beyond simple decoding (Meskill, 2005).

According to Carter and Nunan (2001), schema theory is based on the notion that past experiences lead to the creation of mental frameworks that help us make sense of new experiences. In listening process, the listeners rely more on than just the acoustic signal to decode information. Instead, they rely more on the prior contextual knowledge represented by existing image schema to process information (Rohrer, 2005). During the listening process, listeners need to make use of image schemata through a process of matching new input with meaning based on their previous experiences (Diller, 1981). In fact, learning to trigger and utilize mental image schemata is an essential strategy for listeners to learn and improve. Pearson (1978) suggested that it is important to teach learners bottom-up processing skills such as the ability to discriminate between minimal pairs; but it is even more important to help learners to use what they have already known to understand what they hear as new by using top-down processing. Flowerdew and Miller (2005) also pointed out that in applying contextual knowledge to facilitate utterance interpretation, listeners can use pre-established patterns of knowledge and discourse structure in memory. These pre-established patterns or structures in memory always take the form of DIS. It is believed that once the structure of an event is stored as a DIS in memory, it aids individuals in negotiating future events in allowing them to predict what is likely to happen, that is, to aid in negotiating subsequent texts and thus enhance comprehension.

Recent research in listening comprehension demonstrated the inadequacy of DIS activation. Because there is always a gap between the existing knowledge and incoming new information, it is difficult for learners to reach dynamic interaction between the existing and the incoming knowledge and gain fully understanding in listening comprehension as expected. In this situation, the application of DIS becomes necessary to facilitate listeners in improving their listening ability (Humphrey, 1998).

The DIS Model in ESL Listening Comprehension

The DIS model, as shown in Figure 1, consists of many different subsystems such as students and teachers' demographic features, socio-cultural contexts, situational contexts, existing knowledge, incoming information, etc. Among each of the subsystem, there are also many variables which contribute to the overall change of the holistic system. For example, a learner's genetic potential such as aptitude, intelligence, his or her motivation, age, personality, strategies in learning, meta-cognitive awareness, and personal goals are all the necessary variables within the subsystem of learner demographic features. The learner's world knowledge, previous experience, etc. belong to the subsystem of his or her existing knowledge. This DIS model is continuously changing in order to carry out its functions and to preserve its equilibration or balance through dynamic assimilation and accommodation. The goal of this model is to explain the many interconnected relationships within the system and between the subsystems where all the variables are interacting with each other and bringing about the overall changes of the whole system.

Figure 1
The Dynamic Image Schema Model
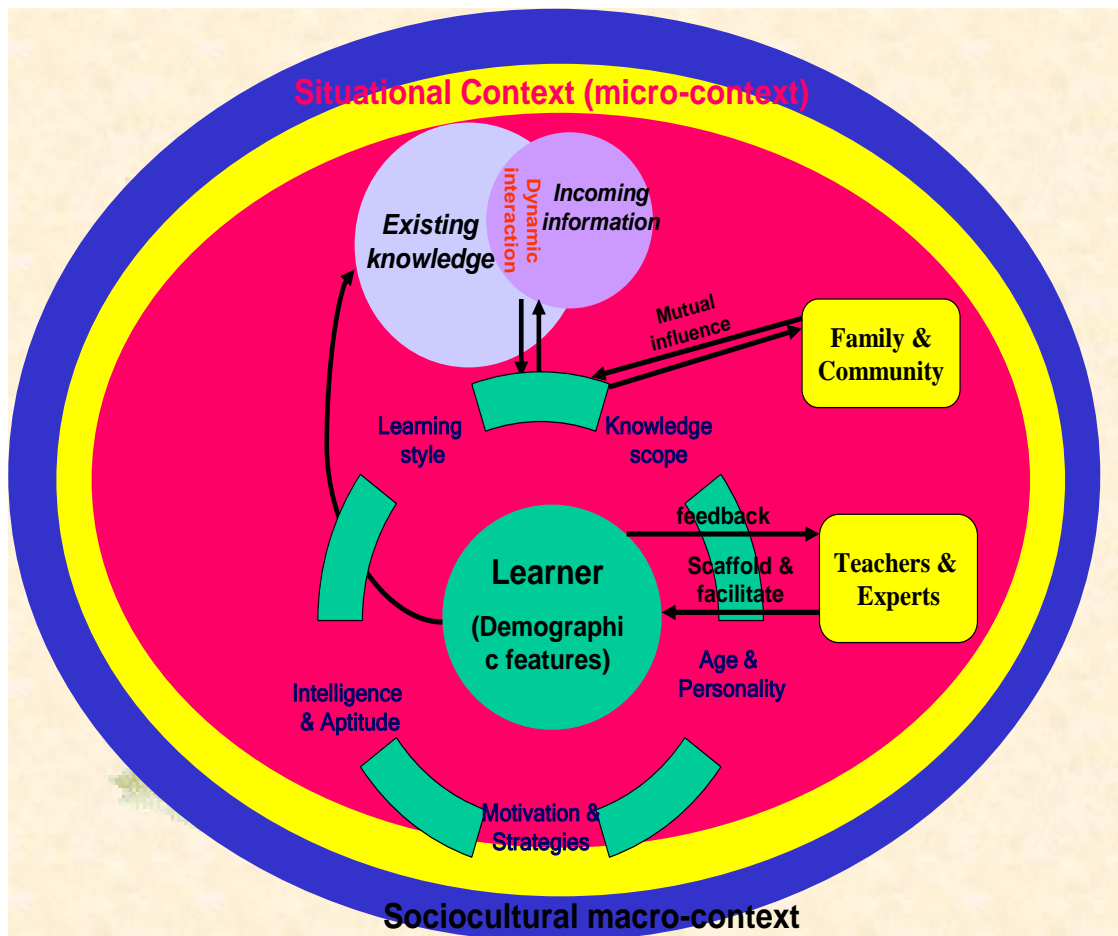
This DIS model emphasizes the importance of what the learner brings to the learning situation as an active self-constructor of knowledge and meaning-maker. Thus, the learner plays a central role in this model. As shown in Figure 1, through the dynamic interaction between existing knowledge and incoming information, the learner filter out irrelevant information, observe from holistic situation, and construct DIS based on assimilation and accommodation. Teachers and experts scaffold and facilitate the learner's learning process and at the same time, the learner provides feedback for teachers to update teaching method and adapt to his or her needs. Community and family are also important in contributing to the learner's knowledge scope and influencing learner demographic features.

This model not only emphasizes the interaction between the learner's existing knowledge and the incoming information, but also lays efforts on the interplay between teachers, learners, family, community, and socio-cultural contexts. Since learning never takes place in isolation, we also recognize the importance of the learning environment or contexts within which the learning takes place. The situational context provides a micro-context or immediate information for learners and the socio-cultural context provides the macro-context (background) for providing learner space to discover far beyond their current ability in an

authentic environment. In this sense, the model provides a breakthrough of Vygosky's Zone of Proximal Development (ZPD) and Krashen's comprehensive input (i+1) hypothesis. All the two theories stress that the input should be slightly higher or beyond the learner's current knowledge level or existing knowledge scope. However, they ignored the fact that learners could also benefit from incomprehensible input and discover knowledge far beyond their current cognitive and academic levels. In fact the comprehensive input helps learners make quantitative progress while the "incomprehensible input" provides learners space to develop "discovery learning" and lead to the qualitative improvement. That is, the learners need to be challenged to discover what is beyond their cognitive and intellectual levels. This challenging interaction can broaden learners' view and free their minds from the confinement of immediate situation and provide learners space to discover further to achieve excellence and deep insights.

METHODOLOGY

The Research Questions

From a DST perspective, the purpose of this study was to examine the effects of DIS on ESL students' systematic improvement of listening comprehension. ESL students were trained to re-organize the listening materials systematically by building up the DIS and achieve dynamic interaction between their existing knowledge and the incoming information in order to improve their listening comprehension. The following two research questions guided the study: a) did the DIS have significant effects on ESL students' systematic improvement of listening comprehension? And b) was there a significant relationship between gender and ESL students' evaluation of DIS in terms of whether or not it helped them elaborate on information and improved their listening comprehension systematically?

Data Collection Procedures

Data were collected through multiple procedures. An experimental design was implemented. Forty ESL learners of two classes at an American university were invited to participate in the experiment. These students were all ESL learners from the intensive English program (IEP) at the university. This university recruits more than 500 international students each year and offers excellent IEP programs for more than 1500 ESL learners. There were 11 girls and 9 boys in Class one while there were 8 girls and 12 boys in class two. Based on the placement test results provided by the IEP program results prior to the study, students in both classes were very similar in terms of their levels of English proficiency (i.e., between intermediate and intermediate-low). Further, demographic features in terms of their linguistic (i.e., Chinese, Japanese, Korean, and Thai) and social economic status (i.e., high, average, and low) backgrounds were also similar.

Prior to the study, a listening comprehension test (pre-test) was administered to both groups to confirm that the students in both groups were similar in terms of their listening comprehension proficiency, as indicated in the placement test results. Then all learners in Class One (experimental group) attended the ten specially designed listening comprehension lessons in one month. However, during this month all learners in Class Two (control group) just attended ten regular listening comprehension classes.

During the ten lessons, the learners in the experimental group were instructed to construct DIS from the overall situation by connecting their existing knowledge with the incoming new information. They were also trained to refine and re-code the incoming information based on their previous knowledge. During this period of time, the learners in the experimental group were required to take notes while they were listening to the materials in the classroom. Specifically, they were asked to write down what was in their mind when they were listening to designated materials. In addition, after the ten listening comprehension lessons, they were asked to answer one question, "The DIS did help me bridge the gap between my previous knowledge and the incoming new information and therefore improve my listening comprehension systematically. Do you _____ (choose one from the following: strongly disagree; moderately disagree; neither disagree nor agree; moderately agree; and strongly agree)?" Their answers to this question together with their class notes were collected for analysis. Finally, right after the ten listening comprehension lessons, both classes took another listening comprehension test (post-test). The post-test was administered to see whether the experimental group received significantly higher scores than the control group.

The Ten Specially Designed Listening Comprehension Lessons

The DIS is a mental pattern that recurrently provides structural understanding of various experiences and is available for use in metaphor as a source domain to provide an understanding of another experience. These meaningful, dynamic patterns recur in our everyday actions and allow us to mentally structure our experiences and perceptions. The basic dynamic image schemata are -CONTAINER-, -LINK-, -CENTER-PERIPHERY-, and -FORCE- schema, which function as guidelines for the activation of other subsidiary image schema. In the experimental group, the teacher trained the ESL learners in terms of how the following categories of dynamic image schemata could be metaphorically projected from the realm of physical domain (our own objectivist experience) to other more abstract conceptual domains (mental representation).

-CONTAINER- image schema. It is a basic DIS that involves a physical or metaphorical boundary, enclosed area of volume, or excluded area or volume. For example: Marriage is a castle. This schema is consisted of a boundary distinguishing an interior from an exterior. In listening comprehension, learners need to step out of the container schema in order to see the holistic picture (overall meaning) of the listening materials.

-LINK- image schema. It consists of two or more entities which are connected with each other by means of a linking device of some kind. For example: A girl is holding her mother's hand. It could be metaphorically transformed to the domain of social relationship. After training, the ESL learners would be aware of the interrelationship between the parts or subsystems and find the hidden relationship in listening comprehension.

–CENTER-PERIPHERY-image schema. It contains core (essential) parts and peripheral parts. The periphery depends on the center which is typically associated with importance, whereas peripheral parts are less important and they may be damaged or even destroyed without giving rise to the disintegration of the whole (Santibanez, 2002). For example: Beijing is the political and economic center of China. This image schema gives learners inspiration that they should focus more on the main idea or the core information and

try to ignore or filter out the peripheral information (interference of unimportant details) in order to save more space for working memory to process information effectively and upgrade listening comprehension.

–*FORCE- image schema.* It includes both an acting force and a counterforce which lead to the dynamic equilibration or an active state. For example: The ball kept rolling because the wind blowing it. -FORCE- image schema shows the interaction between the acting force and the counterforce. Learners will gradually realize the dynamic nature of elements in the system when they could use -FORCE- image schema to process information.

In the ten specially designed listening comprehension lessons, the teacher's responsibility was not only to present new knowledge, but to "activate" the stored knowledge frame in the ESL students' minds in order to make the new information easily understood, taken in, and merged into the existing schema, thus produce new schema enriching the former one, understanding the heard content.

Accordingly, a certain scene (input information) was mentioned in the listening material, the student's certain script (frame) would be activated in memory as an important port of the listening comprehension process. For example, in listening information about wedding, a Chinese can come up with five basic scenes in their mind and they are proposal and engagement, pre-wedding, wedding day, wedding night, and post-wedding, respectively. The specific scene, for example, the wedding night embedded with a series of sub-schemata such as "wine of union cup" could be activated for further elaboration. In the wedding scene, marriage could be seen as a container as explained in the above -CONTAINER- schema and it would provide basic skeleton for the new information to be embedded into it.

Further, when hearing the phrase like "the arrival of the groom", learners could possibly filter out irrelevant scenes of the proposal and pre-wedding and focus on the wedding day scenario. Further sub-schemata activated should include music, "hong bao", firecrackers, dumpling, or wedding ring. During this process, -CENTER-PERIPHARY- image schema could be activated to help learners to focus on the main points of the listening material while filtering out the unimportant details.

Finally, learners need to activate the stored schema in mind while integrating the new information to think, suppose, modify, guess the meaning and predict the development of the content. For example, when the learner heard the "white wedding gang", they need to modify his or her wedding scenario to the western style because Chinese people think red is the best color in traditional wedding, although nowadays some youngsters also put on white wedding gang for wedding photos. If further information about "cake cutting" is heard, learners could assume that the wedding is held most probably in a Western culture because Chinese wedding ceremony favors dumplings instead of the cake. As a result, the modified scenes such as choice of vows, ring exchanges, poems and prayers, music, flowers or cakes could facilitate further meaning construction.

The process described above belongs to the dynamic interaction between the known and the unknown. During this process, learners could disambiguate or select a reasonable interpretation for a problematic segmentation and predict the ongoing discourse and interpret messages. In this scenario, -FORCE- schema could help learners to realize the dynamic nature of learning system with different variables interacting with each other. Following the -FORCE-

schema, learners would easily find out both the acting force and the counterforce which contribute to the chaotic result or dynamic equilibration of the system.

Data Analysis Methods

Using SPSS, the following data analyses were performed. First, descriptive statistical analysis of the pre- and post-tests was performed. Second, two independent sample *t*-tests on the pre- and post-tests were conducted. The first *t*-test was to examine whether or not the students in both groups were similar in terms of their listening comprehension proficiency, as indicated in the placement test results provided by the IEP program. The second *t*-test was to determine whether there was a significant mean score difference between the control group and the experimental group. If yes, the ten DIS training classes for the experimental group did have significant effects on their systematic improvement of listening comprehension. Finally, a Chi-square test was conducted to see if there was a significant relationship between gender and ESL students' answers to the question regarding the effectiveness of DIS in systematically improving their listening comprehension. The Chi-square results together with students' class notes were then analyzed to find an answer to the second research question of the study; namely, was there a significant relationship between gender and ESL students' evaluation of DIS in terms of whether or not it helped them elaborate on information and improved their listening comprehension systematically?

RESULTS AND DISCUSSION

The results of descriptive statistics and the two independent sample *t*-tests are presented and discussed first, followed by the discussion of the Chi-square test and the class notes by the ESL students in the experimental group.

The Independent-sample *t*-test on the Pre-test

As mentioned previously, a listening comprehension test (pre-test) was administered to all students in both the control group and the experimental group prior to the study. An independent sample t-test was performed and the results are presented in Tables 1 and 2.

Table 1

Descriptive Statistics Results

Class	N	Mean	Standard Deviation
Control	20	69.30	7.35
Experimental	20	69.13	5.94

Table 2

Results of Independent Sample t-Test on the Pre-tests

Variable	N	df	*t*	Sig. (2-tailed)
Pre-test	40	38	.097	.923

As shown in Tables 1 and 2, there was no significant mean score difference between the control group and the experimental group. Actually the mean scores were almost identical for both groups. The mean scores for the control group and experimental group were 69.3 and

69.13, respectively. This result indicated that the students' overall listening comprehension proficiency levels in both classes were very similar, which was consistent with the placement test results.

The Independent-sample *t*-test on the Post-test

After the ten listening comprehension lessons, a post-test was administered to both classes to see whether there was a significant mean score difference between the control group and the experimental group. The results are presented in Tables 3 and 4.

Table 3

Descriptive Statistics Results

Class	N	Mean	Standard Deviation
Control	20	71.67	5.37
Experimental	20	82.07	4.74

Table 4

Results of Independent Sample t-Test on the Pre-tests

Variable	N	df	*t*	Sig. (2-tailed)
Pre-test	40	38	6.75	.000

As shown in Tables 3, the post-test mean scores for the control group and experimental group were 71.67 and 82.07, respectively, indicating that the students in the experimental group received much higher scores on the post-test than the students in the control group. Further, as shown in Table 4, the independent-sample *t*-test indicated that the mean score of the students in the experimental group was significantly higher than that of the control group ($t_{(38)} = 6.75$, $p < .001$). This result suggested that the ten DIS training classes for the experimental group did have significant effects on their systematic improvement of listening comprehension.

The Chi-square Test

At the end of the ten listening comprehension lessons, the students in the experimental group were asked to answer one question, "The DIS did help me bridge the gap between my previous knowledge and the incoming new information and therefore improve my listening comprehension systematically. Do you _____ (choose one from the following: strongly disagree; moderately disagree; neither disagree nor agree; moderately agree; and strongly agree)?" Their answers to this question were collected for the Chi-square test. The results are presented in Table 5.

Table 5
Chi-square Test Results

Independent Variable	Did the DIS help you bridge the gap between your previous knowledge and the incoming new information and therefore improve your listening comprehension systematically?						χ^2	*df*	*p*
	Strongly Disagree	Moderately Disagree	Neither Disagree Nor agree	Moderately agree	Strongly agree	Total			
Female									
Count	3	3	3	8	2	19			
Expected Count	2.6	3.3	3.6	5.6	3.9	19.0			
Male							2.331	4	.675
Count	4	3	4	5	5	21			
Expected Count	4.4	2.7	3.4	7.4	3.1	21.0			
Total									
Count	7	6	7	13	7	40			
Expected Count	7.0	6.0	7.0	13.0	7.0	40.0			

As shown in Table 5, the results show that there was not a significant relationship between gender and ESL students' evaluation of DIS in terms of whether or not it helped them elaborate on information and improved their listening comprehension systematically. Male learners didn't show a great variety in their answers to the question and thus the percentage of each ordinal category remained almost the same (20%). However, from a descriptive statistics perspective, female learners did respond to this question very differently. Ten out of 19 female learners (53.7%) strongly or moderately agreed that the integration of DIS did help them to process information effectively in the listening process and improved their listening comprehension systematically. Further, the learners demonstrated gradually improved ability of self constructing of image schema and systemically better understanding of listening materials, as reflected in their class notes. The analysis of their systematic class notes also confirmed the positive effects of DIS on their systematic improvement of English listening comprehension proficiency.

CONCLUSION

The present study was limited in the following four ways. First, the study only examined the effects of DIS on the improvement of listening ability of ESL learners. Whether or not DIS also improves the other three main areas, namely, speaking, reading, and writing in

ESL learning process remains unsolved. Second, the experimental period of this research study lasted only one month and it was hard to predict whether the positive effects can be retained for a longer period of time. Third, the DST as a coarse-grained theoretical framework for this research could not explain exactly how all the contributing variables were interacting and caused the change of the entire system. Finally, the research was conducted in one university with small numbers of participants. Further, other extraneous variables such as learners' motivation, attitudes, learning styles, cultural backgrounds, and familiarity with the topic could possibly have limited the generalizability of the results of the present study.

In light of the limitations, the following three conclusions were reached. First, the DIS could facilitate ESL learners' listening comprehension. With the help of DIS under the DST framework, ESL learners could realize the dynamic and interactive nature of the learning system and effectively process the incoming information by building on their previous knowledge to scaffold their understanding. Second, construction of DIS allowed ESL learners to organize listening materials in the basic frameworks for systematically information processing. Finally, DIS helped to enhance learners' ability of refined sorting, categorizing, predicting, organizing, and analyzing information to reach meaningful re-configuration of knowledge and thus improve their listening comprehension.

The findings in this study, taken in consideration with past research in this area, offer some insight to teachers seeking to improve their ESL students' listening comprehension as well as other language skills systematically. Language system is a matrix schema which is composed of different subsystems. These subsystems interact with each other, bringing the changes in other systems and thus cause the holistic change of the overall system. DIS guides students to observe from holistic situation, organize information into basic structure, and realize meaningful reconstruction of information by systematically combining their existing knowledge and the incoming information. Further, second language development should be seen as a dynamic system with a set of variables interacting with each other over time. The DST has provided a basic theoretical framework for the instruction of DIS in SLA. Therefore, second language practitioners should be aware of the variability in SLA and view language attrition, fossilization, regression, and development as normal and necessary processes from a dynamic perspective.

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