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Surface and deep learning processes in distance education: Synchronous versus asynchronous systems

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Abstract

Distance learning is different from regular learning in the classroom. One of the main factors which influence the effectiveness of the learning process is the interaction that exists between the teacher and the student. Our research indicates that different interactions have different effects.

There are two methods used for implementing distance learning systems, i.e. synchronous and asynchronous. Our research is based on the model developed by Oliver and McLaughlin. According to this model, there exist five types of teacher–student interactions: social, procedural, expository, explanatory and cognitive. The present study refers to the cognitive interaction and differentiates between surface processes and deep processes.

The study presents different variables and their influences on the students' achievements and their satisfaction from learning via a synchronous versus an asynchronous distance learning system. The interaction level between the students and the teacher and among the students was found to be a significant factor in determining the effectiveness of the teaching method. The observations and interviews which we held with the students helped clarify the information that was obtained using the quantitative research tools, and showed that the presence of a teacher–student interaction which accompanies the learning process is very important for all learners. However, students with high-level thinking can overcome the low-level of interactions in asynchronous learning.

Keywords: Interactions; Surface processing; Deep processing; Distance education; Synchronous system; Asynchronous system; Cognitive interaction

1. Introduction

Moore and Kearsley (1996) examined students' autonomy in various distance learning programs, and proposed a theory according to which the autonomy required of the student increases with the increase in the transactional distance. Linn (1996) presented a variety of opinions that relate to success in distance education, and claims that the independent learner is characterized by resourcefulness, which is necessary

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for success in the course. Such learners can control their learning process independently. They recognize the need for help and look for opportunities to test their understanding. In contradistinction, learners who are not independent are unable to create learning opportunities and are therefore also unable to correctly assess their level of understanding. The distance education framework requires a greater independent learning ability than the regular courses, mainly because it lacks full interaction between the students and the teachers.

Henri (1992) developed a communications model in order to examine the possibilities for interaction that exist in the distance learning method, which is an analytical model for content analysis of computerized dialogue. This analytical model was developed for five dimensions of the learning process which are reflected in messages, i.e. participation, interaction, social, cognition and metacognition. These dimensions were chosen due to their relation to the work of the instructor and a group of distance learners, as detailed herewith:

The dimension	Indicators	Definition
1. Participation	Number of messages	Set of messages transmitted by one person or group
2. Social	Verbal support presented by a person to the group "I'm feeling great ..." "Thank you very much for ..." "Welcome everybody to ..." "Let me wish all a happy ..."	Complete or partial message that does not belong to the formal topic being discussed
3. Interaction	"In response to Celine's remark ..."	Connecting to previous messages
4. Cognition	Asking questions about the material that is taught	Declarations of knowledge and skills that refer to the learning process
5. Metacognition	"I understand ..." "I wonder ..."	Declarations related to general knowledge and skills that indicate awareness, self-control and self-regulation of learning

Oliver and McLaughlin (1996) changed Henri's model such that it included the following dimensions: Social, procedural, expository, explanatory and cognitive. The five critical dimensions of the interactions are described as follows:

Dimensions of interactions	Description
Social	Establishing and developing rapport
Procedural	Explanation on course requirements and procedures
Expository	Demonstration of knowledge or skills in response to a direct request from one another
Explanatory	Lecturer using students' responses to explain knowledge and develop content
Cognitive	Lecturer providing constructive feedback to a student to reflect and to reconsider an alternative perspective/reality

Offir and Lev (2000a, 2000b) used this modified model and found that the most frequent interactions in distance education are the procedural and expository interactions, whereas the explanatory and social interactions are more prevalent in classical classroom teaching. This led them to additional conclusions:

1. It is still not possible to define the interaction since there is no list of expected behaviors in this field. The perception of the cognitive interaction is not sufficiently clear since the expository and explanatory interactions are not dichotomously differentiated from it.
2. There are not sufficient significant differences between the different interactions. Offir and Lev therefore modified the model according to the following principles:

a. The five interactions were classified into interactions that encourage interaction and content-related interactions. The former group includes the social and procedural interactions and the latter includes the expository, explanatory and cognitive interactions.
b. According to Cookson and Chang (1995) recommendations, they differentiated between positive and negative emotional interactions and divided the social interaction into negative and positive. They also redefined the procedural interaction as the total of all interactions that contain student-directed administrative behaviors.
c. The three content-related interactions were defined according to Henri as interactions that activate surface and deep learning processes. Surface learning processes included the explanatory and the expository interactions, whereas the cognitive interaction was termed a deep learning process.

2. The cognitive dimension

Cognitive skills support significant learning processes related to understanding, through cause, analysis and evaluation, and ending in solving practical problems. Quellmalz (1985) refers to this type of thinking as cognitive skills.

Entwistle and Waterson (1988) differentiate between "surface processing and "deep processing within the cognitive dimension of handling information, and define and characterize this dimension as presented herewith:

Variable	Definition	Values of the characteristics
Surface processing	• Repeating the statement of a problem without quotes or interpretation. • Repeating what was said without adding new elements. • Using ideas or concepts that were presented, without adding personal comments or advancing the idea. • Proposing solutions without explanations. • Judging without justifying. • Asking questions about information that is irrelevant to the problem or that do not contribute to its understanding. • Proposing several solutions and refraining from indicating the most suitable solution.	Number of information units identified as expressing low-level cognitive processing relative to the total number of information units (of the particular participant) that were defined as cognitive analysis, expressed as percent.
Deep processing	• Connecting facts, ideas and concepts in order to interpret, propose or judge. • Proposing new elements of information. • Creating new information from information that was collected, using hypotheses and quotes. • Proposing one or more solutions in terms of judgment. • Assuming advantages and disadvantages for a situation or solution. • Presenting proof for support by examples. • Judgment supported by justifications. • Handling a problem in a wider perspective. • Developing new strategies with a wider framework.	Number of information units that were characterized as expressing high-level cognitive analysis, relative to the total number of information units (of the particular participant) that were defined as cognitive analysis, expressed as percent.

The table presents the criteria used for distinguishing between a surface and a deep learning process. The aim of analyzing the cognitive dimension is to identify skills that pertain to giving reasonable explanations and evaluating them.

Distance education obligates basic definitions for describing the surface and deep learning processes that occur during learning. These definitions comprise the basis for describing the learning process among students in general and for analyzing the course content in particular.

Deep learning processing, i.e. "evaluation of information by the learners, its organization in conceptions, comparison and relating to existing information" (Schemeck, 1983), is a process that takes place when students translate new information into engraved concepts and relate it to their life experience. Existing thinking schemes change during this process and the learned material is assimilated within the student's perceptions web.

Surface learning processing, i.e. understanding and remembering existing information, primary absorption of new information and understanding it at a simple level, does not change the student's engraved thinking processes.

3. How can deep learning processes be cultivated?

According to Yopp (1988), the question is the source and beginning of thinking, and comprises an effective tool for improving thinking and cultivating a learner who knows how to learn. Questions are effective since they motivate the students, concentrate their attention, and reveal deep processing of information. The question enables the students to estimate the extent of their mastery of the learned material, and affords an opportunity to review the material. Asking high-level questions by the students comprises a significant encouragement for deep learning processing. Asking questions by the students improves their understanding and enables the development of an independent learner who is able to regulate and direct his/her learning according to need (Dillon, 1988; Wong, 1985). Thus, questions in class, whether asked by the teacher or by the students, promote deep processing of the learned material.

The literature details several differentiations for classifying questions asked in the classroom. One type of differentiation is classification according to the type of information required (Jarolimek, 1977; Suchman, 1962). In this type of classification the questions are arranged from the lowest stage of factual questions to the presentation of problems via high-level questions.

Another type of differentiations for classifying questions is according to the cognitive level, i.e. the thinking level of the question. Gallagher and Aschner (1963) differentiate between four levels: The lowest level of conscious recall questions which are very limited, convergent questions which are predictable questions, branching questions which are creative and full of imagination, and the highest level of evaluative questions that refer to judgment, evaluation and choice.

Taba, Durkin, Fraenkel, and McNaughton (1971) classify the levels of the questions according to the question's extent of generalization, beginning with questions at the lowest, factual level, through searching for relations between facts (connection, sequence, results), and ending with the highest level of combining relations and broad generalizing hypotheses and principles in various fields.

Hunkins (1969) investigated the differences between the types of questions and their influence on the learners. For this purpose he divided the questions into six categories according to the taxonomy proposed by Bloom, Engelhart, Hill, and Krathwohl (1956). Hunkins found significant differences between the achievements of students who participated in a class in which high-level questions were asked, i.e. questions of analysis, synthesis and evaluation, and the achievements of students who participated in a class in which lower level questions were asked. These results led to the conclusion that high-level questions do indeed significantly influence the improvement of students' abilities to evaluate information (deep learning processing), whereas no decrease occurred in the level of knowing the material at the superficial level, although there were less questions at the lower cognitive level. Thus, according to Hunkins, use of high-level questions should train students to independent work on the learned material, and not only its repetition. Similar conclusions were also reached by Gall (1970) and Redfield and Waldman-Rousseau (1981), who found a positive relation between the level of the teacher's questions and the students' achievements. Students who were asked higher level questions which focused on the specific learned context improved

their achievement levels and understanding more than students who were asked low-level questions (Strother, 1989; Yopp, 1988).

According to Rosenshine (1976), learning is better when the questions are limited and only test knowledge. Such questions test the students' knowledge of the material, and the teacher can immediately respond to the given answer with "true" or "false". Dantonio (1989) raises the possibility of using levels of questions according to the learning goals required in each instruction unit. More mature students have higher learning and thinking skills and higher level questions will be more suitable for improving and deepening the learning process. Dantonio (1989) claims that teachers who ask questions in order to improve and direct their students' answers, especially questions of knowledge and understanding, help their students understand the material and lead to a more effective discussion and lecture. Dillon (1988) divides the teacher's questions into two types: Low-level repetition questions and deep illumination high-level questions during the class discussion stage, and claims that each of these types of questions has a different goal, and that both types are important.

As mentioned, the structure of the question and the answer comprise the basis for the interaction. The importance of the interaction and its influence on the learning process in distance education was described by Moore (1993) in a model called the "transactional distance", i.e. the distance created between the teacher and the students during the lesson, which potentially increases in distance education. The term "transaction" refers to a mutual action between the environment, the individuals and the behavioral patterns in a particular situation. The distance education transaction is "the mutual action between teachers and students, in environments whose uniqueness is their separation from each other, and as a result exhibit unique behavior patterns of distance education" (Moore & Kearsley, 1996).

This theory assumes that the transactional distance is a pedagogic phenomenon, i.e. geographical distance causes a gap in the students' understanding and perception of the teaching, which usually does not occur in classical teaching. The physical distance in distance education, according to Moore, results in gaps in communication and a psychological void with a potential for misunderstandings between the teachers' and the students' behaviors. Thus, it is the psychological-communicational distance that may disrupt communication and understanding, not the physical distance. Since this is an abstract distance, it can also be created in frontal teaching, when a great communicative distance exists between the teacher and his/her students. However, in distance education the transactional distance is so large and significant that it always has a significant effect on the teacher's and the students' behavior. In other words, the transactional distance leads to a gap in communication and may lead to misconceptions between the teacher and the students. The transactional distance therefore influences the teacher's teaching behaviors and the students' learning behaviors.

According to Moore, the transactional distance is affected by two variables, the dialogue or verbal interaction and its adaptation to distance learning. The transaction distance will decrease as the level of dialogue increases and this will lead to an increase in the effectiveness of learning.

The structure of a particular course is found on a continuous scale, from a very rigid to a very flexible structure. When the structure enables adaptation to each student's unique needs it is more flexible. When the structure is more flexible, the transactional distance is smaller. The course structure is comprised of the following characteristics:

1. The goals of the curriculum – adjusting the goals to the unique needs of each student creates flexibility.
2. Teaching strategies – adjusting the strategy to the students' needs creates flexibility.
3. Means of evaluation – combining alternative means of evaluation characterizes structural flexibility.
4. Congruence between the learning material and the individual student's needs, i.e. teaching that enables branching and not linear (i.e. a lecture) information enables flexibility.

Dialogue (interaction) is important for advancing the learning process and the interaction is essential for internalizing the learning. Interaction encourages deep learning processes. The question must therefore be asked, whether absence of interaction, and as a result an increase in the transactional distance as occurs for example in asynchronous learning, will affect the deep learning processes to the same extent for all learners, or whether other mechanisms that compensate for the absence of the interaction can be identified.

An essential component that does not appear in Moore's transactional model, although Moore refers to it at a later date (1996), pertains to the student's own characteristics. The structure of the course and the inter-

action during the course are general variables that can be changed and directed. The student's characteristics in general and his/her approach to learning in particular are tools for evaluating the student's existing ability and predict his/her chances of becoming integrated in a distance education system.

Bloom (1976) recognized the relation between the quality of teaching and the student's characteristics and learning results, and presents it in his school learning theory. This theory clarifies the interpersonal differences in learning and even indicates how to cope with these differences in order to improve the learning product. Mathesion (1982) presented the advantages of teaching via computer for students with great variability. Groups with disabilities exhibit significant improvement in the achievements of many students. However, it must be indicated that in this case teaching via computer is used as an additional and not as the only means of teaching.

It may be stated that most investigators regard the different types of interactions as promoting deep learning processes. The structure of a question and an answer are the foundation of the interaction and encourage learning. As the amount of interaction increases, and as it pertains to higher levels of thinking, its contribution to the deep learning process increases. Investigators also studied the learning processes of students studying by distance education and found that the autonomous approach to learning is effective in the distance education system (Liu & Reed, 1995). The student's cognitive ability was presented as the foundation for the existence of autonomous learning skills. The question regarding the assimilation of the learning process is raised when the teaching method is synchronous but the learners have a low cognitive ability, or in an asynchronous learning system, even when the learners have a high cognitive ability. In such a system the contribution of the interaction must be complemented in other ways and the student is required to exhibit autonomous learning (Candy, 1991; Linn, 1996) and critical thinking abilities, both of which are based on high thinking abilities.

4. The structure of the research

Assimilation of learning materials requires deep learning processing. A precondition for the existence of such learning processes is the level of interaction between the lecturer and the student. Better assimilation of the learning materials is expected for students who are taught by the synchronous distance education method than for students who are taught by the asynchronous intervention method, due to the limited interaction in distance learning.

It has been proven that the ability to learn autonomously and the ability for critical thinking results in a more effective asynchronous learning process (Candy, 1991; Kreber, 1988; Linn, 1996). These abilities are more prominent among students with a high cognitive ability who are able to perform deep learning processing even without interactive support. Some success is therefore expected for students with a high cognitive level who are learning via the asynchronous intervention method, as opposed to an absolute lack of success of students with a low cognitive level who are learning via this method. A similar gap is expected among those learning via the synchronous intervention method.

Exposure of general gaps between those learning via the synchronous versus the asynchronous intervention method will raise the need for activating additional supportive factors in order to balance these two learning methods. Gaps between those with high and low thinking ability in the two types of interventions will present the need for mapping learning methods via the internet according to the students' cognitive abilities.

The present research examined differences in the achievements of students who studied the same "Introduction to Computers" course using a synchronous versus an asynchronous method. The differences between students with a high and low-level of thinking were examined within the context of the different intervention methods in distance learning, using a personality test (Glanz, 1969, 1975, 1989). Abstract verbal thinking ability was also tested. The personality test was standardized to ages 11–18 in its abbreviated version for younger adolescents. The test is comprised of a closed questionnaire that can be given to groups or individuals, without a time limit, and includes six sections that pertain to various conceptualization activities, one section that pertains to understanding sentences (idioms) and two sections that pertain to deduction processes.

The first five sections test conceptualization. The first two sections of "synonyms" and "opposites" are directed towards clarifying the ability to understand concepts by recognizing other identical concepts or the complete opposites. The third section forces the subject to look into the concept, in order to find its typical characteristic as opposed to other possible characteristics. Sections four (classification) and five (categorization) test the ability to group concepts using two opposing methods: Elimination of the exceptional in a par-

ticular group and integration of concepts in the most appropriate of several proposed groups. The sixth section, definition, tests judgment ability. This section combines conceptualization activities and requirements of essence and grouping. The seventh section tests understanding of idioms. Sections eight and nine test the deduction ability.

Data on the two research groups were also collected using the qualitative research tools of the interview and the observation. These included a description of the course, the lessons and the events that took place during the lessons as well as a description of each student's learning process and how it affects the student and his/her achievements. Special emphasis was placed on the influence of the various teacher–student and student–student interactions and how they affect the learning process and its products.

This comprehensive study was performed on 160 students who participated in an "Introduction to Computers" course that was transmitted via the internet. Approximately 50 students dropped out during the research period, and 90 students took the final examination. Of these, 59 students who met the criteria required for maintaining validity using Glanz's personality test were chosen. New immigrants, students with various types of learning disabilities (dyslexia, attention deficit) and students who did not answer some of the exam sections were excluded. Observation was performed for the entire duration of the course.

After taking the final examination, the students who studied synchronously were interviewed in order to clarify the learning and memorization processes in the course as well as the contribution and advantages of this course. The interviews were held before they received their scores in the examination and the course.

After collection of the data, analysis of variance was performed regarding the total score of the personality test results. A MANOVA analysis was performed in order to determine possible between-group differences.

Observations were carried out in the classroom, in order to evaluate the subjects' tendency to maintain interpersonal relations. An interview was held with 13 of the students who participated in the learning process. The purpose of the interview was to collect information that would help the investigators gain an in-depth understanding of the students' attitudes and preferences during the learning process.

The observation and the interview supplied information which enabled judging and understanding the data which were obtained by the quantitative analysis tools. The observations were carried out according to a "non-participant" observation, i.e. an observer who does not take part in the actual activity, but rather observes it passively out of an awareness and alertness of what is going on. This enables the observer to remain neutral.

The observations were carried out by two judges. Each judge was trained for several hours. During the training, the criteria were clarified, examples for each criterion were presented, different situations were analyzed, and a discussion with both judges was carried out in order to clarify any differences of opinion in analysis of the situations. The instructions were given in writing as well as orally.

The observers entered each classroom twice, once at the beginning of the school year and once at the end. The observation lasted for an entire lesson. Each of the students participating in the research was observed by both observers separately in order to avoid bias in judgment. It should also be emphasized that the observers did not know which of the students were classified as field-independent and which were classified as field-dependent.

The observer sat next to the student, read the statements and marked the student's interaction level with those around him on the observation sheet. The observer evaluated the student's tendency to initiate interpersonal relations based on a Likert scale (1 = little interaction with the environment, i.e. low tendency towards developing interpersonal relations to 5 = high interaction with the environment).

Examination of the inter-observer reliability yielded a correlation of $r = .87$. Therefore, the mean between the two judges was calculated for each of the items in the observation sheet. The observations sheet contained ten statements divided into two groups: seven items referred to contact made by the student with his friends while experiencing internet-based learning and three items referred to contact created by the student with the teacher:

1. The student talks with friends.
2. The student learns by himself and ignores his friends.
3. The student exchanges ideas and materials with his peers.
4. The student does not talk with his friends.

5. The student compares the results of his work with his friends.
6. The student talks about social subjects which are not related to the learning task.
7. The student studies alone but once in a while compares his work with his friends.
8. The student turns to the teacher for clarification.
9. The student turns to the teacher to receive personal instruction.
10. The student does not turn to the teacher at all.

The learning processes (deep and surface) used by the subjects and the interactions which each of them maintained with his peers and with the teacher, were evaluated during the intervention program. Correlations were examined between these measures and achievements and satisfaction from the school.

5. Results

The subjects were divided according to the median of the score in the abstract verbal test (Mdn = 98) and 2 × 2 analysis of variance was performed (groups × abstract thinking), regarding achievement in the course. The means and standard deviations of the research groups are presented in Table 1, according to the general achievements score in the course.

No significant differences were found between the two research groups (Table 2) or between the two levels of abstract thinking.

Only a small difference was found between the two study groups among those with low abstract thinking. However, there were significant differences between the two intervention methods among the subjects who are characterized by high abstract thinking. Indeed, simple effects analysis for locating the source of the significance of the interaction indicated a significant difference between the two intervention methods among subjects with high abstract thinking, $p < 0.05$, $F(1,29) = 7.33$, but not among the subjects characterized by low abstract thinking, $p < 0.05$, $F(1,26) = .63$.

These results indicate that differences exist between these two intervention methods among subjects characterized by high abstract verbal ability. Pearson correlations between abstract thinking and achievements in the "Introduction to Computers" course compared to students who experienced the asynchronous learning are presented in Table 3. The results of Fisher's Z analyses for comparing between the correlations in the two intervention groups are also presented.

The correlations among subjects who experienced the synchronous intervention are generally higher than among those who experienced the asynchronous intervention. The correlation was higher among those learning via synchronous teaching than among those studying via asynchronous teaching in nine out of the ten calculated correlations. Fisher's Z analyses revealed significant differences in three measures: The opposites test,

Table 1
Means and standard deviations of the achievements in the course among those with high and low verbal thinking in the two research groups

Groups	Synchronous intervention		Asynchronous intervention	
Abstract verbal thinking	*M*	SD	*M*	SD
Low	62.00	16.44	66.86	15.90
High	76.75	16.83	61.80	13.58

Table 2
Analysis of variance (2 × 2) of achievements in the "Introduction to Computers" course

Source of variance	SS	DF	MS	*F*	Significance of *F*
Error	13629.11	55	247.80		
Intervention groups	374.47	1	374.45	1.51	.224
Abstract verbal thinking	345.38	1	345.38	1.39	.243
Abstract verbal Thinking × intervention	1442.24	1	1442.24	5.82	.019

$R^2 = .143$, adjusted $R^2 = .096$.

Table 3
Pearson's correlations between abstract thinking and achievements in the "Introduction to Computers" course among the subjects in the two intervention methods

Evaluation measures	Achievements in "Introduction to Computers"		
	Synchronous intervention	Asynchronous intervention	Z
General score	.41*	.03	1.46
Opposites	.41*	.04	1.42
Synonyms	.30*	−.17	1.75*
Essentiality	.24	−.11	1.27
Classification	.14	.02	.44
Categorization	−.09	.11	.73
Definition	.63***	.14	2.18*
Idioms	−.01	.11	1.44
Inference	.48**	.03	1.78*
Syllogisms	.38*	−.01	1.49

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

the definition test and the inference test. The assumption that a higher correlation exists between abstract verbal thinking and achievements in the "Introduction to Computers" course among subjects who experienced the synchronous teaching method is apparently correct.

It should be indicated that the relations in this group are especially prominent in three of the thinking measures which test deductive ability: The definition test, the inference test and the syllogisms test, i.e. subjects with higher levels of abstract thinking exhibit better achievements.

Non-participant interviews were carried out in order to collect information that can help gain an in-depth understanding of the students' attitudes and preferences during the learning process.

Table 4 indicates a significant negative correlation between the subjects' interactions with their peers and achievement and a significant positive correlation between interactions with the teacher and satisfaction. In other words, it appears that those students who were observed talking with their peers or asking them for help during the learning process are those with lower achievements. Furthermore, students who maintain an interaction with the teacher have a higher satisfaction from the school.

The results further indicate that the correlations between the processes and the achievements are higher and positive, mainly for surface processes.

Pearson correlations were also calculated in order to examine the relation between the learning measures themselves, i.e. between the two learning processes (deep and surface) and the two interactions (student–student, student–teacher) Table 5.

Table 4
Pearson correlations between learning process measures and achievements and satisfaction

	Achievements	Satisfaction
Deep processes	.18*	−.06
Surface processes	.40***	−.05
Interactions with peers	−.31***	−.09
Interactions with the teacher	−.09	.15*

*$p < .05$; ***$p < .01$.

Table 5
Pearson correlations between learning process measures and interactions

	Interactions between the students	Interaction with the teacher
Deep process	−.23**	−.21*
Surface process	−.19*	−.15*

*$p < .05$; **$p < .01$.

The data indicate significant negative correlations between the extent to which the students use the learning process and their interactions with their peers and with the teacher. Subjects who use more learning processes (deep and surface) exhibit a smaller tendency to include their friends or the teacher in the learning process.

The research results emphasize the importance of the student–teacher interaction in the learning process. These results are supported by an analysis of the interviews. In-depth interviews were carried out with 13 students. Each interview lasted approximately 45 min.

The interviews revealed that the teacher's functioning is most significant for the students. The students claimed that the presence of a teacher in the classroom does indeed contribute to an improvement in achievements: "In distance learning there is no teacher in the classroom and the teacher can therefore not be asked questions..." "In (synchronous) distance learning we do not ask questions because we don't want to disturb the other students..." "In a regular classroom I would feel free to ask questions."

Twelve students claimed that "The presence of a teacher when going over the lessons in preparation for the exam was essential..." "The teacher focuses the material..." "The teacher in the classroom is better acquainted with subjects which the students find difficult..." "The teacher is personally familiar with the students..."

The interviews can be summarized as complementing the information obtained from the questionnaires and the observations, regarding the importance of the teacher's contribution to the effectiveness of the learning system.

6. Discussion

The results of the present investigation demonstrate that synchronous learning is more effective among students with a high cognitive ability than among those with a low cognitive ability. This can be explained by the fact that the inflexible nature of the teaching and the few and poor quality interactions increase the transactional distance and the gaps in communication and create a psychological void which can potentially lead to misunderstandings between the teacher and the students, resulting in a decrease in the quality of learning.

These findings are compatible with findings presented in the theoretical background, which indicate that when the students are more active in the learning process, the material becomes more relevant and more significant for them, they remember it better, understand it, and as a result their achievements improve. Effective learning obligates asking questions, and therefore obligates the lecturer to integrate stimuli that evoke the asking of questions. Yopp (1988) claims that the question comprises the source and the beginning of thinking, and is an effective tool for improving thinking and encouraging the knowledgeable learner to learn. Questions are effective because they motivate the students, concentrate their attention, and reveal deep processing of information. Questions enable the students to estimate their control of the learned material and afford an opportunity to rehearse the material.

These findings, which indicate the limited success of those with a high cognitive ability in asynchronous learning, are also compatible with the findings of Linn (1996) and Straka (1995). Straka (1995) determined that abstract cognitive ability is an important means for predicting success. Linn (1996) found that students with autonomous learning ability, which requires high-levels of judgment and deduction type of thinking (organizing time, deciding on the learning materials, being familiar with learning habits, placing reasonable goals) will also succeed in learning via asynchronous interventions.

These findings lead to the conclusion that students prefer learning via a synchronous system rather than by an asynchronous system. However, students with high ability are better able to overcome the transactional distance both in synchronous and in asynchronous learning. The achievements of students who participated in interactive courses were equal or better than those of students who participated in courses in which the learning environment was less interactive.

The need for the physical presence of the teacher was also raised in the interviews. As explained by one of the students during the interview, "There is no relation between what the lecturer says and what goes on in the classroom. The lecturer lectures and what we understand – we understand, and what not – not. He continues in any case. It would be better if the lecturer or teacher were in the classroom." Thus, the teacher's physical presents affords emotional support and encourages interactive intervention. This is in agreement with previous research (Offir, Bezalel & Barth, 2007).

Most of the interviewed students in distance education indicated the need for a teacher. However, in practice they did not ask for help. The presence of a teacher also contributed to the maintenance of learning tension among the good students with high thinking ability. They too need the presence of a mature and authoritative figure who is able to guide, support and encourage during the learning process.

The interviewed students with medium to good scores evaluated the final examination in the course as reasonable, as compatible with the learned material, and also evaluated their own estimated achievements as reasonable. In practice they received much lower grades than they expected. This result raises a question as to the student's self-criticism ability in a distance education course and raises the possibility that a gap exists between the learner's evaluation of himself/herself and his/her actual achievements.

A significant correlation was found between success in a sub-test that examines the ability to differentiate between synonyms, definition, inference and syllogisms and success in the achievements test in the course. The strongest correlation was found in tests that examine higher values of thinking according to the Aristotelian scale. The definition test examines the subject's judgment ability and the tests that examine inference and syllogisms examine the deductive ability. Thus, more specific abstract ability is required in order to succeed with teaching using the internet via synchronous intervention, i.e. the student is required to perform higher thinking processes of judgment and deduction during this type of lesson.

Furthermore, the results gathered from the interviews and observations indicate that the asynchronous teaching method, which lacks a dialogue between the teacher and the student or between students, does not enable raising questions by the students to the teacher, questions which enable better understanding and deeper processing of the learned material. Since the students are active components in classroom learning, the material becomes more relevant and more significant for them. They remember it better, understand it, and turn it around in their thoughts. As a result, their achievements improve.

Therefore, questions, instructions and the presence of a teacher were found to be essential, since they motivate the students, concentrate their attention and enable deep processing of information, which enable the students to evaluate the extent of their mastery of the learned material.

In conclusion, the transactional distance of a learner whose approach to learning is more autonomous is smaller, since the student directs his/her learning, takes responsibility for the learning and exhibits self-direction and self-criticism. When the interaction is richer, more comprehensive and more synchronous, the importance of the learning profile decreases. However, cognitive ability that enables some level of autonomous learning is still necessary. Students with a low cognitive ability, and therefore low ability for autonomous learning, will usually not be able to become integrated in a framework of distance education, even in its synchronous form in which the interaction is relatively higher than in the asynchronous form. The transactional distance is too large for these students to internalize the learning material. According to Simonson, Schlosser, and Hanson (1999), it is apparent that the present form of teaching via a synchronous method has not yet fulfilled some of the conditions that exist in conventional teaching. The missing conditions in this system should be localized via comparative studies, so that weak students can also be integrated in a synchronous distance education system.

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