TEACHER-STUDENT INTERACTIONS AND LEARNING OUTCOMES: MOVING FROM DESCRIPTIVE TO PRESCRIPTIVE RESEARCH[1]

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Abstract

We have been researching the process of integrating technological systems in education for the past three decades, using the "ongoing" research method. The schools are our laboratory and research field. The results of each research are taken into account in the planning and formulation of the next research. This process includes three phases: conceptualization (identifying concepts), validation of the concepts, and examination of the correlation between the different learning environments. These are the basis for formulating models that will comprise a basis for analysis and making decisions in the field.

Introduction

Research has shown that a relation exists between the level of learning in the schools and universities and a country's strength. A relation also exists between education and the level and quality of life. Education today is a significant factor for ensuring society's normal existence, development and prosperity. However, major cities can afford the student the opportunity to acquire knowledge more than cities found in the periphery. A gap therefore exists between the level of learning in the major cities and the level of learning in the peripheral settlements. Students with high learning abilities who live in the cities can participate in university courses and other learning centers, whereas students with high learning abilities who live in the periphery do not have a framework which can afford them knowledge in accordance with their talents and abilities.

This reality was the basis for our research on the integration of technological systems for the advancement of students towards academic studies. Our research aims to investigate how technological systems can be used to advance populations

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of students who live in distant areas, to afford them the opportunity to learn academic courses and to be university students while still in high school.

Teacher–Technology Partnership

The process of change is very complex, since it must take numerous educational and pedagogical factors which are involved in the process into account. It must recognize the teachers' and students' personal attitudes, must evaluate the student's level, analyze the sociological processes taking place in the classroom, formulate an appropriate teaching method, recognize the teacher's position and status in the classroom, etc. Proper activation of technological systems in order to reduce gaps between populations is very complex, and its successful implementation depends on the understanding and control of numerous diverse and complex parameters.

We have been researching the process of the integration of technological systems in education for the past three decades, using the "ongoing" research method. Each phase of the research completes the preceding phase, i.e. each phase of research is based on data found in previous researches. This process includes three phases:

- First phase: Conceptualization, i.e. identifying concepts, out of existing scientific knowledge, which appear relevant to the environment which we are investigating. At this stage we examined whether the concepts are indeed valid for the field of the integration of technological systems in education. This stage, of the validation of the concepts, was performed by calculating the between-judge correlation (descriptive research).

- Second phase: Validation of the concepts, i.e. examining the validity of the concepts as an instrument which will enable differentiation between learning environments.

- Third phase: Examination of the correlation between various variables in an attempt to explain the differences between the different learning environments. These explanations will be the basis for formulating models that will comprise a basis for analysis and making decisions in the field (prescriptive research).

The function of the education system today is indeed complex. It must educate towards values and mold each student's behavior, afford the student the ability to crystallize his/her viewpoint and attitude while concomitantly leading him/her towards achievements and affording him/her the tools with which s/he will be able to learn and acquire a profession so that s/he will be able to earn a living for him/herself and his/her family and will be able to contribute to the society in which s/he lives. These goals are not identical, and are sometimes not compatible,

since the strict and demanding educational framework which accurately evaluates and judges the student's achievements is not necessarily the same educational framework that is gentle, encouraging, educating and guiding. We must formulate a method that will help us use technology in order to achieve change in the education system, help the teacher achieve his/her aims, and afford him/her the opportunity to devote more time and attention to the students, to shape their behavior, shape their attitudes and built their personality. Thus, we deal with the integration of technological systems in the learning process.

Research on the various variables involved will enable a better understanding of how the process of change takes place in the education system. It also elucidates the factors and rules that affect this process. Integration of a technological system must enable the education system to achieve its goal of educating and imparting knowledge to the student. It must therefore take into account the abilities, feelings, attitudes, wishes, personalities and worldviews of all factors involved in the process of change, from the stage of examination, research and learning of a single variable, up to the stage where this variable becomes integrated with other variables, where together they create a body of knowledge, a model, that enables analysis and making decisions regarding the methods and modes of generating change (Offir, 1988; Offir & Cohen-Fridel, 1998; Offir & Katz, 1990; 1995; Offir et al., 1993). It will enable assessment of their effectiveness and measurement of the change's contribution to the achievement of the education system's goals.

In research that we carried out since 1978 we tried to identify and define variables from the field of psychology, which may help describe the process of activating computers in learning. These researches presented possibilities of using psychological variables when constructing a model for making decisions during the process of defining the method, a model that can help in the process of integrating advanced systems in teaching. Since 1991 we have concentrated on distance learning (DL) research. DL is an innovative system in the school, and its integration requires changes. The articles we published described variables that may assist in understanding the process of integrating DL in education.

Only in the next stage of research, when information was available on the existing variables, did the research turn to study the relations and effects between the variables.

In our research on DL we implemented the conclusions which we reached from the research data on the integration of computers in teaching which were collected in the previous phase of our research. The first studies in the field of DL dealt with the definition and identification of the different variables which influence the process of implementation of the DL method. The following studies examined the relation and influence between these variables and comprise the basis for a model which enables

more effective activation of a DL system for the advancement of students who live in peripheral areas and are not awarded the teaching level which is in accordance with their needs.

The teacher's role in the education system is crucial. The teacher educates, imparts values, serves as a personal example, encourages, and creates a personal human bond with the student. The education system will never be able to discard the role of the teacher. Today, technological means, computers and the Internet can help the teacher achieve his/her goals. Educational research should produce data that can be used for guidance and direction: how to correctly integrate the technological innovations so that they will advance the education system towards achieving its goals.

Research that examines the integration of technological systems in teaching begins with descriptive research whose aim is to evaluate, measure, and identify the existing components and variables. The research must examine, investigate and describe an existing situation. The next stage, of carrying out prescriptive research, will be carried out based on data obtained from the descriptive research. Within the framework of this stage of the research we will examine the effect of changes that can be generated in the variables in a controlled manner (Offir, 2006; 2007; Offir et al., 2002; 2004; 2007; 2008a). We will focus on researches whose goal is to determine and shape the place of the teacher in the classroom in a teaching process that also uses a DL system. In the described method, the teacher from a distance concentrates mainly on high-level transmission of the learning material in an experiential manner, by presenting complex knowledge by an expert in the field. A teacher is found in the classroom, and s/he fulfils the role of "mediator" between the complex learning material and the student.

The role of the teacher in the classroom is to give the student personal attention, to encourage, to develop thinking ability and the ability to cope with problems, while the function of transmitting material is mostly transferred to the teacher from a distance. The program resembles a "logo" in the hands of the teacher. The teacher in the classroom leads the program and determines the teaching method. The integration and cooperation between the teacher from a distance and the teacher in the classroom create a situation in which the student receives high-level material and is also awarded personal attention. Research that is taking place at this stage examines the effectiveness of the teaching system. The research data that are collected comprise a basis for making decisions that will be implemented in the next stage of operating the DL system.

The research results that are related to the place of the teacher and his/her role in the classroom versus the teacher from a distance have yielded an approach and a theory that enable defining the functions of the teacher in the classroom as

"mediator." The teacher in the classroom undergoes in-service training to help him/her to fulfill his/her role as mediator.

One of the main defining features of all forms of DL is the separation of teachers and students in space and/or time. This separation has a profound effect on both teaching and learning processes in a DL environment. Moore (1972) coined the term "transactional distance" to indicate the psychological and communications space that needs to be crossed when teachers and students are no longer physically present in the same place at the same time. This theoretical construct has contributed significantly towards an understanding of the special patterns of teacher-student interactions that characterize DL environments.

Method

In our research we learn how a five-category content analysis instrument was used to identify which types of verbal dialogue exist across conventional and videoconference-based DL environments. No content analysis instruments were available for use in a DL environment until Henri (1992) developed the first DL coding system in 1992. Henri's analytical framework is based on findings in the field of cognitive psychology, and enables the observer to reach a more profound understanding of the different types of dialogue that characterize the teacher-student relationship in a DL environment. Henri's instrument is very valuable in that it is derived from recent research on learning, and has served as a basis for the models subsequently developed by Oliver and McLaughlin (1996) and Offir and Lev (2000).

In these models, Henri's metacognitive category was eliminated and many of her original category definitions were expanded and revised. The instrument used to analyze verbal dialogue in this study contains the following five categories: (1) social interactions; (2) procedural interactions; (3) expository interactions; (4) explanatory interactions; and (5) in-depth interactions:

- Social interaction: The teacher/student talks in order to create and develop a social relations system. For example: Teacher: Hi Joe, how are you? Student: Fine, thank you. Teacher: Good to hear that, what are you going to do for us?

- Procedural interaction: The teacher/student dialogue serves for transmitting information concerning the requirements of the course and related procedures. For example: Student: How long should the paper be? Teacher: About two pages.

- Expository interaction: The student or teacher exhibits knowledge or talents in response to a demand from the other party. For example: Teacher: Can anyone tell me the name of this animal? Student: That is a tiger cat. This is an interaction solely on the knowledge level.

- Explanatory interaction: The teacher uses the students' responses in order to explain the knowledge and develop the lesson's content. For example (from a flute lesson): Teacher: Joe, can you play the flute? Student: (playing do). Teacher: That was good, but you must blow a little softer.

- In-depth interaction: The teacher gives constructive feedback to the student, which will cause the student to re-examine his/her ideas (reflection) and consider points for an alternative view. For example: Teacher: Can you tell me what you think was the main reason for his actions? Student: Maybe he wanted revenge. Teacher: But was this the only reason? What about the fact that . . .

Results

These categories were used to analyze teacher-student exchanges of verbal dialogue in two different contexts: videoconference-based and conventional learning environments.

First Phase: Conceptualization, i.e. Identifying Concepts

The observation instrument for recording verbal exchanges of dialogue in the classroom was developed from previous categorization systems developed by Henri (1992), Oliver and McLoughlin (1996), and Cookson and Chang (1995). Based on these theories of observation, an instrument was constructed. A lesson of 45 minutes was videotaped and observed by eight judges. The judges were asked to identify and classify the different teacher–student interactions. Category validity, content validity and an inter-judge reliability level of 0.82 were established (Offir & Lev, 2000; Offir et al., 2001; 2003).

Second Phase: Validation of the Concepts

This phase included examination of the validity of the concepts as an instrument which will enable differentiation between the two learning environments, i.e. do the concepts behave differently in the two learning environments? A total of sixty lectures, thirty transmitted via videoconferencing and thirty given by the same lecturers in a conventional learning environment, were videotaped for content analysis purposes. Our integrated analysis of verbal dialogue and nonverbal behaviors generated data that empirically validate and expand aspects of Moore's

"transactional distance" theory and may form the basis for the development of theory-driven, data-based models of evaluation and staff development for DL environments.

A total of 245 subjects participated in these courses, 190 in a traditional and 55 in a DL environment. The students' ages ranged between 18 and 40. All were studying for their BA in social sciences or the humanities. Content analysis was qualitative-interpretative, and the main interpretation that was carried out was to determine the type of interaction that took place. Five specific categories of verbal interactions were examined: social, procedural, expository, explanatory and in-depth. A MANOVA analysis with repeated measurements revealed significant differences in two categories of interactions of verbal dialogue: procedural and explanatory across learning environments [$F(5,42) = 2.41$, $p = 0.5$]. Table 1 presents the analysis of variance for each category of interaction.

Table 1: Comparison of Means and Standard Deviations for Categories of Verbal Interactions in Conventional and DL Environments

Categories		**DL**		**Conventional**	
	***F*(1,46)**	***SD***	***M***	***SD***	***M***
Social	0.10	2.51	1.92	2.13	2.12
Procedural	*5.07	2.48	3.79	1.37	2.33
Expository	0.00	4.36	5.04	4.23	5.12
Explanatory	**7.11	1.42	89.	4.19	3.29
In-depth	0.11	5.64	4.54	4.76	5.04

*p<.05, **p<.01

Procedural interactions increase, while explanatory interactions decrease compared to a conventional learning environment. Table 1 also shows that the standard deviations are large compared to the means. The data were transformed to logarithms, and a MANOVA analysis was conducted to reduce standard deviations. Similar results were obtained after logarithmic reduction of the data. The results confirm our central hypothesis which predicted that significant differences would be found in specific categories of verbal dialogue patterns across two different learning environments.

The results comprised a conceptualization of the various interactions that exist between the teacher and the student. We found that not all interactions can also be created in a DL system. The role of the teacher in the classroom is not identical to the role of the teacher from a distance. It appears that more of the teacher's roles in the classroom can be transferred to the technological system if we succeed in

defining the various interactions that take place in the classroom. Indeed, if interactions are studied and investigated, it will be possible to transfer some of the roles of the teacher in the classroom to the technological system. The more sophisticated and accurate our knowledge regarding various interactions, the more flesh and blood teachers' roles can be transferred to the technological system.

Empiric evidence regarding differential use of procedural and explanatory categories of dialogue in a DL environment confirm Moore's (1993) transactional distance theory. As we described previously, this theory predicts cross-context changes in teaching and learning processes in a DL environment due to the greater communicative-psychological distance that exists when teachers are separated from their students. Although this distance can also exist in a conventional learning environment, its effect is magnified during DL, and results in a greater potential for gaps in perceptions and misunderstandings in the teacher-student relationship.

Understanding how the dynamics that characterize DL affect specific categories of verbal interactions has both theoretical and practical applications. Information regarding potential cross-context changes in teacher-student interaction patterns can assist educators in understanding the relative advantages of different learning environments and make data-based decisions regarding the compatibility of learning objectives and learning environments.

The development of theory-driven, data-based models for evaluation and staff development may help rectify the current situation in which technological changes are often adopted and implemented without an adequate educational rationale. According to Salomon (2000), recent technological development has been so rapid that some think it dictates the learning processes in the classroom, instead of first preparing an educational rationale based on theories of learning processes, with technology serving as a tool for its implementation.

Integration of a DL system in teaching requires the presence and influence of the teacher, since there is no teaching without the teacher's contribution. Distance learning is an instrument that may even enhance the teacher's contribution and may afford the teacher greater opportunities to express his/her influence. Empowerment of the teacher and clearly defining the place and method where the teacher's contribution may be most significant requires use of a unique research strategy.

The research field is the learning frameworks and the research results are analyzed and taken into account during the process of the implementation of the technological systems. Our research began with identification, definition and understanding the variables that influence the process of the implementation of a

DL system, i.e. the descriptive research stage. This was followed by an examination of the relations and mutual influences between these variables.

Third Phase: Correlation between Variables

The definition of "explanatory interaction": The teacher uses the students' responses in order to explain the knowledge and develop the lesson's content. It was found that teacher-students "explanatory interactions" decrease in DL environments. The described study was conducted in order to analyze the factors which influence the effectiveness of the "explanatory interaction" in a DL environment (prescriptive research). One hundred and twenty high school students were divided into three groups (the students studied a university course via a synchronized distance learning system). One research group received cognitive interaction, a second group received cognitive interaction, referring to the effort invested by the student and a third group received cognitive interaction referring to the student's ability. It was assumed that differences in motivation and self-efficacy would be found between the three research groups. Differences between the three research groups regarding their satisfaction from the course and from their achievements were also examined. Comparison between the research groups was performed based on three groups of parameters. One group of parameters was examined only before the intervention program, one group was examined only after the intervention program and one group of parameters was examined both before and after the intervention. The research hypotheses focused on the differences between the three research groups.

Differences in the influence of the interaction on improving motivation and the sense of efficacy were examined. The parameters in these fields were examined before and after the course. It was hypothesized that the improvement in the research groups that received statements of effort or statements of ability would be greater than the improvement in the other groups. Analyses of variance were first performed in order to examine the differences between the groups before beginning the intervention program. It was assumed that the groups would be similar in terms of the motivation components before beginning the activation of the different types of interaction. MANCOVA analyses were then performed, where the measurement performed after the intervention program comprised a dependent variable and the parameter before the intervention comprised a covariate. The findings of these analyses are presented. Five parameters were examined: internal motivation, external motivation, sense of effort, sense of importance and self-efficacy. The range of possible scores for each of these measures was 1–7, i.e. the higher the score the higher the motivation components.

No significant differences were found between the three researches groups in a MANOVA analysis for examining the differences between the groups in the measurement taken before the intervention program [$F(10, 324) = 1.5$, $p < 0.05$].

Thus, these groups began at a similar level of motivation. MANCOVA analysis was performed for testing the differences between the groups that took place between the two measurements. This analysis indicated a significant difference between the three research groups [$F(10, 216) = 24.46$, $p < 0.05$]. The means and standard deviations of the research groups in the five motivation parameters, as well as the MANCOVA analysis results performed for each parameter separately, are presented in Table 2.

MANCOVA analysis for each parameter separately indicated significant differences between the three research groups in all five parameters. The greatest difference was found in internal motivation and self-efficacy, followed by importance and effort. The smallest difference was found in external motivation. MANCOVA analyses were performed in order to examine the source for the differences between the groups. A comparison was made between the group that received cognitive interaction and interaction of ability and the group that received cognitive interaction and interaction of effort. MANCOVA analyses were also performed for comparing between the group that received cognitive interaction and interaction on ability and the group that received cognitive interaction and interaction on effort, as well as for comparing between the second and third research groups.

Table 2: Means and Standard Deviations of the Motivation Components in the Three Research Groups

		Research groups						
		Cognitive + ability ($N = 45$)		Cognitive + effort ($N = 44$)		Cognitive ($N = 31$)		
		Before	After	Before	After	Before	After	$F(2,112)$
Internal motivation	*M*	5.86	6.31	5.88	6.61	5.54	3.87	135.56***
	SD	0.89	0.64	1.03	0.49	0.95	1.18	
External motivation	*M*	5.52	4.46	5.86	3.86	5.65	5.18	9.76***
	SD	1.41	1.62	0.94	1.52	1.15	1.52	
Importance	*M*	5.95	6.04	6.10	6.40	6.18	4.29	51.16***
	SD	1.10	0.82	0.99	0.63	0.80	1.40	
Self-efficacy	*M*	5.77	6.24	5.81	6.54	6.06	4.00	142.67**
	SD	1.28	0.75	1.03	0.62	0.69	1.03	
Effort	*M*	5.48	6.02	5.66	6.23	5.48	4.30	46.99**
	SD	1.13	0.80	0.93	0.80	1.05	1.19	

** $p<0.01$, *** $p<0.001$

Discussion and Conclusions

The present paper presents the types of teacher-student interactions that exist in a regular lesson and also defined types of teacher-student interactions that cannot be maintained within the DL framework. Recognition of different types of interactions is important, since these must be taken into account in the process of constructing and determining the method of a learning system, which integrates, advanced technological systems.

During our research we identified interactions that exist between the teacher and the student, which cannot be created in the DL method of teaching. Our project was therefore constructed such that the teacher would be able to maintain these significant interactions (Offir, 1988; Offir & Cohen-Fridel, 1998; Offir & Katz, 1990; 1995; Offir & Lev, 2000; Offir et al., 1993; 1994; 2005). Identification of the variables was performed by descriptive research, which examined the context. In contradistinction, examination of the interrelations between the variables was carried out using prescriptive research. The research results afford a model for deliberation and decision-making regarding the teacher's position and his/her contribution to the learning process. The teacher's role and the teaching method change according to the teaching and learning goals (Offir, 2000; Offir et al., 2008b).

Our conclusion is that in order to blunt the influence of negative motivation and reinforce the student with positive motivation, the teachers should use two types of interaction strategies. They should focus on the effort that the student invests, emphasizing the perception that errors and mistakes are an immanent part of any learning and advancement process. They should also afford interaction that promotes the student's self-esteem and his/her belief in his/her ability to invest effort and achieve the aim. The student must be supplied with interaction that reflects his/her achievements not only in terms of knowledge, but also in terms of effort and ability. An interaction that refers to affective processes and not only to cognitive processes increases students' motivation.

In conclusion, the potential contribution of this research is embedded in the use of an integrative approach. The model integrates between different types of interaction and learning products. Clarification of the interrelationships between these variables may contribute to the identification of components necessary for optimal utilization of the advantages of distance learning environments. This study is mainly qualitative, but quantitative tools were also used. The results produced using these tools are intended for a more in-depth discussion of the quantitative findings, as well as for exposing other dimensions in the analysis of the research questions.

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