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Lifelong Learning at the Technion: Graduate Students' Perceptions of and Experiences in Distance Learning

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Abstract

This study examined the development of two Distance Learning (DL) courses and their effect on students' perceptions and learning experiences. Our study included about 260 science and engineering graduate students. Among them, 105 students were divided into two research groups: on-campus students (N=70) and DL students (N=35). These two groups served as a traditional classroom setting and an online setting, respectively. Data was collected through an online questionnaire consisting of both open-ended and close-ended questions and analyzed via the mixed methods model. Findings indicated that the DL students asserted positive perceptions of their learning experiences compared to the on-campus students. Female DL students were more confident about their ability to communicate with their classmates and lecturers in comparison to their male DL peers. We also found that younger students, in comparison to older ones, held higher positive opinions about the quality of the DL courses and the support they received from the lecturer and the teaching assistants. Content analysis revealed four main categories related to lifelong learning via DL: cognitive and professional skills, affective learning, social interactions, and resource management. Learning about students' perceptions of and experiences in DL is an important step toward improving the next generation of online courses in higher education.

Keywords: Distance learning, Science and engineering, Graduate students, Lifelong learning, Perceptions.

Introduction

Lifelong learning is the continuous pursuit of knowledge and skills throughout an individual's career for either personal or professional reasons. In the global economy of the 21st century, there is increasing pressure to enhance lifelong learning among employees, contributing to their professional development (Moore, 2007). In the past, graduate students updated their knowledge and skills by enrolling in professional on-campus courses. Nowadays, commuting to university locations is costly and time inefficient, especially since the emergence of advanced web-based technologies, which can facilitate delivering learning materials anywhere and anytime (Allen & Seaman, 2010; Jones & O`shea, 2004). In the past decade, understanding of the importance of web-based instruction for enhancing students'

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meaningful learning and higher-order thinking skills has grown (Barak & Dori, 2009; Dori, 2007; Kali, Levine-Peled, & Dori, 2009). The increasing demand for web-based instruction resulted in the establishment of numerous online distance learning (DL) courses in higher education (Lee & Pituch, 2006). Universities are undergoing dramatic growth in delivery of DL courses; some institutions even offer entire online degree programs (Allen & Seaman, 2010).

DL is defined as a planned instruction that occurs far from the designated learning place, and as a result special techniques are needed for designing the online courses (Moore & Kearsley, 1996). DL systems can be used to integrate instructional material, live chat sessions, online discussions, quizzes, and assignments. These systems offer learners flexibility as to the time and place of instruction, which can be conducted at the same time (synchronously) or at different times (asynchronously), providing a variety of instructional materials and communication methods.

With DL programs, higher education institutions have increased the number of enrolled students and reached different audiences without expanding the number of classrooms within the university campus (Allen & Seaman, 2005). Studies have examined the factors that affect course design and training of lecturers (Kanuka, Rourke, & Laflamme, 2007; Liu & Lee, 2005), learner's perspectives, such as satisfaction (Gunawardena & Zittle, 1997), communication between colleagues (Hammond, 1999), technical skills (Ross, 1996), meaningful learning (Arbaugh, 2000; Barak & Dori, 2005; Martinez-Caro, 2009), and thinking skills (Barak & Dori, 2009; Barak & Rafaeli, 2004). Other studies have shown that online learning in higher education faces many challenges, and the effect of DL on the teaching and learning culture in academic institutions is still limited (Bonk, Wisher, & Lee, 2003; Cuban, Kirkpatrick, & Peck, 2001; Kali et al., 2009).

To date, most studies examined the effect of DL on undergraduate students who studied social sciences. Despite the encouraging findings, there is little evidence in the literature on the process of development and evaluation of graduate courses in science and engineering. Although higher education institutions have invested substantial resources in DL systems, their pedagogical advantages are yet to be examined. The DL trend requires universities to re-think strategies, in various areas, especially in pedagogy, educational quality assurance, and educational partnerships (Jones & O'shea, 2004).

This paper includes a theoretical background related to transactional distance theory and DL. The paper describes the initiative of TIDES Center– Technion International Distance Education & Studies, established by Professor Yehudit Judy Dori in 2010. It examines science and engineering students' perceptions of DL and their learning experiences. It also describes the study's results, significance, and lessons learned.

Transactional Distance Theory

Our study's theoretical framework is based on the 'transactional distance theory' defined by Moore (1993) as "a psychological and communications space to be crossed, a space of potential misunderstanding between the inputs of instructor and those of the learner" (p. 23). Moore (1993) asserted that 'transactional distance' is a concept describing the universe of teacher-learner relationships that exists when learners and instructors are separated by space and/or by time. Transactional distance can be perceived as individuality and disposition of distance learners that differs from one cultural to another (Kawachi, 2003). The transactional distance theory assumes that the most profound impact on distance education is not the physical or temporal distance that separates instructor and learner, but rather the pedagogy and the instructional methods (Gorsky & Caspi, 2005).

Moore (1993) suggested that the nature of the transaction developed between teachers and students in DL consists of three factors: dialogue, structure, and learner autonomy. *Dialogue* refers to the extent to which teachers and learners can interact with each other, taking into account the

quality of the dialogue and the different forms of interaction. *Structure* refers to the program's educational objectives, teaching strategies, and evaluation methods, and their levels of flexibility. The third factor, *learner autonomy,* is the extent to which the learner rather than the teacher determines the goals, the learning experiences, and the evaluation decisions of the learning program. This factor of the transactional distance theory is closely tied in with a learner's sense of self-direction or self-determination, and can be significantly affected by the two other factors: dialog and structure.

It is assumed that dialogue is in inverse proportion to structure, meaning that any increase in one leads to the decrease of other. Increase in course structure leads to reduction of dialogue and, consequently, increase in transactional distance. Contrary to this, learner autonomy and transactional distance are proportional to each other, as increases or decreases in the one result in corresponding increases or decreases in the other (McIsaac & Gunawardena, 1996).

Patterns of personality characteristics among students were indicated while analyzing the data used to generate the concepts of distance, dialogue, and structure (Moore, 1993). In our study we investigated students' characteristics that may lead to reduction in transactional distance and, as a result, to successful DL implementation.

Distance Learning

Distance learning is not a new phenomenon. Over a hundred years ago, people studied in distance by exchanging educational books and letters (Passerini & Granger 2000). Moore & Kearsley (1996) identified three main evolutionary stages of DL. The first DL generation, which crossed the end of the 19th and the beginning of the 20th century, was titled *correspondence learning*. In this learning stage, the major means of communication were printed materials, usually customized textbooks that contained lesson outlines and exercises. Students completed assignments based on the textbook instructions and mailed their assignments to the instructor. The instructor's feedback was also given via mail. The second generation of DL started in the early 1970s, when the British Open University was granted the status of a degree-granting program (Moore & Kearsley, 1996). In this stage, instruction was delivered through radio, television, recorded audiotapes, and correspondence tutoring. Audio-conferencing (using telephones) was also part of the second generation of DL programs. The third generation, which started in the early 1980s and ended in the 1990s, benefited from satellite technologies and the emergence of communication networks facilitating the delivery of analog and digital content to computer workstations. These technologies enabled new forms of real time interaction with two-way videoconferencing, or one-way video and two-way audio communication. During this stage, CD-ROM products for multimedia self-paced learning were introduced. DL students studied by reviewing videotapes, audiotapes, textbooks, or multimedia CD-ROMs (Moore & Kearsley, 1996). Today, we are in the midst of the fourth generation of DL, which involves the use of internet technologies, web-2.0 systems, and social networking. Internet technologies empower the joint exploration of learning materials, adding stronger collaborative learning elements compared to previous generations.

DL is defined today as a planned instruction that occurs far from the designated learning place, and as a result special techniques are needed for designing the online courses. DL, today, applies advanced technologies and requires special administrational and organizational changes (Moore & Kearsley, 1996). Graves (1997) describes DL as distributed learning that combines learning through dialogue that takes place at different times (*asynchronous*) or simultaneously (*synchronous*) when learners are in distant geographical places. According to Rosenberg (2001), DL relies on being available in the Internet for quick updates, distribution of information, and knowledge sharing. DL using the Internet is defined as learning through a variety of technological means, enabling students far away from the teaching place to acquire knowledge and insights as if they

were present at the lessons (Garrison & Shale, 1990; Hegarty, Bostock, & Collins, 2000; Li, 2005; Passerini & Granger, 2000; Schrum & Ohler, 2005).

Hong and Jung (2011) identified a set of competencies displayed in the successful distance learner. Their results revealed that management skills are the most important. Other researchers (Kim, Kwon, & Cho, 2011) reported that in the context of higher DL demographic variables, such as gender, online learning experience, and work status, were not significant factors in terms of influencing on either social presence or learning satisfaction. However, media integration and instructor's quality teaching were significant predictors of both social presence and learning satisfaction.

In our article we relate to variables such as resource management, gender, online learning experience, and satisfaction, all in the context of graduate DL courses.

Research Goal and Questions

The objective of this study was to examine science and engineering graduate students' perceptions of distance learning and their learning experiences. This objective raised the following three questions:

1. What are the science and engineering graduate students' perceptions of distance learning?
2. Are there gender differences between graduate students' perceptions of distance learning?
3. What is the effect of distance learning on graduate students' learning experiences?

Research Plan

This study was conducted at TIDES - Technion International Distance Education & Studies. The research plan included three consecutive stages:

Initial stage – was conducted in order to provide an answer to the first research question, to learn about students' perceptions of DL and to investigate the feasibility of establishing DL courses in our university. An online perception questionnaire which included open- and closed-ended questions was developed and randomly administered to science and engineering students. The reliability and validity of the questionnaire were established in this stage, and the framework of the distance learning courses was developed.

Comparative stage – was conducted in order to answer the second and third research question, to examine the effect of DL on students' learning experience. In this stage we compared two groups of students: those who studied in a regular classroom setting and those who studied from distance via online tools. The study included students from two courses: *Innovation Management* and *From Cell to Tissue*. The *Innovation Management* course was delivered as part of an MBA (Master in Business Administration) program at the Faculty of Industrial Engineering and Management (Hussein-Farraj, Barak, & Dori, 2012). The course *From Cell to Tissue* was delivered as part of an ME (Master of Engineering) program at the Faculty of Biomedical Engineering (Dori, Yarden, & Allouche, 2012). These courses were selected as test-cases because of the lecturers' willingness to be video-taped, because some of the students were work- or place-bound, and because the topics taught as well as the pedagogies were suitable for DL courses. Students from both courses were able to choose to learn in a traditional classroom setting or learn from distance. We assumed that students who are already employed and have family responsibilities will choose the DL mode.

Focus stage – was conducted in order to validate the quantitative and qualitative findings derived from the second stage relating to students' learning experiences in a DL setting. In this stage, students who participated in one of the DL courses were interviewed after the course completion.

The three research stages and the number of participants in each one of them are presented in Figure 1.

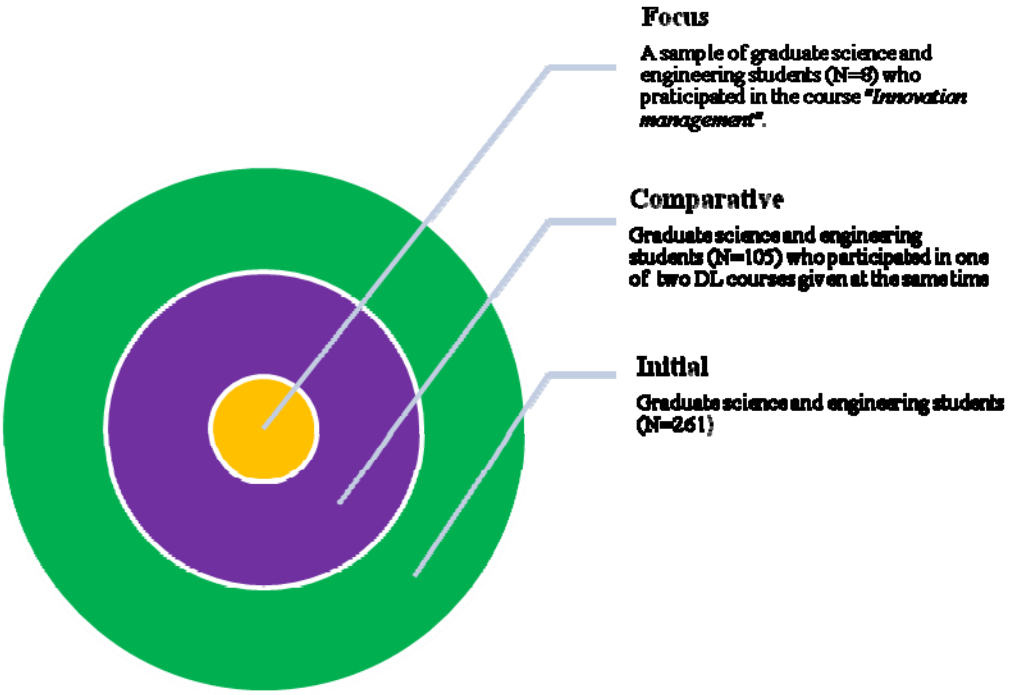

Figure 1: The three research stages and the participants in each stage

The Learning Environment

The Moodle system (http://www.moodle.com), an open-source web application, was used as the learning management system for both DL and face-to-face (F2F) students.

The course website on the Moodle system included syllabus, announcements, and a class section for each lecture. Each class section included three learning activities: readings, assignments, and lectures. *Readings* included links to academic papers in PDF format. Students were asked to read these papers prior to the lecture. *Assignments* included forums, work sheets, and questionnaire that students were asked to participate in or respond to during or following the lectures. *Lecture*s included PowerPoint presentations and videos of the lecture via Panopto system (http://www.panopto.com).

The lecture-videos were broadcasted asynchronously so the students were able to view the recorded lectures and participate in given tasks at their own convenience, anytime and anywhere. From the user (student) point of view, the Panopto system includes four parts: the video of the lecturer on the upper left side of the screen, the power point slides on the upper right side, a list of contents and timeline on the bottom left side, and a list of slides on the bottom right side. Students can select any slide they want to learn from, and by clicking on it the video of the lecturer (voice and the image) is automatically synchronized with it.

While Moodle was a supplementary learning environment for the on-campus students, for the DL students it was the only learning environment. The *Innovation Management* DL students met the lecturer, the teaching assistants, and their classmates only once, at the last week of the semester, when they came to present their final projects. In the course *From Cell to Tissue*, DL students met

their teaching assistant only once, in a review session before the end-of-semester examination. During the semester while the comparative stage took place, both DL groups were able to discuss problems and scientific papers via the Moodle website.

Research Participants

The Initial stage included about 260 science and engineering graduate students. Half of them (51%) were engineers. Among them, about half (53.5%) were males.

The comparative stage included 105 science and engineering graduate students that participated in one of two courses: *Innovation Management* (N=52) or *From Cell to Tissue* (N=53). The students' description, sorted by course, gender, age, major, and veteran in their workplace is presented in Table 1. Please note, that each column at each marked row (two cells) encompasses 100%. For example, DL students (N=35) consist of 63% of *Innovation Management* students and 37% of *From Cell to Tissue* students. Among F2F students, 43% were *Innovation Management* students and the rest students of *From Cell to Tissue* course.

Another example is the gender aspect – in DL mode, the majority was male (66%) and 34% were female, while in F2F the majority was women (57%).

Table 1: The comparative stage students' description

Personal background and demographics		Student percentage	
		DL	F2F
Course	*Innovation Management*	63%	43%
	From Cell to Tissue	37%	57%
Gender	Male	66%	43%
	Female	34%	57%
Age	20–to-34 years old	55%	87%
	Above 35 years old	45%	13%
Major	Engineering	55%	75%
	Science	45%	25%
Veteran in workplace	5 or less	62%	81%
	More than 5 years	38%	19%

The focus stage included eight DL students from the *Innovation Management* course who volunteered to be interviewed. Table 2 presents a short description of each interviewee.

Table 2: Characteristics of the focus stage research interviewed

Pseudonyms	Gender	Age group	Undergraduate major	Workplace	Position at workplace	Veteran in workplace
Gefen	Female	> 30	Engineering	Pharmaceutical Company	Engineer	5-10
Ora		> 30	Science	Pharmaceutical Company	Team leader	1-5
Anat		> 30	Science	Pharmaceutical Company	Team leader	5-10
Meril		> 35	Science	High-tec. company (U.S.A)	Manager	1-5
Yoni	Male	> 25	Science	Military industry	Engineer	5-10
Tom		> 40	Engineering	Engineering company	Manager	10-15
Adam		> 30	Engineering	Communication company	Engineer	1-5
Boris		> 40	Engineering	Engineering company	Manager	1-5

Research Method and Tools

We used both quantitative and qualitative tools and employed the mixed method analysis and interpretation (Johnston & Onwuegbuzie, 2004). The research tools included pre- and post-perception questionnaire and semi-structured interviews among students.

The perception questionnaire was delivered online and included two parts: open- and close-ended questions. The questionnaire's close-ended part included items that were adapted from previous studies that investigated DL (Pituch & Lee, 2006; Schrum & Ohler, 2005; Shin & Chan, 2004). It consisted of 32 items on a 1-to-5 Likert type scale (5-strongly agree to 1-strongly disagree). The items were divided into six main categories: a) Promoting meaningful learning, b) Techno-pedagogical benefits, c) Social aspects and communication, d) Course quality and students' support, e) Self-efficacy and self-assurance, and f) Work-place and promotion. The questionnaire's internal consistency, Cronbach's Alpha, was 0.93. The questionnaire's open-ended questions focused on students' interest in participating in DL courses and their learning preferences.

The semi-structured interviews with six of the students who took the *Innovation Management* course in DL were conducted during the final meeting. These DL students came to the university in order to present their final projects. Two interviews were conducted from distance using Skype online system (http://www.skype.com). The interviews were audiotaped by Audacity software (http://audacity.sourceforge.net), and lasted about 30 minutes. A researcher diary was used for documenting the interviews and for quality assurance.

In the first stage, the close-ended questions of the perception questionnaire were analyzed; in the second stage we analyzed the open-ended questions and created the categories relating to students' perceptions of DL. In the third stage we analyzed the transcripts of the students' interviews in order to establish a *methodology triangulation* (Denzin, 1978).

The content analysis of the science and engineering students' answers to the open-ended questions relating to their perceptions of DL were content analyzed by three educational research experts for establishing research trustworthiness via investigator triangulation (Denzin, 1978; Denzin & Lincoln, 2000). The content analysis was conducted in four stages. First, the students answers

were collected; second, each answer was divided into short sentences; third, each sentence was classified under a uniting theme; finally, sentences under a similar theme were collected together, resulting in the generation of categories. The inter-raters consent was 100%.

T-tests and Analysis of covariance (ANCOVA) test were conducted to compare science and engineering students' perceptions while taking into consideration their diverse backgrounds and demographics.

Findings

This section includes three parts. The first one describes science and engineering students' perceptions of DL before the DL courses were developed – the *initial* stage. The second part describes the effect of DL on students' learning experiences, by examining two research groups: DL and F2F – the *comparison* stage. The last one presents the qualitative findings – the *focus* stage.

Science and Engineering Students' Perceptions of DL

Findings indicated that graduate science and engineering students have high positive perceptions of DL in all the categories except the category *social aspects and communication*. It appears that students had concerns about their ability to communicate with their classmates and lecturers from distance. Mean scores and standard deviations of the students' pre-questionnaire by categories are presented in Table 3.

Table 3: Mean scores and standard deviations of the pre-perception questionnaire by categories – the initial stage

Category	Mean (N=261)	S.D.
Meaningful learning	3.40	0.78
Techno-pedagogical benefits	3.74	0.70
Social aspects and communication	2.95	0.86
Course quality and student support	3.06	0.82
Self-efficacy and self-assurance	3.82	0.82
Workplace and promotion	3.44	0.79
Total	3.40	0.64

Independent t- tests were conducted in order to compare students' perceptions of DL by personal background and demographics. Finding indicated that students who had previous experience in DL held statistically significant higher positive perceptions of DL ($t_{(239)} = 3.61$, $p < 0.001$). It should be noted that some students did not respond to some of the questions.

Findings also indicated that students who preferred a-synchronic DL delivery mode held statistically significant higher positive perceptions of DL ($t_{(192)} = 6.5$, $p < 0.001$).

There were statistically significant difference in all categories related to students' preferred delivery mode of DL – synchronic or a-synchronic ($t_{(193)} = 3.01$, $p < 0.01$). The a-synchronic mode was preferred by most of the students.

There were no statistical significant differences between the perceptions of male and female students of DL. Also there were no statistically significant differences in students' perceptions of DL relating to their position in workplace and veteran.

Statistically significant differences were found in students' perceptions of DL by age groups in the following categories: *promoting meaningful learning* ($F_{(2, 234)} = 3.36$, $p < 0.05$), *course quality and student support* ($F_{(2, 234)} = 5.93$, $p < 0.01$), *workplace and promotion* ($F_{(2, 234)} = 3.27$, $p < 0.05$) so as in the total questionnaire mean scores ($F_{(2, 234)} = 3.14$, $p < 0.05$). Younger students had more positive perceptions of the mentioned categories in comparison to their older peers.

The Effect of DL on Students' Learning Experiences

The students' pre- and post-perception questionnaire mean scores by research group are presented in Table 4.

Table 4: Mean scores and standard deviations of the pre- and post-perception questionnaire – the comparison stage

Research group	N	Pre questionnaire		Post questionnaire	
		Mean*	S.D.	Mean*	S.D.
F2F	70	3.22	0.45	3.12	0.49
DL	35	3.54	0.64	3.58	0.58

* The mean scores are out of 5 points

No statistically significant difference was found between the pre- and post-perception questionnaire mean scores for both research groups. However, data indicated that DL students asserted higher positive opinions on the course in comparison with their F2F peers. Indeed, at the end of the course, the DL students were more satisfied with their learning compared to the F2F students ($F_{(1, 74)} = 7.10$, $p < 0.01$). The DL students asserted statistically significant higher positive opinions about *meaningful learning*, and *self-efficacy and self-assurance* ($F_{(1, 74)} = 5.37$, $p < 0.05$; $F_{(1, 74)} = 4.24$, $p < 0.05$, respectively), meaning that DL students felt that the online courses contributed to their knowledge and self-efficacy.

When examining students' learning preferences, we found that more DL students (72%), in comparison with F2F students (65%), preferred the a-synchronous mode for course delivery. This is probably so because a-synchronous DL allows flexibility in time and place of learning, independence, and self-responsibility for their learning processes.

While examining gender differences, we found that both female and male students from the F2F group asserted relatively low perceptions of DL in the post-perception questionnaire. In the DL group, we found that female students, in comparison with their male peers, asserted statistically significant higher positive perceptions of DL (see Figure 2). Interestingly, the main difference was due to females' positive perceptions of *social aspects and communication* in the course ($F_{(1, 33)} = 4.77$, $p < 0.05$). It appears that female students were more confident about their ability to communicate with their classmates and lecturers from distance.

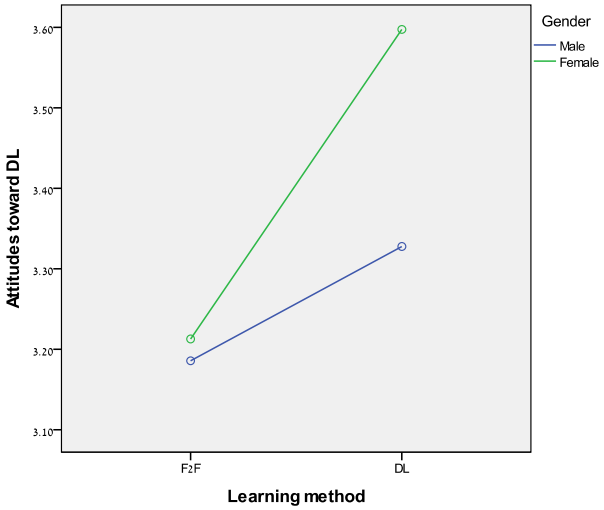

Figure 2: Comparison of male and female perceptions of DL

During the examination of differences between age groups, we found that young DL students, ages 20 to 24, asserted statistically significant higher positive perceptions of the quality of the DL courses and the support received from the teaching staff, in comparison with older peers ($F_{(1, 33)} = 7.89$, $p < 0.05$). It may be because younger students are more computer savvy and they feel they do not need much technical support. No statistically significant differences were found among any of the categories within the F2F group relating to DL nor in the overall questionnaire mean scores.

When examining perceptions of students of different workplace statuses, we found that in both groups (F2F and DL), students that were employed as engineers or scientists had higher positive perceptions of DL in comparison with students in managerial positions (Figure 3). Among the DL students, statistically significant differences between employees and managers were found in the category *course quality and student support* ($F_{(1, 33)} = 8.90$, $p < 0.01$). DL students working as engineers evaluated the DL course they learned as a high qualitative course, and they were more satisfied with the support level they received from the course staff than their peers from managerial sectors.

Among the F2F students, statistically significant differences were found in the category of *techno-pedagogical benefits* ($F_{(1, 33)} = 4.29$, $p < 0.05$). Engineers that learned the F2F course on campus evaluated the DL techno-pedagogical benefits higher than their managerial peers.

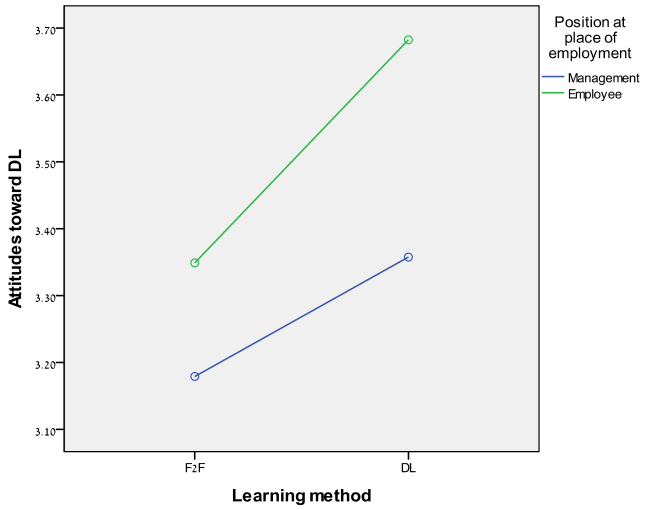

Figure 3: Comparison between employee and manager perceptions of DL

Findings indicated that young employees, who had worked less than four years at their workplace, were more satisfied with DL than student working over five years at their workplace (Mean = 3.93, S.D. = 0.82; Mean = 3.10, S.D. = 1.05 respectively) ($F_{(1,33)} = 4.60$, $p < 0.05$). These results correspond positively with our previous results indicating that young people are more accustomed to online learning and are more likely to perceive that participating in DL courses is beneficial for them.

In order to examine the possibility of predicting students' perceptions of DL, we conducted a stepwise regression test while the net gain of the questionnaire mean score served as a dependent variable. Findings indicated that students' age (mid-twenties) and learning mode preference (a-synchronous) are the strongest predictors for positive perceptions of DL (Table 5).

Table 5: Parameters which predict students' positive perceptions of DL

Parameter	B	S.E.	Beta	t	Significance p<
Age	-1.06	0.26	-0.77	-4.14	0.005
Learning delivery mode	0.85	0.32	0.49	2.66	0.05

Content analysis of students' answers to the open-ended questions in the post-perception questionnaire raised both positive and negative perceptions of DL. The number of statements about DL in the post-questionnaire was higher by about half (56%) than the number in the pre-questionnaire within the DL research group and about one tenth (8%) within the F2F group. These findings indicate that students attributed more importance to DL and elaborated their answers after experiencing it. There was no significant difference between the means of pre- and post-perception questionnaire statements within the two research groups.

Content analysis of students' explanations for their preferences to learn or not from distance raised four themes and several categories that show positive and negative perceptions and experiences in DL. The themes are: 1) Cognitive aspects and professional skills, 2) Affective aspects, 3) Social interaction, and 4) Resource management. Figure 4 shows the percentage of DL students' positive and negative statements about DL by categories.

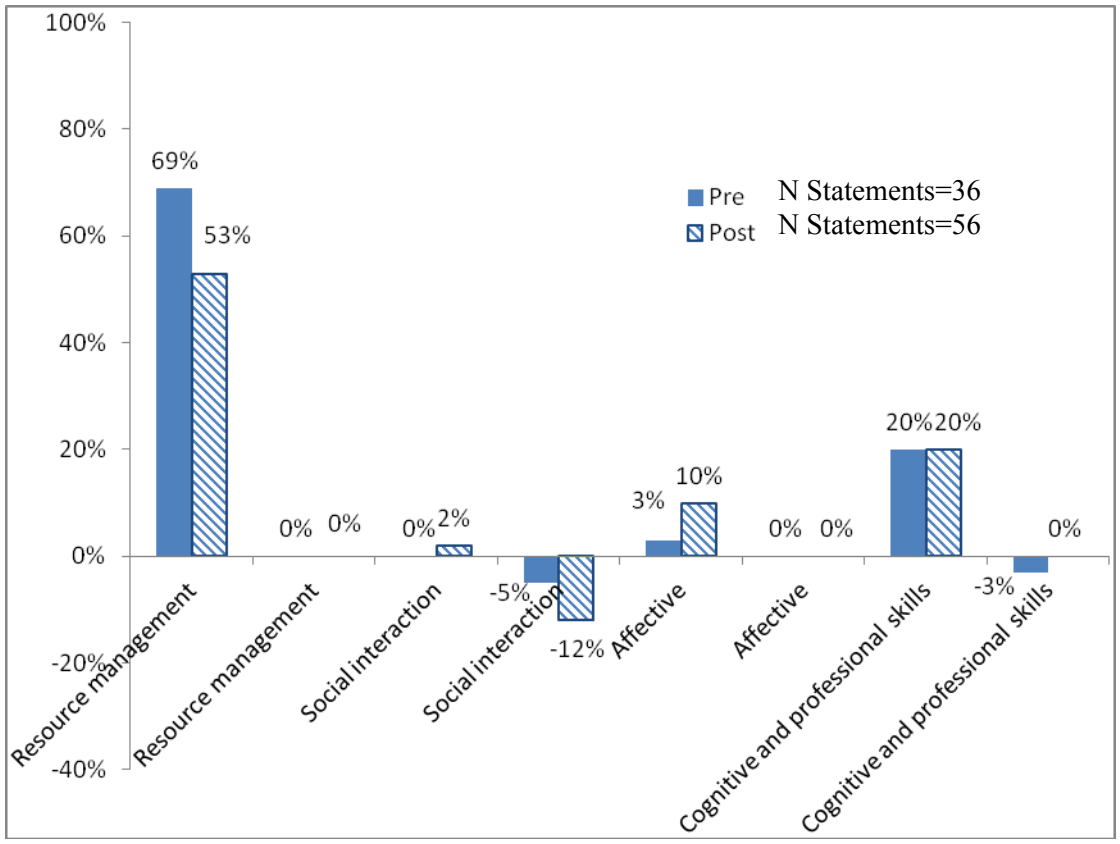

Figure 4: Distribution of positive and negative statements about DL by DL students

* Columns below thex axis indicate negative statements.

From content analysis for these negative statements we can understand that most statements DL students wrote about DL were positive (91.6%) and only (8.4%) were negative. All the negative statements related to the category *social interaction*, meaning that some DL students lack interaction with their peers and with the lecturer when learning from distance.

In order to understand also the positive and negative perceptions and experiences of F2F students toward DL, we present the distribution of positive and negative statements about DL by F2F students in Figure 5.

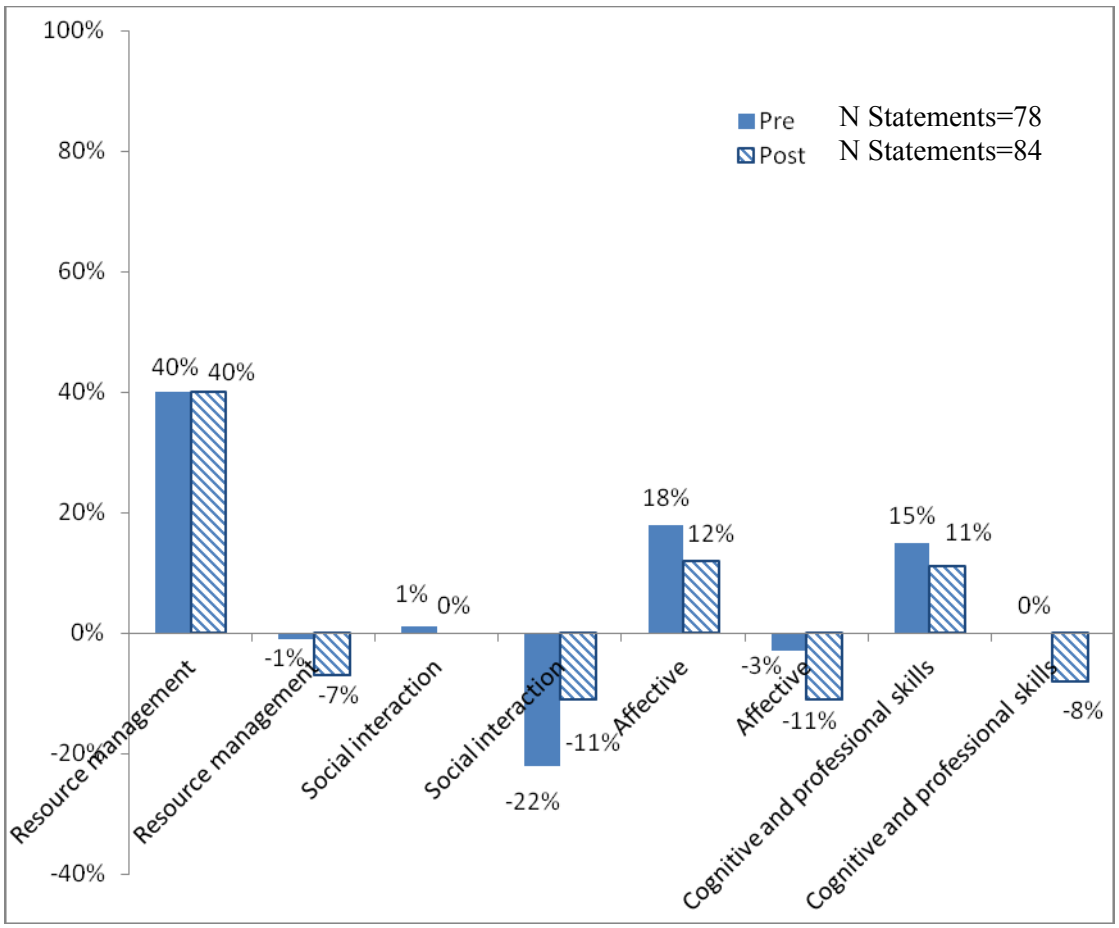

Figure 5: Distribution of positive and negative statements about DL by F2F students
* Columns below the x axis indicate negative statements.

Figure 5 shows that F2F students have concerns about DL in all the categories. About one third (29%) of all the negative statements in the post questionnaire expressed negative perceptions and experiences about *social interaction*, about another third (29%) were related to *affective aspects* while most of these statements were related to negative perceptions and experiences about *self-discipline*. About a quarter (23%) of the negative statements were related to *cognitive and professional skills* while most of them related to perceptions about promoting t*hinking skills* while learning from distance. Finally, about one fifth (19%) of the negative statements expressed F2F students focused on *resource management*.

It appears that while students who learned the course from distance had negative perceptions and experiences about DL relating to "*social interaction*" only, F2F students had negative perceptions in every one of the mentioned categories. It may be because they did not learn the course from distance so they expressed concerns about DL learning method without experiencing it.

Themes, categories and examples of DL students' responses to the open-ended questions in the pre- and post-questionnaire and in the interviews are presented in Table 6.

Table 6: Themes, categories, and examples of DL students' responses to the open-ended questions in the pre- and post-perception questionnaire and in the interviews

Themes	Categories	Examples		
		Pre-questionnaire	Post-questionnaire	Interviews
Resource management	Time management	*I will choose to learn from distance mainly because it allows better management of time.*	*DL has opened to me the possibility to attend the course at times convenient to me.*	*I chose to study from distance because it allows me to build my own schedule, it is very convenient. (Gefen, 09:00)*
	Environment management	*I want to learn DL from home because of convenience of some of the courses.*	*This convenient method allows study of smaller classes.*	*DL allows me to choose the learning environment which is good for me. (Anat, 13:00)*
	Learning management	*DL opens up possibilities to study courses not available in the center.*	*DL provides opportunities to study with a large variety of first class lecturers.*	*DL is appropriate method to me because I like to learn alone. (Yoni, 12:30)*
Social interaction	With lecturer	*I think DL creates a supportive social framework especially when you can communicate with the lecturer through the forum.*	*DL will be effective if there is possibility for direct interaction with the lecturer.*	*DL does not lack interaction because you can communicate with the lecturer by Email. (Adam, 13:00)*
	With students	*I choose to learn from distance because of forums attended by all students in the course.*	*I love the idea of the resulting interaction between students through the forum with questions and answers.*	*I need to Interact with people. DL does not give the opportunity to participate in discussion with my peers in a real time. (Boris, 11:30)*
Affective aspect	Self-discipline	*Although convenient, but requires discipline and sometimes very high setting and routine that's what counts.*	*DL requires very high self-discipline.*	*DL requires self-discipline that I have and therefore I have no problem to learn from distance. (Meril, 21:00)*
	Interesting and challenging experience	*I would be interested in DL if the course is interesting to me.*	*Learning character appeals to me, I would love to try it.*	*When the course team explained to us the method of distance learning course I was very interested so I decided to participate in distance learning. (Tom, 11:00)*
	Innovation	*New experience and new learning method.*	*I want to learn from distance because it is the next trend and the future teaching method. I want to practice and to know this system.*	*DL is a new concept and I wanted to try it. (Ora, 09:30)*

Themes	Categories	Examples		
		Pre-questionnaire	Post-questionnaire	Interviews
Cognitive aspect and Professional skills	Thinking skills	*In a previous course, distance learning material was presented in a very high-level of thinking.*	*Distance learning allows me to return to certain chapters and understand the concepts better the second time*	*If to compare my understanding level in DL it is the same level of understanding as learning face to face. (Gefen, 09:00)*
	Professional skills	*I think distance learning can contribute to my skills.*	*Distance learning gives me skills required to my company.*	*In DL I work with my colleagues through Skype calls, so we talk to the point and learn to build a professional basis. (Meril, 21:00)*
	Regulation of cognition	*I learn better when I can stop the recorded sections that I did not understand and see and listen again.*	*I can go back and watch the sections that I did not understand for one reason or another.*	*In DL I can concentrate better when learning on my own computer. (Tom, 11:00)*

Similar to the qualitative data presented in Figures 4 and 5 the data that was collected and analyzed from the open-ended questions and the interviews suggested that students are concerned about the social interaction they might not have with their peers while learning from distance as well as with their self-discipline. Therefore, social interaction as part of their learning experience should be enhanced. Also, in order to learn efficiently from distance, students' self-regulation should be taken into consideration.

Summary, Discussion, and Recommendations

Our study was set to examine science and engineering graduate students` perceptions of DL and its effect on students' learning experiences. Nowadays, DL is an educational innovation that many universities are starting to adopt for attracting and retaining students (Allen & Seaman, 2010; Hussein-Farraj, Barak & Dori, 2011). To cater to the increasing need for DL programs, TIDES was established. However, some studies report that the integration of DL in academia faces a wide range of problems (Bonk, et al. 2003; Cuban, et al. 2001). Therefore, the effect of DL on the institutes' teaching and learning should be further examined. In this study we add another layer to the growing body of knowledge on students' perceptions of DL and their learning experiences in different aspects.

When examining science and engineering students' perceptions of DL, our findings indicated that students who had previous experience in DL hold higher positive perceptions of DL which are statistically significant. Online learning experience has also been reported to have close relationship with DL satisfaction. In their research Hostetter and Busch (2006) reported that students who had taken more DL courses tended to have more positive perceptions of elements in DL. Our findings also indicated that there were no statistical significant differences between perceptions of male and female students about DL, nor in students' perceptions about DL relating to their position in workplace and veteran. On the other hand after learning from distance, we found that female students, in comparison with males, asserted statistically significant higher positive perceptions of social aspects and communication in the DL courses. According to previous studies, the levels of social presence vary by gender. Rovai and Baker (2005) reported different learning experiences between genders showing that female students found online learning more social and more beneficial and learned more than male students. Another study found that female students

tend to be more active in social and interactive behaviors, sending more interactive messages than males (Barrett & Lally, 1999). These two studies are in accordance with our results. However, other studies found no significant relationship between gender and dependent variables of DL (Arbaugh, 2000; Kim et al., 2011; Wu & Hiltz, 2004). In our research it appears that female students have more positive perceptions of DL in general. One explanation can be that females are trying to deal with or balance between multiple roles such as couple relationships, parenting, and career. We do not claim that men do not struggle with these issues. However, male and female might be different in several aspects and, therefore, their emphases in everyday life while attending online courses might vary as well (Yukselturk & Bulut, 2009).

When examining students' perceptions of different workplace statuses, we found that in both groups (F2F and DL) students that were employed as engineers or scientists had higher positive perceptions of DL in comparison with students in managerial positions. It may be because engineers are more experienced with usage of technology and more exposed to online learning environments in their work. Other researchers found that demographic variables such as online learning experiences and work status were not significant factors in terms of influencing DL satisfaction (Kim et al., 2011). We think that such variables that vary in different research populations might be culturally-related and need further research.

When examining DL students' perceptions after learning the course from distance, our findings indicated that young DL students, ages 20 to 24, asserted statistically significant higher positive perceptions related to the quality of the DL courses and the support received from the teaching staff, in comparison with older peers. Our results can be explained due to the fact that younger students are usually more computer savvy and more experienced with advanced technology (Martinez-Caro, 2009; Smith & Necessary, 1996). Although the technology was relative simple to use, it seems that in our study older students expected to receive better support from the teaching staff. Other researchers found no statistically difference or relationships between age and students' satisfaction with DL (Arbaugh, 2000; Hong, 2002). Further studies among students with different age groups, technology proficiencies, and learning experiences in different countries are needed.

Our findings indicated that students' age and learning mode preference are the strongest predictors for positive perceptions of DL. Other researchers indicated that student-student and student-lecturer interaction predict success of DL (Arbaugh & Benbunan-Fich, 2007; Flottemesch, 2000; Hong & Jung, 2011; Moore, 1993, 2007; Zhao, Lei, Chun Lai, & Tan, 2005).

When examining the effect of DL on students' learning experiences, our findings indicated that DL students were more satisfied with their learning compared to the F2F students. It was also found that most DL students preferred the a-synchronous mode for course delivery, since it allows flexibility in time and place of learning. It appears that a-synchronous mode may lead to reduction in transactional distance and as a result to satisfaction with DL (Moore, 1993). However, content analysis led to the conclusion that DL students were concerned with their self-determination and self-discipline. They were also concerned about lack of social interactions with peers while learning from distance. Researchers indicate that the isolation which characterized earlier distance education can be overcome by interactive and collaborative learning. Our study strengthens the claim that well-developed collaborative, interpersonal, social, and reflective skills are also important (Anderson & Garrison, 1998; Powell, 2000; Williams, 2003). Therefore, we state that the courses' pedagogy and technology can be further improved by enabling better interactive communication and enhancing students' social interaction as part of their learning experiences.

Finally, learning about graduate science and engineering students' perceptions of and their learning experiences in DL may assist in developing the next generation of online courses in higher education. Our findings indicated that although lifelong learning is crucial for the professional

development of graduate students, not all the students are able or willing to study from distance. To succeed in DL students need to adopt self-discipline practices and self-regulated learning, be responsible for their learning, and plan their time efficiently. Following our findings, online DL courses should consist of organized and well-structured learning materials. The learning environment should be easy to navigate and friendly to the learner while encouraging interactions between lecturer and students. The learning assignments should promote meaningful and active learning and should be a challenging experience with opportunities for world-wide interactions and knowledge sharing.

This study has some limitations. First, the participants of the comparative stage were from one university in Israel and the number of students who learned from distance was relatively smaller than the F2F students. This limits the generalization ability of the study. Second, some students did not respond to some of the questions in the online questionnaire, thus we received missing data in some cases. Third, some of our results contradict the results of other studies, indicating that further research should be conducted to reach a better understanding of the pedagogical, technological, and cognitive aspects of DL.

Despite the above limitations, the present research is innovative in focusing on science and engineering graduate courses for professionals.

In the theoretical aspect, the research can contribute to the body of knowledge of learning in technology-based environments by understanding graduate students' perceptions of DL and their learning preferences. In the practical aspect, our research contribution is twofold. It can contribute to the development of diverse courses in the distance mode focusing on the use of multimedia and the promotion of active and interactive learning. It can also contribute to the development of online close and open-ended questionnaires for exploring different variables that may improve best practices for meaningful learning, may lead to reduction in transactional distance, and encourage leaders in higher education to implement distance education.

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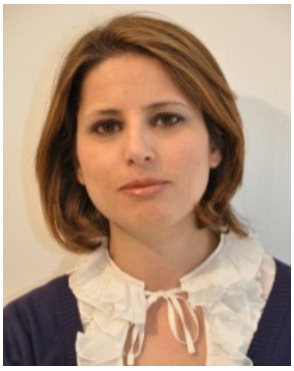
Biographies



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