ASSESSING LEARNING STYLES AMONG STUDENTS WITH AND WITHOUT LEARNING DISABILITIES AT A DISTANCE-LEARNING UNIVERSITY

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Abstract. **Differences in the learning styles of students with and without learning disabilities (LD) at a distance-learning university were examined. Two hundred and twelve students answered self-report questionnaires on their learning styles. Results revealed that students with LD preferred to use more stepwise processing, including memorizing and drilling, than NLD students. In addition, students with LD reported a higher need for self-regulation strategies than their NLD peers, including controlling their learning process, self-orientation, planning, monitoring, and continuous evaluation of their learning process and results. LD students also claimed to lack regulation, noting their difficulties with the learning process. Findings are discussed in relation to how distance-learning universities can better cultivate the abilities of their LD and NLD students.**

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Intuitively, students with learning disabilities (LD) who face a variety of academic difficulties may be expected to use different learning styles than students without learning disabilities (NLD). Based on this presupposition, various studies have described different modes of learning styles among individuals with and without disabilities, but few studies have examined the learning styles of students with and without LD in a distance-learning university framework.

Learning Styles

Learning style refers to the way students concentrate on, process, internalize, and recall new and difficult information (Rochford, 2003). The term takes into consideration the existence of a range of individual differences in how students prefer to gather and absorb data, and in how they process and organize such data (Felder & Silverman, 1988; Van Zwanenberg, 2000). Further, learning style is considered an inborn characteristic; that is, although this personal trait is affected by experience and the environment, it is fairly stable over time (Dunn & Stevenson, 1997; Matthews, 1994).

According to Vermunt's (1996) theoretical classification, learning styles can be broken down into two categories. *Processing strategies* relate to how students accomplish their studying, and *regulation strategies* refer to what students do to keep studying. Dunn and Dunn (1993) described five main factors that influence an individual's learning style: the environmental situation (e.g., noise level, temperature, light); personal emotional characteristics (e.g., motivation, persistence,

responsibility); sociological preferences for learning (e.g., learning alone vs. learning with peers); physiological characteristics (e.g., motor abilities, focus on visual or auditory stimuli); and global aspects (the overall combination of the previous factors). Others (e.g., Aragon, Johenson, & Shaik, 2002) have suggested that the nature of an individual's learning style depends on his or her motivation, on prior experience with the learning task and consequent behavior, and on cognitive processes such as perception, scanning, reflectivity, and impulsivity. Despite the impact of these factors, it has also been shown that trained tutors are able to teach specific learning strategies that complement students' existing learning styles (Dunn & Stevenson, 1997).

Additional studies have aimed to delineate differences in the learning styles of particular populations of students (e.g., students taking different majors). For example, Matthews (1994) found that students who majored in the humanities tended to exhibit a conceptual learning style, while those who majored in mathematics and the exact sciences tended to exhibit a learning style described as more practical. Gadzella and Masten (1998) compared the learning styles of psychology and special education students with those majoring in sociology, social work, and criminal justice. They found that psychology and special education majors scored significantly higher on the deep processing subscale of the Inventory of Learning Processes (ILP) than the latter group. Similarly, Skogsberg and Clump (2003) evaluated differences between the learning styles of psychology and biology majors, and found that psychology majors scored significantly higher than biology majors on the deep approach subscale, whereas both groups achieved similar scores on the surface approach subscale. It seems that adept learners, who invoke cognitive strategies to make cognitive progress, develop different strategies to monitor this progress (Flavell, 1979) and use these strategies to enhance learning (Brown, Bransford, Ferrara, & Compione, 1983; Paris, 1988).

The development of measures to assess learning styles has been based on comprehensive studies of students' mental models of learning and learning experiences, and have focused on different learning strategies (Vermetten, Lodewijks, & Vermunt, 1999). In recent years, self-regulation strategies have been extensively investigated as a subcomponent of learning style (Boekaerts, 1999; Schunk & Zimmerman, 1998; Zimmerman, 2001). Martin (2004) describes self-regulation as a constructive and self-directed process whereby the student consciously selects particular strategies during the learning process. These strategies can include setting goals, monitoring performance, managing time efficiently, using self-evaluation methods, attributing causation to success or failure, and adapting new methods to use in the future (Zimmerman, 2002).

Another component of learning style is internal and external regulation. Boekaerts (1999) illustrated the distinction between these two types of regulation by describing two groups of students. In the group that uses internal regulation, students specify their own learning goals and do not need instructions or guidelines from others to choose a learning or problem-solving strategy. In contrast, students in the second group, who are more dependent on others to get started or to complete a task, need external regulation to direct their learning. Between these two types there may be mixed forms of regulation, where both students and teachers share regulatory functions.

Several researchers have drawn attention to the disadvantages and risks of too much external regulation (Weinert, Schrader, & Helmke, 1989). They point out that since external regulation is a form of support, students who are not skillful in orienting, planning, monitoring, or evaluating their own performance may rely mainly on the teacher's instructions. Their achievements are likely to decrease when they find themselves in an environment where they have to direct their own learning process. However, it has been suggested that in most cases, matching the tutors' instructions to the students' learning styles increases academic achievement and/or improves attitudes toward learning among all students (Lovelace, 2005).

Self-directed learning is especially relevant to students in distance-learning environments. Although previous research has investigated the learning styles of students in traditional universities, few studies have been conducted on the learning styles of students with LD in higher education frameworks using distance-teaching methods.

Students With Learning Disabilities

A growing number of students with LD are enrolled in universities, and various studies have examined their academic adjustment and the challenges they face. For example, students with LD must adapt to the academic demands of higher education, must learn to deal with their lack of adequate academic skills or appropriate social skills, and must be able to organize their time in order to meet deadlines (Braxton, Milem, & Sullivan, 2000; Cohn, 1998; Jones, Kalivoda, & Higbee, 1997; Parker, 1999; Reiff, Gerber, & Ginsberg, 1992). Greenbaum, Graham, and Scales (1996) found that most students with LD at institutions of higher education were well adjusted academically and socially, but graduated approximately a year later than their nondisabled peers.

Available studies of students with LD have mostly examined their learning strategies (Ruban, McCoach, McGuire, & Reis, 2003); these studies indicate that LD students differ significantly from NLD peers in their use of learning strategies during academic study. For example, it has been found that students with LD prefer oral explanations or visual learning methods, whereas students without LD use more written examples and prefer more written explanations. In addition, students who are aware of their difficulties are able to adopt unique learning strategies (Heiman & Precel, 2003; Vogel & Adelman, 1992). Consistent results pertaining to university and college students with LD revealed that these students are more predisposed to applying a variety of learning strategies, since they require more time and effort and more constant self-regulation to meet their academic demands than students without learning difficulties (Hatzes, 1996). However, the manner in which these students acquire such strategies is influenced by their learning styles (Dunn & Dunn, 1999), and there is no single best learning strategy for all students with LD (Swanson, 1990).

In Israel, students are formally classified as having LD based on comprehensive psychological and educational assessment. The classification of the Ministry of Education (2003) regarding students with LD corresponds to the guidelines for the definition of learning disabilities of the U.S. National Joint Committee on Learning Disabilities (NJCLD, 1998). In Israel, the criteria for LD classification include two main domains: (a) students' lack of success as marked by a discrepancy of at least two years in reaching appropriate academic achievements compared to their same-age peers, and academic deficiencies in one or more learning processes (i.e., reading, writing, mathematical calculation, or mathematical reasoning); and (b) significant discrepancies between students' intellectual abilities and their academic achievements, documented with standardized assessments. At the Open University of Israel (OUI), in order to be classified as having LD, students must provide the university with a recent diagnosis from a psychologist or a psychological center detailing their difficulties.

Distance-Learning Universities

The physical separation between students and teachers in distance education makes it likely that the experience of distance students will be different from that of campus-based students, and may involve a considerable amount of independent study (Rumble, 1989). Open universities worldwide face the challenge of widening educational access to large numbers of individuals from various groups in society (Guri-Rozenblitz, 1991). During their academic studies, students in traditional universities usually hear face-to-face lectures directed at large groups of students. A recent examination of the learning styles of university students enrolled in distance-learning courses (as opposed to face-to-face courses) suggests that students' success (in terms of achievement scores) in both frameworks is similar (Aragon et al., 2002). However, in a distance-education environment, materials are transmitted in both audio and text forms, using various types of presentations, and students are required to utilize more reflective observation (learning by watching and listening) and abstract conceptualization than their peers in face-to-face courses (Aragon et al., 2002).

As far as is known, few studies have examined LD in the context of distance education. A recent study conducted of students at the Open University found, as would be expected, that students with LD used different learning strategies than students without disabilities. The LD students complained of their lack of effective learning strategies, writing problems, attention disorders, and difficulties in managing their time (Heiman & Precel, 2003).

In summary, the present study differs from, and extends, the existing literature on learning styles of distance-university students by investigating the learning style patterns of students with and without LD at a distance-learning university. We hypothesized that students with LD would employ different processing strategies than NLD students, and would have more difficulty monitoring their study process than their NLD peers.

METHOD

Participants

Data were collected from 212 undergraduate OUI students who were pursuing a degree in the social sciences. The study sample was limited to social science students for three reasons: First, because previous studies have shown that students taking different majors have different learning styles (Gadzella & Masten, 1998; Skogsberg & Clump, 2003). Second, the Social Science Department has the largest student body (comprising 68% of OUI students; OUI Report, 2002-2003) and, in particular, the largest proportion of LD students (78% of the students with LD at the OUI study social sciences). Third, classes in the Social Science Department are larger than in those other departments and have a representative gender distribution.

Students were in their first or second year of study in a program typically lasting four years, and were taking courses in various disciplines such as education, psychology, sociology, management, economics, communications, or political science. Most students majored in social sciences only (57%); others also minored in management and economics (21%), education and psychol-

Table 1
Participants' Characteristics

	LD (*N* = 32)		NLD (*N* =180)	
Variables	***n***	**%**	***n***	**%**
Gender				
Men	17	53	65	36
Women	15	47	115	64
GPA				
mean	80.64		80.59	
SD	6.86		5.92	
Credits earned [a]				
mean	49.74		53.35	
SD	34.40		33.13	

Note. LD = students with learning disabilities. NLD = Students without learning disabilities; [a] The minimum number of credits required for graduation at the Open University is 108 (between 18 and 25 courses).

ogy (10%), sociology and political science (8%), and humanities (4%).

The group with LD included 32 students who reported having learning disabilities. These consisted of 17 men and 15 women, aged 18 to 50 years (M = 28, SD = 6.6). The NLD group included 180 students, who served as the control group. This group consisted of 65 men and 115 women, aged 16 to 52 years (M = 29, SD = 7.4).

Students in the LD group had been identified as having dyslexia or dysgraphia prior to the study. Most of them (67%) had taken the complete Wechsler intelligence test, scoring between 95 and 120; others provided partial test scores on verbal IQ, performance IQ, Raven tests, various neuropsychological tests, memory tests, and other specific reading and writing tests. As the privacy of diagnostic documents is protected by Israeli law, specific test scores were unavailable.

No significant statistical differences were noted between the LD and the NLD groups with respect to the proportion of men and women, $\chi^2(1, 211) = .09$, $p > .05$; students' degree of completion of their degrees, measured according to the number of credits accumulated $F(1, 211) = .24$, $p > .05$, or for academic achievement as measured by GPA, $F(1, 211) = .02$, $p > .05$. Table 1 summarizes the characteristics of the two groups of students.

Procedure

Data were collected from students who volunteered to answer the questionnaires. The research assistant introduced herself to the students at the start of the face-to-face tutorial session and asked them to complete a questionnaire. Of 300 students, 260 agreed to complete the questionnaire; of these, we obtained 212 fully completed questionnaires. The size of this sample permitted a comparison of learning style measures across students with and without LD, as well as a comparison of students' demographic characteristics.

To ensure that the sample was representative, the demographic characteristics of the respondents were compared with data collected from OUI's institutional records (Open University Report, 2003). Both groups reflected typical age distributions compared to the general OUI student population (age of overall OUI students, M = 28.7, SD = 7.9; sample students, M = 29.8, SD = 6.8). The proportion of students with LD in the sample (15%) corresponds to the estimated percentage of individuals with learning disabilities in the overall social science university population (18%). In addition, the gender distribution of the sample (58% women and

42% men) corresponds to that of all undergraduates at the OUI (61.8% women and 38.2% men).

Instruments

The Inventory of Learning Styles (ILS; Vermunt, 1996) was developed to measure university and college students' self-reported learning styles (Vermetten, et al., 1999). The instrument is composed of four elements: cognitive processing strategies, metacognitive regulation strategies, mental models of learning, and learning orientations.

For this study, we focused only on two of the ILS domains: cognitive processing strategies and metacognitive regulation strategies. The first domain included 27 items divided into three subscales. Deep processing (11 items; alpha = .87) relates to integrating the subject matter with the individual's existing knowledge into main ideas and conclusions; stepwise processing (11 items; alpha = .90) refers to selecting facts, concepts, and details in order to review the subject matter; and concrete processing (5 items; alpha = .87) deals with relating the course content to one's own experience.

The second domain, metacognitive regulation strategies, included 33 items divided into three subscales. Self-regulation (11 items; alpha = .88) refers to controlling the learning process through planning, monitoring, repairing, evaluating and reflecting; external regulation (11 items; alpha = .85) refers to dependence on external sources in the learning process; and lack of regulation (11 items; alpha = .80) indicates difficulties in monitoring the learning process. All items were scored on a 5-point Likert scale, ranging from *never* (1) to *always* (5). Higher scores represent more use of that category. Previous studies (Severiens, Ten Dam, & VanHout Wolters, 2001; Vermetten et al., 1999; Vermunt, 1996) validated the ILS by examining different samples of students several times at three-month intervals over a period of one year.

Participants also completed a short questionnaire regarding their demographic characteristics, their GPA, number of credits accumulated, and whether they had ever been diagnosed with a learning disability.

RESULTS

Univariate analysis was performed to examine differences between groups (LD vs. NLD) as the independent variable, with total score on ILS measures as dependent measures, using GPA as a covariate variable. Results revealed a significant main effect for group differences, $F(1,211) = 5.04$, $p < .05$; effect size = .22.

Next, a multivariate analysis was performed to examine the relationship between students (LD vs. NLD) as independent variables, and the subscales of ILS, again using GPA, as a covariate variable. The results revealed

Table 2

Means, Standard Deviation, and F Scores of Learning Style Subscales Among Students With and Without LD

Variables	Students With LD (N = 32) Mean (SD)	NLD Students (N = 180) Mean (SD)	F (1,211)	ES
Learning style				
Deep processing [a]	34.53 (7.63)	34.47 (8.57)	.17	.00
Stepwise processing [a]	35.17 (8.73)	31.68 (8.72)	3.94*	.30
Concrete processing [b]	16.9 (4.59)	17.38 (4.32)	1.25	.00
Self- regulation [a]	28.80 (7.89)	24.96 (8.59)	3.04*	.26
External regulation [a]	36.78 (6.07)	38.61 (6.45)	.71	.04
Lack of regulation [c]	18.87 (4.59)	15.82 (4.55)	7.55**	.38

Note. * $p < .05$ ** $p < .01$. Range scores: [a]1-55; [b]1-25; [c]1-30.

Table 3

Correlation of Learning Style Subscales and Academic Achievements by Group: LD and NLD

Variables	Students with LD (n = 32) 1	2	3	4	5	6	NLD Students (n = 180) 1	2	3	4	5	6
1. Deep process												
2. Stepwise processing	.24						.49**					
3. Concrete processing	.49**	.11					.53**	.29**				
4. Self-regulation	.57**	.46*	.40*				.54**	.57**	.33**			
5. External regulation	.57**	.37*	.24	.35			.38**	.44**	.36**	.30**		
6. Lack of regulation	-.25	.14	-.36	-.17	.12		-.06	.06	-.06	-.05	.16*	
7. Academic achievements	.39*	.13	.29	.30*	-.18	-.30*	.22*	.10	.26*	.10	.01	.16

Note. * $p < .05$. ** $p < .001$.

significant differences for groups, $F(1, 209) = 2.25$, $p = .04$, but not for GPA. The follow-up ANOVAs for ILS measures revealed that students with LD preferred to use more stepwise processing (memorizing and drilling) than NLD students. Further, students with LD reported a higher need for self-regulation strategies than did their peers, including controlling their learning process, self-orientation, planning, monitoring, and continuous evaluating of their learning process and effectiveness; they also reported greater lack of regulation, and difficulties with the learning process.

Examining the relationships between cognitive processing strategies (the combined score for deep process, stepwise process and concrete process) and metacognitive regulation strategies (the combined score for self-regulation, external regulation and lack of regulation) yielded significant correlations between these two types of strategies in both groups (for the LD group: $r = .69$, $p < .001$; and for the NLD group: $r = .70$, $p < .001$).

Table 3 details the correlations between the learning style subscales scores and the academic achievement levels of students with LD and without LD. Correlations between the ILS subscales in each group were significant and in the moderate range. These results suggest that NLD students who used higher stepwise processing also reported higher deep processing and greater use of concrete learning processing. NLD students with higher external regulation reported higher levels of concrete processing, self-regulation, and lack of self-regulation than did students with LD.

In addition, this analysis indicates that deep processing strategies and concrete processing are significantly correlated with achievements for the NLD group. For the LD group, achievement scores were positively correlated with deep processing and with self-regulation, but negatively correlated with lack of regulation.

DISCUSSION

The purpose of this study was to examine differences in the learning styles of students with and without LD at a distance-learning university. These differences are discussed below in light of the contribution of these new data, including their limitations and implications for future research.

As hypothesized, the results of this study indicated that the learning styles of students with LD differ significantly from those of students without LD. Specifically, students with LD reported using more stepwise processing and self-regulated learning styles, and claimed to lack regulation to a greater extent than did

NLD students. Previous studies have related stepwise processing to academic skill deficits among LD students, including difficulties with lexical retrieval and phonetic awareness, or having to struggle to read accurately (Allor, Fuchs, & Mathes, 2001). Other studies have shown a relationship between stepwise processing and deficits in math skills (Mercer, Campbell, Miller, Mercer, & Lane, 2000) and in cognitive academic processing (such as managing time, memory, and being organized) throughout students' K-12 learning experience (Miller & Mercer, 1997). It appears that during their university studies, students with LD also need to use stepwise methods for some course content, and they tend to learn in small incremental steps on the way to mastering the academic material.

The greater use and need for self-regulated learning among students with LD, which includes controlling the learning process, self-orientation, planning techniques, self-testing, and continuous evaluation of their learning process and results, may be understood in the context of these students' past learning experiences, and is probably due to their academic difficulties. Thus, students claimed that only through intensive work, repetition, memorization, and other techniques were they able to pass their courses (Heiman & Precel, 2003).

When the learning styles of both groups were examined, an additional difference was found: Students with LD had significantly higher scores on the lack of regulation subscale than students without LD. This self-reported lack of regulation may indicate that students with LD encounter difficulties in monitoring the learning process, which probably stem from their disabilities.

These findings should not be interpreted as a negative assessment of the ability of students with LD to succeed in higher education. We must take into consideration the mixed results in which no differences were observed between the groups for deep processing, concrete processing, and external regulation. The lack of differentiation between groups on the first two subscales, both cognitive processing strategies, may reflect the successful academic adjustment of students with LD at OUI, or may indicate similar abilities among students in both groups. Furthermore, it is encouraging to find that students with LD did not differ from their NLD peers regarding external regulation. This may indicate that students with LD at OUI did not feel dependent on external sources to understand, to make progress in their studies, or to succeed.

As distance education is gaining popularity due to students' desire for flexibility and control of their learning, there is a need to cultivate students' unique competencies, and, during instruction, to take into account their characteristics, including cognitive and metacognitive factors (Dooley, Lindner, & Dooley, 2005). Self-regulation and autonomy may be viewed as part of a unique learning style required when studying at a distance, when students need to be more autonomous, more self-oriented, and more active in monitoring their abilities and behaviors. It is possible that the differences in stepwise processes, self-regulation, and lack of regulation are learning styles unique to distance-learning students. Further research is needed to investigate the different learning styles in other higher education institutions and with a variety of majors.

The results of this study indicated that students with LD do not significantly differ from students without LD in their self-reported academic achievements. The positive correlations between the use of learning styles and achievements, however, may indicate that the use of more deep processing and higher self-regulated learning and/or reduced lack of regulation explain the academic success of students with LD.

Limitations

This study provided valuable information on the differential impact of learning styles of university students with and without LD. However, the findings should be viewed in light of several limitations.

First, the results are limited by the relatively small group of students with LD (n = 32) who volunteered to participate, and whose commonality is an elected major in social sciences. The attempt to explain the academic achievements of students with LD in higher education must take into consideration this limitation. It may be worthwhile to validate the results using a larger sample. Moreover, as the respondents majored in the social sciences, generalizing the results to all students may be inappropriate. Therfore, studies should examine students majoring in different fields.

Second, the students were asked to provide self-reports on their preferred learning styles and their achievement scores. Further studies may verify these findings by supplementing observation instruments to measure students' learning styles across academic contexts.

The third limitation relates to the composition of the LD group, which was a non-homogenous sample that consisted of students with a range of learning difficulties. It is well known that the diagnosis of LD includes various deficiencies (e.g., difficulties in reading, arithmetic, cognitive processing, spatial or visual perception). Therefore, further investigation is necessary to consider the effects of these different deficiencies on learning styles.

Fourth, the findings may be unique to students at OUI, where the particular teaching methods may have affected the students' learning styles. For example, Open University's extensive use of modern communi-

cation techniques for distance learning enables students to choose between distance learning through interactive virtual sessions via the Internet, attending weekly face-to-face tutorial sessions, or a combination of these. For this study, participants were students who attended face-to-face courses. A generalization of the present findings would, therefore, require sampling students who choose different models of academic study (e.g., only interactive sessions). In addition, further research is necessary to compare these findings with those obtained for LD and NLD students at traditional universities.

Implications for Practice

Numerous researchers argue that to be successful, students must develop effective study strategies and methods. Understanding the learning styles used by students with LD can benefit both institutions of higher education and the students themselves. Specifically, universities can develop more tailored learning skills workshops to help students, and can raise instructors' awareness of their students' various learning styles so that they can better plan and structure their teaching. In addition, we assume that examining students' learning styles can serve as a basis for training students to utilize appropriate learning strategies, which can help them to better deal with academic tasks and to reduce stress.

As mentioned in previous studies (Clarke & Lane, 2005; Lovelace, 2005; Matthews, 1994), adjusting instruction to students' learning styles (such as by focusing on stepwise processing, or using reflection during classes), and encouraging students to be aware of their learning styles, can increase the academic achievement of all students. In addition, studies demonstrate the advantages of collaborative learning, in that students who take part in this kind of learning report greater self-awareness of their own learning styles (Hendry et al., 2005). Finally, the present findings encourage further investigation of the learning styles of students with LD and an examination of the various teaching methods and special conditions designed to help them. Moreover, a valid assessment should be developed to assess the specific learning deficiencies of LD students, appropriate to the university setting.

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