

# INTEGRATING TECHNOLOGY INTO MOTHER-TONGUE EDUCATION: EXAMPLES FROM HEBREW

TSILA SHALOM\* & BRACHA NIR-SAGIV\*\*

*\*Levinsky College of Education, Israel & \*\*Tel-Aviv University, Israel*

**Abstract:** This paper describes the current approach to the instruction of Hebrew as a mother-tongue (L1) language based on technological developments and on the relationship between technology and pedagogy. As such, we rely on well-known models of integrating computerized tools and distance learning in the educational system, while emphasizing the potential contribution of these environments to L1 education. At the core of this paper is the combination of linguistic and didactic approaches to L1 teaching that bring together both theoretical and functional aspects of learning and teaching language via a computer.

The focus here is on technologically-based L1 learning environments that combine different types of computerized tools within a comprehensive language-learning/teaching system that is designed for facilitating and improving language skills. This system is cognitively motivated, and is modeled on a combination of elements, such as principles of constructivist, social, and active learning. The structural-conceptual framework of this environment complies with principles of both local and global connectivity and hierarchy. For example, at the local level, learning materials are connected through a hypertext structure; at the global level, the entire system is inter-connected, with assignments linked to dictionaries and relevant websites, and the learners themselves connected through email and forums.

The teaching/learning processes that take place within this L1 environment are illustrated by examples of both online and offline computerized courses.

**Keywords:** L1, technology, computer, development, learning environments, teacher training

**Dutch. Samenvatting.** [Translation Tanja Janssen]

In deze bijdrage wordt een benadering beschreven van het onderwijs in het Hebreeuws als moedertaal (L1), die gebaseerd is op technologische ontwikkelingen en op de relatie tussen technologie en onderwijskunde. We steunen op welbekende modellen voor het integreren van computertools en afstandsleren in het onderwijssysteem, waarbij we de nadruk leggen op de mogelijke bijdrage van deze leeromgevingen aan het moedertaalonderwijs. Centraal in deze bijdrage staat de combinatie van linguïstische en didactische benaderingen van het L1-onderwijs waarin zowel theoretische als functionele aspecten van taal leren en onderwijzen via de computer worden samengebracht.

*Shalom, T., & Nir-Sagiv, B. (2007). Integrating Technology Into Mother-Tongue Education: Examples from Hebrew.*

*L1 – Educational Studies in Language and Literature, 7(2), p. 121-140*

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*Correspondence concerning this article should be directed to Tsila Shalom, 39 Golda Meir St, Yehud, Israel. Electronic mail may be sent to: tsila@macam.ac.il.*

De aandacht is hier gericht op technologisch-gebaseerde L1 leeromgevingen waarin verschillende typen computer tools worden gecombineerd met een veelomvattend taal-leer/onderwijs systeem, ontworpen om taalvaardigheden te ondersteunen en te verbeteren. Dit systeem is cognitief georiënteerd, en gemodelleerd op een combinatie van elementen, zoals principes van constructivistisch, sociaal en actief leren. Het conceptuele kader van deze omgeving berust op principes van zowel lokale als globale connectiviteit en hiërarchie. Op het lokale niveau, bijvoorbeeld, worden leermaterialen met elkaar verbonden door middel van een hypertextstructuur; op het globale niveau is het hele systeem onderling verbonden, met opdrachten die gelinkt zijn aan woordenboeken en aan relevante websites, met leerders die met elkaar contact onderhouden via email en op forums.

De onderwijsleerprocessen die plaatsvinden binnen deze L1 omgeving worden geïllustreerd met voorbeelden van online en offline computercursussen.

**French. Résumé** [Translation Laurence Pasa].

Cet article présente une approche courante de l'enseignement de l'hébreu langue maternelle (L1) basée sur les développements technologiques et sur le lien entre technologie et pédagogie. En tant que tels, nous présentons des modèles connus qui intègrent les outils informatiques et l'enseignement à distance dans le système éducatif, tout en soulignant l'apport potentiel de ces environnements à l'enseignement des langues maternelles. Au cœur de cet article se trouve la combinaison d'approches linguistiques et didactiques qui rassemblent des aspects à la fois théoriques et fonctionnels de l'apprentissage et de l'enseignement du langage écrit par l'intermédiaire d'un ordinateur.

L'accent est mis ici sur des contextes d'enseignement basés sur la technologie qui combinent différents types d'outils informatiques au sein d'un système d'enseignement/apprentissage cohérent, conçu pour faciliter et améliorer des compétences linguistiques. Ce système est motivé cognitivement, il repose sur une combinaison d'éléments, tels que les principes constructivistes, l'apprentissage social et l'apprentissage actif. Le cadre structuro-conceptuel de cet environnement est conforme aux principes de connectivité locale et globale et de hiérarchie. Par exemple, au niveau local, les supports d'apprentissage sont reliés par une structure d'hypertexte ; au niveau global, l'ensemble du système est inter-connecté, on y trouve des tâches reliées à des dictionnaires et à des sites Web appropriés, et les étudiants eux-mêmes sont en liaison par email et sur des forums.

Les processus d'enseignement/apprentissage qui ont lieu dans cet environnement sont illustrés par des exemples de cours informatisés en ligne et en différé.

**Mots-clés:** L1, technologie, ordinateur, développement, environnements d'apprentissage, formation des enseignants

**German. Zusammenfassung.** [Translation Irene Pieper]

Moderne Technologien im muttersprachlichen Unterricht: Beispiele aus dem Hebräischen  
Der Beitrag thematisiert einen gegenwärtigen Zugang im Unterricht des Hebräischen als Erstsprache, der auf technologischen Entwicklungen und dem Verhältnis zwischen Technologie und Pädagogik basiert. Wir nutzen bekannte Modelle der Integration von computerbasierten Werkzeugen und Fernstudien im Bildungsbereich. Unser Interesse gilt dem besonderen Potenzial dieser Lernumgebungen für den Unterricht in der Erstsprache. Im Zentrum des Beitrags steht die Kombination von linguistischen und didaktischen Ansätzen im Erstsprachunterricht, die theoretische und funktionale Aspekte des Lernens und Unterrichtens durch den Computer verbinden.

Den Fokus bilden technologie-basierte Erstsprachlernumgebungen, die verschiedene Typen von EDV-Werkzeugen innerhalb eines Sprachlern- und Sprachunterrichtssystems kombinieren, das dem Erwerb und dem Ausbau von Sprachfähigkeiten dient. Dieses System ist kognitiv motiviert und basiert auf einer Kombination von Prinzipien konstruktiven, sozialen und aktiven Lernens. Der strukturell-konzeptionelle Rahmen dieser Umgebung schließt Prinzipien von lokaler und globaler Konnektivität und Hierarchisierung ein. So sind Lernmaterialien auf der lokalen Ebene durch eine Hypertext-Struktur verbunden; auf der globalen Ebene ist das gesamte System vernetzt: die Aufgaben sind mit Wörterbüchern und weiterführenden Seiten verlinkt und die Lernenden selbst durch Email und Foren miteinander verbunden.

Die Lehr-/Lernprozesse, die in diesen L1-Umgebungen stattfinden, werden durch Beispiele aus online- und offline Programmen illustriert.

**Portuguese. Resumo.** [Translation Paulo Feytor Pinto].

Neste texto é descrita a actual abordagem do ensino do hebraico como língua materna (L1) baseada em desenvolvimentos tecnológicos e na relação entre tecnologia e pedagogia. Neste contexto, apoiamos-nos

em modelos conhecidos de integração de ferramentas computadorizadas e de ensino a distância no sistema educativo, destacando as potencialidades destes ambientes para o ensino da L1. No cerne deste texto está a combinação de abordagens linguísticas e pedagógicas de ensino da L1 que reúnem aspectos teóricos e funcionais do ensino e aprendizagem de línguas assistido por computador.

O nosso enfoque incide sobre ambientes tecnológicos de aprendizagem da L1 que combinam diferentes tipos de ferramentas computadorizadas no quadro de um sistema abrangente de ensino e aprendizagem que visa facilitar e promover as competências linguísticas. Este sistema é cognitivamente motivado e baseia-se numa combinação de elementos tais como os princípios construtivista, social e activo do ensino e aprendizagem. O quadro estrutural e conceptual deste ambiente obedece a princípios tanto locais como globais de conectividade e hierarquia. Por exemplo, ao nível local, os materiais de aprendizagem estão ligados através de uma estrutura hipertextual; ao nível global, todo o sistema está interligado, com tarefas ligadas a dicionários e sítios relevantes e com os próprios alunos ligados entre si através do correio electrónico e dos fóruns.

Os processos de ensino e aprendizagem que têm lugar neste ambiente de L1 são ilustrados com exemplos de cursos computadorizados, disponíveis ou não em linha.

**Palavras-chave:** língua materna, computador, desenvolvimento, ambientes de aprendizagem, formação de professores.

**Polish. Streszczenie** [translation Elzbieta Awramiuk]

Niniejszy artykuł opisuje aktualne podejście do nauczania języka hebrajskiego jako języka ojczystego (L1), bazujące na osiągnięciach technologicznych i relacji między technologią a pedagogiką. Opieramy się na dobrze znanych modelach włączenia narzędzi komputerowych i nauczania na odległość do systemu edukacyjnego, podkreślając potencjalny udział tych środowisk w nauczaniu L1. W centrum naszego zainteresowania znajduje się powiązanie lingwistycznej i dydaktycznej perspektywy nauczania L1, które pozwala łączyć teoretyczne i funkcjonalne aspekty uczenia się i nauczania języka za pośrednictwem komputera.

Koncentrujemy się na tych uwarunkowanych technologicznie środowiskach uczenia się L1, które łączą różne typy narzędzi komputerowych w obrębie takiego powszechnego systemu uczenia się / nauczania języka, który jest projektowany dla ułatwienia nauki języka i poprawienia umiejętności językowych. System ten jest kognitywnie motywowany i wzorowany na kombinacji takich elementów jak zasady konstruktywistycznego, społecznie uwarunkowanego i aktywnego uczenia się. Strukturalno-koncepcyjna rama dla tego środowiska stosuje się do zasad lokalnej i globalnej zdolności przyłączeniowej i hierarchii. Przykładowo, na poziomie lokalnym, materiały dydaktyczne są połączone poprzez strukturę hipertextu; na poziomie globalnym cały system jest wewnętrznie połączony, wraz z zadaniami odsyłającymi do słowników i odpowiednich stron internetowych, ponadto osoby uczące się łączą się między sobą za pośrednictwem e-maili oraz forów.

Procesy uczenia się i nauczania, które mają miejsce w wymienionych środowiskach L1, są zilustrowane przykładami skomputeryzowanych kursów online (podłączonych do sieci) i offline (autonomicznych).

**Słowa-klucze:** L1, technologia, komputer, rozwój, środowisko uczenia się, kształcenie nauczycieli

## 1. INTRODUCTION

Technological developments in the post-modern age have led to major changes in education in general, opening new vistas in the instruction of various subject matters. The rate of technological innovation requires rapid changes in teaching purposes and techniques, and provides new tools for individual scientific inquiry and learning. Throughout the world, educators and school administrators are developing and implementing new curricula that reflect the growing importance of technology in present-day education by using computerized tools, such as the electronic worksheet, updated computerized databases, dictionaries, e-mail, Internet websites, computerized presentations, and live media. These changes have brought forth new kinds of learning and instruction experiences: The practice of meaning-making,

learner-controlled, interactive distance teaching and learning, and in-depth investigative learning through research of specific topics. Thus, greater emphasis is put on the integration of computerized tools within the teaching practices of various disciplines, ranging from the exact and natural sciences, sociology and civics, to literature, literacy, and languages. Specifically, language education has greatly benefited from such technological advances; although, to date, the main focus of attention has been given to second language learning (cf. Levy, 1997; Beatty, 2003). Set against this background, the purpose of this paper is to describe the current approach to the instruction of Hebrew as a mother-tongue (L1) language. This approach places the emphasis on a scientifically-oriented teaching/learning of Hebrew – that is, learning *about* Hebrew and not learning the rules of the language itself, as these are assumed to have already been acquired.

Specifically, the focus of this paper is the combination of *linguistic* and *didactic* approaches to L1 education<sup>1</sup>, that is, relating to both theoretical and functional aspects of computerized language learning/teaching – with special attention to teaching Hebrew in the Israeli educational system. These aspects are considered within the context of a model that combines different types of computerized tools in a comprehensive language learning system, and, as such, takes advantage of current technological developments and of the relationship between technology and pedagogy.

## 2. CHANGES IN APPROACHES TO TEACHING HEBREW

This section aims to demonstrate how changes in approaches to teaching Hebrew promote the integration of computerized tools within current learning environments. Nowadays, teaching strategies and learning processes are directed towards novel, constructivist teaching/learning principles. These are very different from traditional learning environments when considering the task of the teacher, the role of the student, and the function of the curriculum.

In the traditional approach to instruction, learning takes place as teachers “pour” knowledge into the minds of their students, while students remain passive; the main source of knowledge, thus, is the teacher (Braun, 1993; Brown, 1992; Strauss & Shiloni, 1995; Weber & Mitchel, 1996), the main learning technique is drill and practice, and the dominant tools for instruction are books, notebooks, and computer courseware. In contrast, novel approaches to education require meaningful learning to be based on the learner’s active experience and collaboration with other people (peers, teachers, experts, etc.) as well as with technological resources and databases. Learning is considered a process of problem solving, in which the student gathers information and actively constructs his own knowledge (Prawat & Folden, 1994; Scardamalia & Bereiter, 1991) while using “...computer-based tools and learning environments that have been adapted or developed to function as intellectual partners with the learner in order to engage and facilitate critical thinking and higher order learning” (Jonassen, 2000: 9). These tools may include electronic dictionaries and databases, spreadsheets, computerized presentations, expert systems, mi-

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<sup>1</sup> As such, the remainder of the paper relates to the *linguistic* dimension of language learning, and not to literary or cultural dimensions, such as reading comprehension, creative writing, or book reports.

crowds, Internet web sites, search engines, navigation software, visualization tools, and multimedia publishing tools, as well as communication tools, such as e-mail, discussion forums, and chat systems. Integrating these tools into the learning environment enables the student to become a responsible partner in the authentic learning situation, while the teacher serves as a helpful guide, alert to the student's needs, and ready to support and suggest learning alternatives when needed. Thus, technology-based learning environments foster changes in thinking processes both for teachers and for students, giving way to new modes of teaching and of learning. Educators are considered as *facilitators* or *mediators*, not only transmitting information but also constructing knowledge (Solomon, 2000); learners, on their part, experience differential learning, while, at the same time, share greater responsibility and are allowed greater personal choice.

Hand in hand with these advances have come changes that affect the field of *mother-tongue education*. Teaching Hebrew in early 20<sup>th</sup>-century-Israel was considered a part of the Zionist cause of establishing a social and national entity. "The language of the Bible" was a link that accentuated the inseparability of Hebrew-speakers from their "Promised Land" (Nir, 1999). What is termed here *the functional approach to teaching Hebrew* was perceived as oriented towards the assimilation of speaking and writing. In contrast, social, political and economical factors in the 1980's influenced the formulation of a new approach to language learning. This approach enabled researchers and practitioners to take on new linguistic perspectives that no longer posed a threat to the historical connection between the Jewish people and the land of Israel, while turning to more scientific and academic practices. As such, *the scientific/investigative approach to teaching Hebrew* emphasizes the explanation of linguistic phenomena rather than rote learning of linguistic rules, specifically aiming to raise students' awareness to language by leading them to generalizations rather than supplying them with lists of linguistic rules to be memorized (Shalom, 1999).

The basic tenets of the scientific approach comply with changes that took place in modern linguistics: Originally, modern linguistics emphasizes the natural oral skills of speakers, while focusing on grammar (morphology and syntax), semantics, and the lexicon (Chomsky, 1965). However, since then, various new fields have evolved, namely psycholinguistics, sociolinguistics, pragmatics, and cognitive linguistics (Langacker, 1991). These focus on processes of linguistic comprehension and awareness, and not only on linguistic production/execution. For example, children as young as two to three years of age were found to produce linguistic forms and patterns that serve specific functions, thus implying linguistic awareness of the features of their mother tongue (Berman, 1995) as well as sociolinguistic competence (Canale & Swain, 1980). The consequences of these concepts have greatly influenced L1 teaching, whereby children are not taught their mother-tongue but *about* their mother-tongue, with the specific aim of pushing forward and facilitating literacy (Nir, 1998).

These changes in theory and practice seem to us to serve as natural circumstances for the integration of technology into mother-tongue education. Importantly, it is the move from conceptualizing Hebrew as a tool that serves historical causes (i.e., Zionism) to Hebrew as the mother-tongue of an independent country that cre-

ated the opportunity to accept technological advances in language teaching. Moreover, in our world of rapid technological advancement, children are exposed at a very early age not only to spoken language but also to written modalities in the form of “computer” language. Recognizing the existence of such knowledge must have an impact on learning processes and teaching strategies. Moreover, following the scientific/investigative approach, language learning must conform to the social reality of a greater demand for *advanced academic knowledge*, that is, teaching the Hebrew language in high school as preparation for higher education in Israeli universities (Rabin, 1967; Mioduser et al., 2002). In this social reality, the importance of daily connection to the “real world” is emphasized. The integration of this new understanding of L1 processes with advanced technological knowledge creates new opportunities for language learning and teaching (Shalom & Avinun, 1999).

This is evident from the new curriculum for teaching Hebrew:

The subject matter of ‘Hebrew’ touches upon other domains... **Computerized Communication** (E-learning) – email and chat conferences and their application in education; **Word Processing** – using technology for re-writing and formatting texts; extracting information from **visual/graphic** texts (caricatures, charts, maps, tables etc.). All of the above – although not forming an organic part of teaching Language – interact with this subject matter and are integrated in literate activities. These domains... should be extensively integrated within learning, even though they do not form part of the curriculum itself (New Curriculum for Teaching Hebrew, 2003).

The present work explores new possibilities that are presented in the framework of teaching/learning Hebrew as a mother-tongue language, through the integration of the scientific/investigative approach and available computerized tools, thus suggesting a path for combining such theory with practice.

### 3. MODELING L1 TEACHING / LEARNING: INTEGRATING TECHNOLOGY WITHIN THE SCIENTIFIC/INVESTIGATIVE APPROACH

To date, teaching Hebrew as L1 has benefited to some extent from the integration of technological tools, such as online discussion forums and chats (Margalit & Zabar, 2004) as well as other e-learning activities (Bar-Natan & Herz-Lazarovich, 2004). However, these are all activities that are confined to improving a specific language skill. Below, we describe a model that combines different types of computerized tools within a comprehensive language learning/teaching environment that aims to facilitate and improve various language skills not in isolation, but as part of an interconnected system. This model is cognitively motivated, integrating elements that are fundamental in our opinion to computerized L1 learning environments: A conceptual framework of connectivity and hierarchy, with hypertext as the structural basis, combined with the use of Mindtools, thus complying with principles of constructive, social, and active learning that serve as the natural framework for research activities as part of the learning process.

One of the major themes currently advocated both by researchers and practitioners in the field of education is the notion of *constructivist learning* (Bruner, 1986, 1990; Jonassen, 1991). A constructivist approach considers learning as an active

process in which learners are seen as responsible participants rather than passive responders in the construction of meaning, that is, learning, while engaged in mental activity. This process is not only based on received information but also on mental schemas of information organization as well as contextual factors. A learning environment should expose learners to structured knowledge and to contextualised materials, so as to facilitate the construction of meaning on the basis of information. At the core of the learning environment of Hebrew as L1 described below is the notion of on-line connectivity, or hypertextuality, as a feature that allows for a learner-oriented (and not only subject-oriented) organization of instruction materials, while taking into account the cognitive structures and processes at work.

A hypertext is a complex, multi-linked structure. All components of a hypertext are interrelated – both affecting and being affected by each other (Berner-Lee & Fischetti, 1999). When considered from a teaching/learning perspective, a key theme of hypertextuality is the transition from linearity to an inter-linked, hierarchical structure. Linearity entails step-by-step learning, with books, tasks and teachers all conforming to the notion of learning as a less active, more pre-structured process. Teaching, thus, traditionally begins with the presentation of new material, moving on to task completion, and finally to examination as the main tool for product evaluation – with the teacher expanding on previous materials and supplying additional knowledge throughout the instruction process. In contrast, inter-linked hierarchical learning relates to learners' ability to simultaneously access all sources, at all different levels, while actively participating in the instruction process and choosing their own path for learning.

Several authors have suggested that hypertext reflects mental maps, representing the organization of knowledge within cognition (Johassen, 1992; Eklund, 1995). Learning a new topic can be comparable to entering the first level of a hypertext. Gradually, as we learn, we gain new knowledge, we acquire new structures and restructure the old – we add new “links” to our expanding repository, as our knowledge becomes a network of interrelated concepts (Eklund & Woo, 1998), within which the learner can advance according to his own personal preferences. Organizing knowledge in hypertext on the basis of a mental or conceptual map thus conforms to models of the internal structuring of cognition (Eklund & Zeiliger, 1996). In the hypertextually-structured learning environment presented below, each and every topic is linked to every possible part in the system both internally (to other sections and/or topics within the system) and externally (to sources of written knowledge as well as to human support such as supervisors, peers, or experts), thus reflecting the students' thinking processes as they gather and analyze information about their mother tongue from various sources.

The notions of linear versus hierarchical cognitive structures have been shown to be relevant to school-age language development through the application of discourse analysis methods. Different types of texts (i.e. personal experience narratives versus expository discussion) were found to contain linear, local links as well as hierarchical or more global structures. Expository texts, for example, have been defined in terms of introductory “core” propositions or “move-on” statements which are elaborated by illustrative or delimiting “satellite” discourse elements (Britton, 1994; Matthiessen & Thompson, 1988). The hierarchical organization of such texts (as well as

other genres) was shown to develop as a function of age, moving from a minimally linear text to a fully proficient piece of discourse, that conforms to a cognitive representation shared by speaker-writers of the same cultural community (Berman & Nir-Sagiv, 2007). Introducing students both implicitly and explicitly to learning materials that are organized according to cognitively inherent structures – for example, discursive schemas – should contribute significantly to the effectiveness of instruction and learning.

In essence, any technologically-based learning environment concerns itself first and foremost with the individual learner and his/her personal computer. However, one of the main foci of current approaches to learning is concerned with social interaction. Learning in a social context allows students to encounter alternative teaching strategies, while relying on available context; it facilitates higher levels of learning, through the free interaction of learners with other entities in their world, such as peers, teachers, and parents; and it reinforces construction of knowledge through readily available guidance, encouragement, and mentorship (cf. Meskil & Rangelova, 2000). Similar notions also form the basis for what is termed Activity Theory, which considers social factors and environmental interaction as crucial to the process of learning (Jonassen & Rohrer-Murphy, 1999; Morrison, 2003), although a greater emphasis is put on the impact of external processes on the learner's mind. A key notion of Activity Theory is that of *tools* or *artifacts* (cf. Luria, 1981) used to mediate between the active learner and the environment. Thus, the learner engages in an activity while trying *to solve a problem* or *achieve a certain goal*; this activity is mediated by tools (ranging from physical artifacts to language itself) while collaborating with others (Engeström, 1987). When embedded in a computerized environment, active learning can be facilitated through the use of Mindtools: Mindtools are described in the literature as a way of using a computer application program to engage learners in constructive, higher-order, critical thinking about the subjects they are studying" (Jonassen, 1996: 3). Mindtools are therefore computer-based tools which serve as cognitive amplification or extensions of the mind. They are specifically designed for facilitating the construction of knowledge within learners' minds, while engaging them in active, creative, and reflective processes. Electronic worksheets, updated computerized databases and dictionaries, e-mail, Internet websites, computerized presentations, and live media videos are all examples of Mindtools (Jonassen & Carr, 1999).

The examples below illustrate how, in the framework of the teaching/learning environment presented here, students are guided towards learning about their mother-tongue through completing various assignments that rely on constructive, social, and active learning. Moreover, not only can the effectiveness of these assignments be reinforced by the use of Mindtools, but they in themselves function as mediating tools that motivate the students to participate in active work while collecting and constructing knowledge about their language.



4. TEACHING/LEARNING HEBREW IN A COMPREHENSIVE COMPUTERIZED ENVIRONMENT

The following examples show how the computerized environment presented below can bridge across the natural, authentic linguistic knowledge of a Hebrew L1 speaker and the principles of the new curriculum for teaching Hebrew.

The examples in this paper are based on the first author's experience in developing computerized teaching/learning L1 materials in Israel at the Levinsky Teacher's College and at the Center for Educational Technology (CET). In order to illustrate the range of possibilities for implementing technology in learning environments of Hebrew as L1, the materials include both two *online* distant-learning courses – a preparatory course for high-school students taking the matriculation exam in Hebrew, focusing on morphology, syntax, reading comprehension and writing and a basic course for students at the teachers' college – as well as open, *offline* tools that are applicable to teaching basic language concepts; for example, the structuring of words in Hebrew, in any learning environment (including the classroom). These examples reflect the emphasis on linguistic rather than social, literary or cultural dimensions in current practices of teaching Hebrew as L1.

4.1 Distance teaching and learning

The computerized, Internet-based environments used for distance teaching/learning of Hebrew presented in this paper were conceptualized with the specific aim of promoting high-school preparation for the matriculation exam in Hebrew, and the L1 teaching program at the Levinsky College of Education. The basic principle governing these environments is the existence of a connection between the topics and skills learned by the students, the computerized tools they use in the process of learning, and the applications available for communication, as shown in Figure 1.

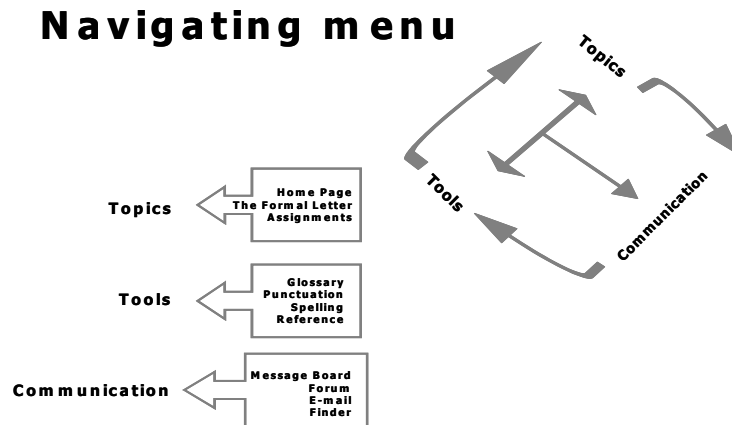


Figure 1. Connectivity Within an L1 Learning Environment.

Figure (1) illustrates how all study topics are not only internally linked but also externally connected to the system's resource center, as well as to external sources of

information and assessment (supervisor, peers, experts) via communication applications such as email, chat conferences and discussion forums, and a specialized message board. In addition, a unique tool was developed for the use of both students and teachers – the FINDER, an acronym for *Fun, Information, News, DirEction*, and *Reality*. This tool invites students and teachers to find examples from their own linguistic reality, such as commercials, jokes, and newspaper headlines, and relate them to current study topics, as a basic principle of L1 learning.

The first example of electronic learning of Hebrew as L1 is an active CET course intended for high school students preparing for the matriculation examination in Hebrew. The course is part of the CET's HighLearn distance learning environment, as illustrated by figure 2.

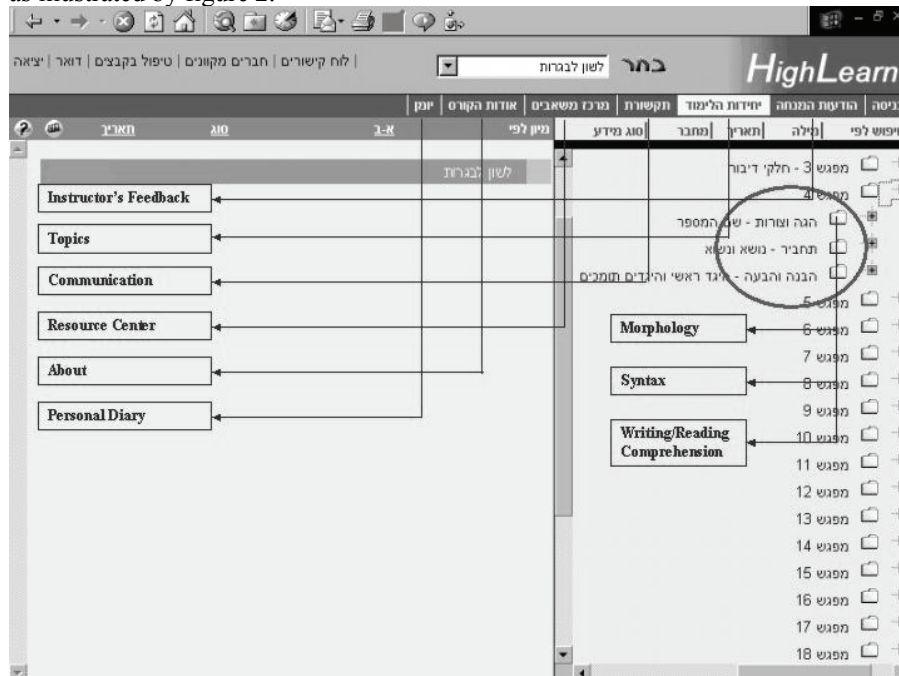


Figure 2. HighLearn Course for Studying Hebrew as L1.

The screen captured in (2) demonstrates the learning process applied in the CET Hebrew matriculation course. At the upper right hand side of the screen, a taskbar is available for use with links to *Instructor's Feedback*, *Topics*, *Communication*, *Resource Center* (Toolbox), *About*, and *Personal Diary*. Whenever learners enter the system, they can choose where to begin – either turning to one of the twenty-three modular sessions available under Topics, posting a message in the discussion forum or message board under Communication, or reviewing their instructor's suggested work plan or feedback (depending on their progress in the course). Under Topics, the different units appear in a hierarchical tree structure, with each unit divided into three chapters, each covering a specific topic in one of the three major linguistic

domains required for the matriculation exam – the more theoretical subjects of morphology and syntax, and the more functional domains of writing and reading comprehension. This hierarchical tree structure enables students to actively participate in the instruction process by choosing their own path for learning. For example, a student can choose to cover all available lessons on the topic of syntax before moving on to study morphology, and vice versa. This tree structure is embedded within the multi-linked, hypertext character of the whole system, which enables students to simultaneously access the different resources at different levels. Thus, at any given point, students can access the linguistically-oriented Mindtools at the resource center which include computerized glossaries and dictionaries, automated spelling and punctuation applications, as well as reference tools (link to language sites) and academic tools of writing -- as these are always available on the computer screen.

Unlike linear L1 teaching practiced to date, this course takes full advantage of hypertext characteristics, by simultaneously separating and linking four levels of instruction – learning a new topic, experimenting with the topic, practicing with exercises and assignments, and testing acquired knowledge, as illustrated in Figure 3.

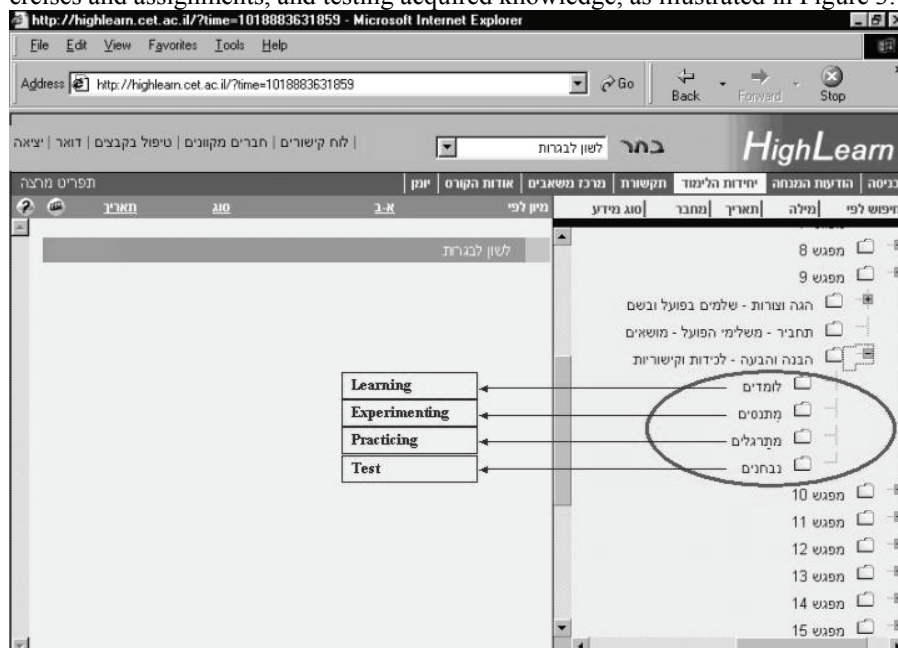


Figure 3. Hierarchy and Hypertextuality in L1 Learning.

Thus, the process of learning each new topic requires the students to enter the first level of hypertext, and then allows them to gain new knowledge that can be integrated within a network of interrelated concepts (Eklund & Woo, 1998). For example, when learning about Modern Hebrew morphology and syntax, or when learning how to write or summarize a text, each topic is first introduced and generalized. This is in line with the fundamental didactic principles of L1 teaching that emphasize

explanation of linguistic phenomena rather than rote learning -- as reflected by the structural organization of materials and activities in the course. Consider, for example, the use of animated PowerPoint presentations, as illustrated in Figure 4.



Figure 4. An Example Screen: A Presentation on Word Formation in Modern Hebrew.

Here, the rules of word formation in Hebrew (linear derivation, discontinuous derivation, and borrowing) are didactically presented, explained, and exemplified. This stage is followed by initial experimentation, where learners are actively implementing the material they have just learned. Experimentation takes place in the form of an interactive lesson that allows the learners to actively “come to their own conclusions” regarding materials they encounter, building on and adding to the formal linguistic explanation that was previously supplied. In this stage of instruction, the learners can “play” with words by creating them, and then receive immediate computerized feedback. Feedback is also part of the learning process, as it includes specific explanations for each linguistic phenomenon instead of simply accepting or rejecting the answer.

The next stage – Practicing – includes active exercises that are typically used in computerized environments, such as answering multiple-choice questions, selecting answers from a drop-down menu, manually typing answers, highlighting correct answers, and so forth. At this stage, learners are engaged in social learning through interacting with other entities in the L1 cyberspace – sharing knowledge and receiving constant feedback from their teachers, peers, and from the computer itself. This

interaction can reinforce the linguistic knowledge that was previously constructed through guidance, encouragement, and mentorship. Finally, the learners test their own knowledge by taking a computerized test, and are thus able to assess their level of proficiency as compared to what they would have to accomplish in the matriculation exam.

As noted, the computerized learning environment allows the users to have continuous access to a variety of tools and resources that support and contextualize the learning process. For example, when practicing how to write a formal letter, each explanation is linked to integrated examples, such as 'Thank you' letters, letters of complaint and letters of recommendation, as well as to relevant Internet websites containing authentic writing, and bibliographic references. Learners can also share their writing with the rest of the course community and receive feedback from their peers and teachers. Importantly, they can also access the resource center that includes Mindtools such as computerized dictionaries and glossaries as well as rules for punctuation and for spelling.

In conclusion, the computerized environment for L1 instruction is adapted to individual learning in the sense that each student can choose his or her preferred way of engaging in the learning process: Either a bottom-up, structured process moving from explanation to tests, or a top-down process that allows for global assessment of the learner's knowledge (as expressed by the results of the test), followed by explanations, exercises, or experimentation. This L1 learning environment is thus uniquely designed to not only promote constructive and social processes, but also individual, cognitively motivated learning.

#### 4.2 *Learning Basic concepts in linguistics using computerized tools*

As noted, the main principle underlying the scientific approach to learning Hebrew as L1 is teaching native speakers *about* their mother-tongue. One of the most basic and accessible linguistic concepts learned in the framework of language courses is the topic of parts of speech (PoS).

In Hebrew lessons based on the traditional approach, the semantic, morphological and syntactic features of parts of speech (nouns, verbs, adjectives, adverbs, prepositions, etc.) are taught as separate subjects, lacking a contextual framework – usually as a prelude to more central topics such as syntax (Shalom & Avinun, 1999). In contrast, the scientific approach, which emphasizes the explanation of linguistic phenomena, considers parts of speech as inseparably integrated within the context of the major features found in a *text*. These include the relative proportion of different types of parts of speech used in producing written discourse, the variety of PoS within a text, the characteristic distribution and level of linguistic usage of PoS across different types of texts, as well as their different functions in the text. These features correspond to the linguistically anchored concepts of lexical density (proportion of content words as compared to function words) and lexical diversity (e.g., type-token ratio), nominal and verbal characteristics of texts, linguistic register, maintaining coherence and cohesion, and reflecting discourse stance. Linguistically-motivated comparisons of such features across different text-types reveal parts of

speech to be highly diagnostic of developing literacy. A series of independent examinations of expository versus narrative texts produced in Hebrew indicate, for example, that expository texts are lexically denser – that is, they contain a higher proportion of content words (nouns, verbs, adjectives) as compared to narratives; they are more nominal in character, as they typically contain more nouns (Ravid, 2004) – and thus represent a more topic-oriented discourse stance (Berman & Katzenberger, 2004); and they also reflect a higher level of linguistic register (Nir-Sagiv, Shternau, Berman & Ravid, in press). As demonstrated below, such usage-based patterns are ideal candidates for examination through using open, offline computerized tools.

The lesson described here focuses on a specific group of PoS termed “function words” (prepositions, conjunctions, auxiliaries, pronouns, etc.). A total of 15 texts of different genres containing 2,397 words were examined during the lesson, with students first taught to identify types of words in the texts, then to distinguish their functions, and finally to recognize differences in levels of linguistic usage (register). The lesson then turned to the concept of PoS type-token ratio, as learners examined the number of PoS tokens in spoken and written texts while comparing them to their types in the dictionary.

The learning process can be divided into the following stages:

- Making predictions (hypothesizing) with regard to the expected proportion of function words in the dictionary;
- Discovering the actual numbers or real data by using a computerized dictionary and constructing a computerized presentation;
- Comparing between predictions and information from the dictionary;
- Making predictions (hypothesizing) with regard to the proportion of function words in real Hebrew texts;
- Analyzing different texts in terms of function words and examining the collected information;
- Entering individual and group data into a shared spreadsheet;
- Processing data in Excel;
- Graphically presenting information in the classroom;
- Discussion, comparing predictions and actual findings, and reporting to the study group;
- Presenting the scientific process and conclusions.

Students were first asked to investigate the distribution of function words in the written modality. In order to facilitate the process of learning while engaging in active, creative, and reflective processes, the students used computer-based tools. Specifically, they explored the topic using electronic spreadsheets and the Rav-Milim computerized dictionary (Choueka & Neeman, 1997). As noted by Jonassen and Carr (1999), spreadsheets are flexible Mindtools for representing (through charts and graphs), reflecting on, and speculating with quantitative information, and they encourage analyzing skills such as recognizing patterns, classifying, identifying assumptions, comparing and contrasting, logical thinking, and deductive reasoning. The students’ preliminary assumption was that more function words would appear in a text as compared to a dictionary. The texts chosen for investigation were an ency-

yclopedia entry on “Humor” and an authentic “Letter to the Editor” taken from a teenage newspaper in Hebrew. All texts were loaded into the computers, and students were instructed to find the total number of words in the texts using the “word count” feature available in the Microsoft Word™ word processor. At this point, the unique structure of Hebrew morphology had to be considered, since many of the Hebrew function words – for example, the conjunctions *ve-* ‘and’, *še-* ‘that’, and *kše-* ‘when’, the prepositions *le-* ‘to’, and *be-* ‘in’, and the definite article *ha-* ‘the’ – are adjoined to the content word they precede. Thus, the English phrase in the house contains three words whereas the parallel expression in Hebrew *babayit* is traditionally counted as one word. However, for current purposes, the number of adjoined function words was added to the total number of words. Results were as follows:

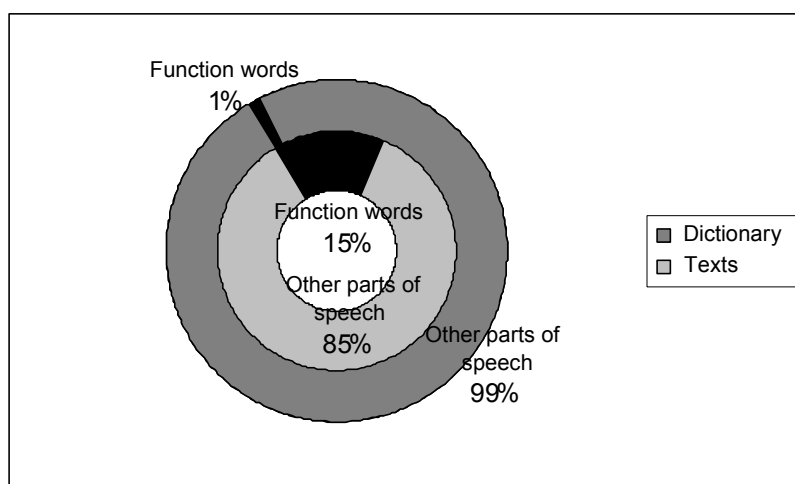


Figure 5: Type-Token Ratio of Function Words as Compared to Other Parts of Speech, in Texts as Compared to a Dictionary

The clear, graphic representation of the students’ computerized investigations was a powerful stimulus that encouraged a class discussion about the clear differences between types and tokens of parts of speech in the students’ native language. The students raised questions about the reasons for this linguistic phenomenon, and were encouraged to find an answer by linking the results of the investigation back to the context of the texts. The students concluded that although function words as a linguistic type or class are a small group, they are widely used as a basis for syntax and discourse in both written and spoken modalities. It should be noted that until such an investigative computerized methodology was applied, this type of discussion was not part of the teaching/learning process of the topic of Parts of Speech. This subject was typically limited to either a separate discussion of each PoS or of a single text (such as a story or an encyclopedia entry).

An additional lesson, based on a similar quantitative investigation, focused on content words (nouns, verbs, adjectives) – where students explored the occurrence of different Parts of Speech in different *genres* (a short story, a personal letter, an informative text, etc.). The purpose of this activity was to promote linguistic awareness by analyzing linguistic structures in different types of texts. The class was divided into groups, and each group chose three texts from one genre. Each group then hypothesized with regard to the number of content word to be found in the genre they investigated. Each group categorized the words in the texts according to the different groups of content words – nouns, verbs, and adjectives. The percentage of each PoS was calculated out of the total number of words in the texts. The data for each genre were inserted into an electronic worksheet, and then graphically represented. Following this presentation, a class discussion was held on the linguistic generalizations for and distinctive characteristics of each genre. In the informative text, nouns were found to have a higher type-token ratio (TTR) as compared to the average TTR in the other texts, in line with findings from prior linguistic investigations pointing to the nominal character of expository texts (Ravid, 2004). As to short stories, these were found to demonstrate a higher type-token ratio of verbs when compared to other texts, in line with previous findings on the event-based nature of narrative texts (Berman & Slobin, 1994).

In sum, the principles governing the learning environment used for teaching the topic of Parts of Speech exposed learners to both structured knowledge and contextualised materials, and encouraged them to act as responsible participants or “investigators” rather than passive responders, while focusing on cognitive processes of reasoning, hypothesizing, and explanation.

## 5. CONCLUSION

Technology and pedagogy are becoming more and more intertwined. Moreover, in light of the constant technological advances in the field of education, learning environments should increasingly be able to reflect this process. The present paper described computerized environments for the instruction of Hebrew as L1 that comply with advanced approaches to learning in general and to language teaching/learning in particular. In order to enhance meaningful learning for students with different purposes and of different levels, these environments were designed based on notions of maximized connectivity, on the one hand, and optimal variety, on the other. Thus, the computerized Hebrew courses illustrated above can be taken in preparation for the matriculation exam, as part of regular schoolwork, or for assisting individual learning. Additionally, the environments themselves offer many learning alternatives, such that students are responsible for their own learning: In completing a task, they are both guided and free to choose their path (either linear or complex and associatively linked), their learning style (using internal, given information or exploring within and/or outside the L1 environment), the type of help they need (digital or human), the amount of collaborative and/or individual work, and so on, so that various language skills are facilitated and improved not in isolation, but as part of an inter-connected system.



These characteristics go hand in hand with investigative-scientific teaching/learning processes that require high-order thinking skills, that have neither time nor place limitations, and that allow for multiple levels of knowledge construction and assessment. This is in line with the current educational approach to the instruction of Hebrew as L1 that emphasizes moving from the traditional linear, closed and static learning processes to hierarchical, connected and dynamic systems. Thus, these learning environments make use of “open”, online features as well as “closed”, or offline computerized tools, but in both cases, learning processes and learning materials are “discovered” and “managed” by the learners themselves through posing questions and problems, gathering relevant information and organizing data, holding discussions, and problem solving.

This is in line with the fundamental didactic principles of Hebrew L1 teaching that emphasize explanation of linguistic phenomena rather than rote learning. That is, learners are encouraged to collect and construct knowledge *about* Hebrew instead of the rules of the language itself. The constructive, social, and active principles that underlie the environments that were presented here motivate the students to participate in active work while learning about their language, bridging across the natural, authentic linguistic knowledge of a Hebrew L1 speaker and the principles of the new curriculum for teaching Hebrew.

The following didactic principles of the scientific/investigative approach to mother-tongue education indicate that it is only natural to integrate technology within L1 teaching/learning: (1) *Learning is similar to laboratory research*. In a computerized environment, linguistic data can not only be presented but also created by the students, and these linguistic products – ranging from single words to entire texts – are available for immediate analysis. (2) *Learning of linguistic concepts and phenomena is achieved through generalizations*. The computerized environment enables active discovery of linguistic rules and patterns while simultaneously introducing linguistic processes and theory. This type of instruction focuses on the understanding of basic linguistic concepts and/or the ability to use language in different contexts. A technologically rich environment invites formal language use, on the assumption that computerized learning results in the development of both oral and writing skills (Shalom & Avinun, 1999). (3) *Exposure to authentic linguistic usage*. Multimedia environment can be used to expose learners to authentic language as the starting point for linguistic discovery and exploration. (4) *Allowing for different levels of individual learning, combined with greater variation of teaching techniques that are designed for a heterogeneous population of learners*. Novel, computerized learning environments allow for flexible use of technology, ranging from a single tool in a semi-traditional setting – in which digital learning is an adjunct to face-to-face instruction – to a purely online distance-learning, with no time or space limitations, with the Internet serving as the main learning environment and digital tools as the main teaching/learning instruments (Harasim, 2001).

In sum, we feel that the changes and processes described in this paper are advantageous for both L1 teachers and students. In the present context, it is argued that these technological possibilities will equip the teacher with a rich variety of tools that can be adapted and modified to suit individual levels of teaching, whereas – for

the language learners – exposure to these tools will facilitate linguistic literacy, transforming them into proficient language users.

As a final note, methods of language learning and teaching are at the point of development and experimentation. No doubt, there is need for additional research in the field of L1 learning in technology-rich environments. Specifically, researchers need to supply more data about the learners' academic achievements, their level of linguistic awareness and their attitudes towards language – and especially towards their mother tongue.

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