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Doktora tezi olarak sunduğum *Effectiveness of a CALL Program with a Morphological Analyser on Turkish Students' Vocabulary Learning* adlı çalışmamın, tarafımdan bilimsel ahlak ve geleneklere aykırı düşecek bir yardıma başvurulmaksızın yazıldığını ve yararlandığım eserlerin bibliyografyada gösterilenlerden oluştuğunu, bunlara atıf yapılarak yararlanılmış olduğunu belirtir ve bunu onurumla doğrularım.

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Tezin yabancı dildeki adı: Effectiveness of a CALL Program with a Morphological Analyser on Turkish Students' Vocabulary Learning

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3. Yarı-Deneysel Araştırma Deseni	3. Quasi-Experimental Research Design

DEDICATION

This dissertation is dedicated to the person to whom I owe the greatest debt and sincerest of thanks, Assist. Prof. Dr. M. Ali Yavuz. He is the person who first opened the door to the field for me and pointed the way.

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ÖZET

Bu araştırmanın amacı, bir ‘akıllı bilgisayar destekli dil öğrenme’ (ABDDÖ) programının Türk öğrencilerin sözcük öğrenmeleri üzerindeki etkililiğini araştırmaktır. Bu kapsamda, sözkonusu amaca hizmet edebilecek bir program geliştirilmiş ve bu program bir İngilizce hazırlık sınıfında kullanılarak öğrencilerin sözcük edinme başarıları ve öğrenme ortamına yönelik tutumları üzerindeki etkileri ölçülmüştür.

Bu çalışmada öntest-sontest kontrol grup deseni kullanılmıştır. Denekler 42 düşük-orta düzey öğrenciden oluşturulmuş ve bunlar deney ve kontrol gruplarına ayrılmışlardır. Deney grubundakiler, bu araştırmanın bir parçası olarak geliştirilen ve bir ‘akıllı bilgisayar destekli dil öğrenme’ programı özelliği taşıyan YVZ ile okuma etkinliklerine katılmışlardır. Kontrol grubundaki öğrenciler ise sözlük kullanımı yada sözcüğün anlamını bağlam yardımıyla tahmin etme gibi geleneksel yöntemlerin kullanıldığı okuma çalışmalarında bulunmuşlardır. Her iki grup da aynı okuma kitabından yararlanmış ama deney grubu metinleri yalnızca elektronik ortamda görmüştür. Araştırmada kullanılan veri toplama araçları Kendini Yorumlamaya Dayalı Sözcük Bilgi Ölçeği ve ABDDÖ Tutum Ölçeğidir.

Deney ve kontrol grupları arasındaki farkların ölçülmesinde t-testi kullanılmıştır. Sözcük öğrenimi, *biçimbilimsel bilgi* ve *sözcüğün tanımlanması ve kullanımı* açılarından ölçülmüştür. Sonuçlar, YVZ ile yapılan okuma etkinliklerinin öğrencilerin sözcük öğrenmeleri ve ABDDÖ’ye yönelik tutumları üzerinde olumlu etkileri olduğunu göstermektedir.

Bu çalışmanın, öğretmenlerin sınıflarında benzer programlar kullanmaları açısından güdüleyici ve bilgilendirici bir işlevi olduğu düşünülmektedir. Ayrıca, YVZ programında bulunan biçimbilimsel çözümleyicinin hem teknolojik hem de eğitimsel açıdan etkili olduğunun kanıtlandığı sonucuna varılmıştır.

ABSTRACT

The aim of this research is to investigate the effectiveness of an Intelligent Computer Assistant Language Learning (ICALL) program on Turkish learners' vocabulary learning. Within the scope of this research, an ICALL application was developed and used in an English language preparatory class to measure its effects on students' achievement in vocabulary acquisition as well as their attitudes towards such an ICALL environment.

This study employed a pretest-posttest control group design. The sample consisted of 42 low intermediate learners who were assigned to experimental and control groups. The experimental group members were exposed to reading activities in the computer lab with YVZ, i.e. the ICALL application developed for this research and the control group followed a conventional reading program through traditional techniques, such as the use of monolingual and bilingual dictionaries or guessing word meaning from the context. Both groups used the same reading book but the experimental group saw only the electronic version. The instruments for data collection were the *Self-Report Vocabulary Mastery Scale* and the *ICALL Attitude Scale.*

The independent samples *t* test was used to study the differences in continuous variables between the experiment and control groups. The improvement in the vocabulary knowledge of the participants was measured as to two different aspects, i.e. *morphological knowledge* and the *knowledge of words' definitions and usage*. The results indicate that 'reading activities with YVZ' have proved to have positive effects on both learners' vocabulary learning and their attitudes towards the use of an intelligent CALL application in the classroom.

It is believed that this study can provide language teachers with necessary knowledge and enthusiasm to incorporate an ICALL application intended to teach vocabulary in their language classrooms. It can also be concluded that the morphological analyser of YVZ has proven to be *technologically mature* and *pedagogically effective*.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Problem

Throughout history, new technologies, including radio, television, video, computers, and the Internet, are proven to bring substantial educational gains, even as old technologies are replaced. Attempts to integrate advancements in technology into the field of language teaching have usually received different reactions that can be conceived of as a continuum. There is profound alienation from technology on one end of the continuum and on the other extreme are overly enthusiastic reactions to technological innovations. The fear of technology is not groundless in that technological breakthroughs have always complicated the way learning and teaching activities are carried out from the point of view of both learners and teachers who have often been forced to focus on a different area of expertise that they are not used to. This usually painful process has either led to a greater psychological distance between users and new technological tools or resulted in successful adaptation to novel learning environments incorporating the new technology. Between the two ends of the continuum ranging from the fear of technology to the enthusiastic welcome is "a healthy dose of scepticism about the pedagogical effectiveness of many current technological tools" (Salaberry, 2001:52).

According to the findings of a national survey conducted by the Canadian Association of Second Language Teachers to examine teachers and students' perspectives about the use of computer technology in French Second Language (FSL) education in Canada, 112 respondents (41% of total sample) reported that they had not used computers in their FSL classes due to the following reasons (Turnbull and Lawrence, 2002):

- lack of access (62%)
- lack of knowledge about how to integrate computers into FSL (43%)
- lack of evidence that computers are effective in FSL teaching (15%)
- beliefs that computers take too much time (23%).

As is clear from the results of the study, a majority of the respondents who have never used computers in their classrooms agree that the lack of available computer equipment discourages computer use in their classrooms. They also cite lack of knowledge about how to integrate computer technology into the curriculum as well as a lack of evidence in favour of pedagogical effectiveness as the two other principal reasons for their inexperience in computer use.

A survey of 1,000 randomly selected teachers from primary and secondary public schools throughout the United States was carried out by Quality Education Data and sponsored by CDW Government Inc., an information-technology company, in March and April 2005. The study aimed to find out how teachers utilize computer technology, and evaluate technology's role and efficacy in education. The survey found that "teachers increasingly cite computers as effective teaching tools, but just over half integrate computers into daily curriculum" and 27 percent of teachers have little or no training in integrating computers into instruction (Teachers Talk Tech, 2005).

Çağıltay *et al*. (2001) conducted a survey of 202 teachers randomly selected from 25 different schools in Ankara, Istanbul and Denizli in order to discover teachers' opinions on utilizing computer technology in education and their concerns about the integration of this technology into the classroom instruction. The findings of their study show that teachers' concerns mainly stem from insufficiency of access to computers, computer illiteracy, unsuitability of the school curriculum and lack of knowledge of how to apply technology in the classroom. Çağıltay *et al*. (2001:26) recommend that teachers should be given support and relevant training and curricula should be adapted to embrace the use of computers.

The findings of the three surveys from Canada, the US and Turkey clearly show that a large number of teachers surveyed in these countries do not use computers in the classroom mainly because there are no or too few computers at their disposal. Most interestingly, a majority of teachers who are reported not to use

computers in their teaching complain about *lack of training in the pedagogical integration of computers to the learning process* as well as *lack of evidence in favour of pedagogical effectiveness of this new technology*.

"How can new technologies be successfully integrated into the curriculum?" is one of the *four major questions* that Salaberry (2001:51) believes the pedagogical effectiveness of different technologies is related to. The other three questions are as follows:

- Is increased technological sophistication correlated to increased effectiveness to achieve pedagogical objectives?
- What technical attributes specific to the new technologies can be profitably exploited for pedagogical purposes?
- Do new technologies provide for an efficient use of human and material resources?

Salaberry asserts that these four questions form a "sound pedagogical rationale" for the use of new technologies and this rationale should be made use of to assess the pedagogical value of newly introduced technologies.

Albirini (2007:231), claiming that information technology has yet to find a place in education, maintains that "the problem does not reside in electronic technology itself, but rather with its uneasy and traumatized entry into the classroom" as the current educational paradigm cannot "host the new media". According to Albirini (2007:233), the solution lies in "thoroughly restructuring education and schools… into a new paradigm and institution".

Computer Assisted Language Learning (CALL) is one of those fields where various attempts are made to *fit* information technology into the existing educational system. Although Albirini (2007:233) asserts that these efforts all "have a narrow sight of the scope of problems surrounding educational technology", it is our contention that they are of vital importance especially if they are based on *a sound pedagogical rationale*. We believe that such attempts will prove fruitful and help to encourage teachers all over the world to integrate the new technology into the classroom by providing them with the knowledge they need.

1.2 Purpose of the Study

The main objectives of this study can be listed as follows:

1. **To develop a CALL program intended to help Turkish learners of English to improve their vocabulary:** The software to be produced should be 'technologically sophisticated' and 'pedagogically effective'. We believe that *pedagogy* and *technology* are equal partners in Computer Assisted Language Learning (Levy, 1997:164) and establishing a "fit" between the two is of vital importance.
2. **To show how to integrate the developed software into the language classroom**: Salaberry (2001:51) argues that "one of the most understudied and perhaps underrated consequences of the use of new technologies has been the interaction among learners generated by activities based on the use of new technologies". We maintain that any attempt to further research into this interaction in a CALL environment will help teachers effectively integrate computers into their classrooms.
3. **To provide evidence in favour of its pedagogical effectiveness and technological quality through experimental research**: In order to assess the efficacy of CALL programs empirical analyses should be carried out. Students' attitudes towards using the CALL application in the classroom and what they have achieved with the help of this experiment should be carefully measured by selecting an appropriate empirical research method.

1.3 Significance of the Study

Teachers' fears that they can be replaced by computers or their lack of knowledge of how to apply technology are among the restrictions that have prevented the successful introduction of CALL into language curricula. The following problems further "handicap the use of CALL systems" in the classroom (Appelo and Jong, 1994:3):

- improper user-interface (not adaptive, not user-friendly etc.)
- tedious multiple choice drill-and-practice
- lack of adequate language processing methods
- gap between teachers and developers and between curriculum and programs

Intelligent CALL applications (aka 'Language Technology Based Applications') can be described as sophisticated CALL systems that incorporate *Natural Language Processing* (NLP) technologies. Levy (1997), by citing Harmon and King (1985:4), maintains that "natural language processing is primarily concerned with developing computer programs that are able to read, speak, or understand language as people use it in everyday conversation".

Intelligent Computer Assisted Language Learning (ICALL) is a field where engineers, linguists and language teachers should work cooperatively in materials production. This cooperation may be discouraged by a number of factors including cultural differences and misunderstandings between these different groups. In Turkey, any project aiming to develop NLP applications, be they ICALL systems or not, has always been initiated and dominated by engineers who have particular interests in the field of computational linguistics and artificial intelligence. The reason why teachers do not play any active roles in such projects may be their incompetence or lack of interest in the relevant field.

This study is believed to be significant from three different perspectives:

1. It aims to develop an ICALL application that incorporates a natural language processing technology, namely *a morphological analyser*.
2. The ICALL software development project to be conducted as a part of this study will be initiated, dominated and assessed *solely by a language teacher*.
3. This study is intended to provide language teachers with valuable information on *how to integrate an ICALL application* intended to teach vocabulary in their language classrooms.

1.4 The Statement of the Problem

The present study attempts to find out whether an intelligent CALL application can be effective on Turkish students' vocabulary learning. Our aim, in other words, is to discover what effects 'a CALL program with a morphological analyser' may have on the attitudes and vocabulary acquisition of Turkish learners of English, which can be formulated as *the central problem of this dissertation* as follows:

Does a CALL program with a morphological analyser have effects on Turkish students' attitudes and their vocabulary learning?

1.5 Research Questions and Hypotheses

The central research problem is divided into two research questions and several sub-questions on which the focus of the research is based. They are presented below with the related hypotheses:

1. Do 'reading activities with YVZ[1]' and 'traditional reading activities' differ in enhancing EFL learners' *vocabulary knowledge*?

   Hypothesis 1: 'Reading activities with YVZ' enhance EFL learners' *vocabulary knowledge* more than 'traditional reading activities' can do.

   a. Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' vocabulary with regard to *the development of morphological knowledge*?

      Hypothesis 1a: 'Reading activities with YVZ' enhance EFL learners' vocabulary with regard to *the development of morphological knowledge* more than 'traditional reading activities' can do.

[1] **YVZ** (**Y**our **V**erbal **Z**one) is the name of the ICALL program developed as a part of this study.

b. Do ‘reading activities with YVZ’ and ‘traditional reading activities’ differ in enhancing EFL learners’ vocabulary with regard to *the learning of words’ definitions and use*?

   Hypothesis 1b: ‘Reading activities with YVZ’ enhance EFL learners’ vocabulary with regard to *the learning of words’ definitions and use* more than ‘traditional reading activities’ can do.

2. Do ‘reading activities with YVZ’ affect learners’ *overall attitudes* to ICALL compared with ‘traditional reading activities’?

   Hypothesis 2: ‘Reading activities with YVZ’ positively affect learners’ *overall attitudes* to ICALL compared with ‘traditional reading activities’.

   a. Do ‘reading activities with YVZ’ affect learners’ opinions of *the usefulness of ICALL programs* compared with ‘traditional reading activities’?

      Hypothesis 2a: ‘Reading activities with YVZ’ positively affect learners’ opinions of *the usefulness of ICALL programs* compared with ‘traditional reading activities’.

   b. Do ‘reading activities with YVZ’ affect learners’ *anxiety about ICALL programs* compared with ‘traditional reading activities’?

      Hypothesis 2b: ‘Reading activities with YVZ’ positively affect learners’ *anxiety about ICALL programs* compared with ‘traditional reading activities’.

   c. Do ‘reading activities with YVZ’ affect learners’ *perceptions of ICALL lessons* compared with ‘traditional reading activities’?

      Hypothesis 2c: ‘Reading activities with YVZ’ positively affect learners’ *perceptions of ICALL lessons* compared with ‘traditional reading activities’.

1.6 Assumptions of the Study

The study was conducted under the following assumptions:

1. The students participated in this research answered the questions in the vocabulary knowledge scales, and the questions in the attitude scales honestly and sincerely.
2. The research sampling represents the whole group.
3. The research model used is congruent with the purpose and the subject matter of the study.

1.7 Limitations of the Study

The following limitations need to be acknowledged and addressed regarding the present study:

1. This research was limited to the study of C-level students (pre-intermediate level at the time) at the department of Foreign Languages, Izmir Institute of Technology, Turkey.
2. This research was limited to the texts in the reading book intended for C-level students at the department.
3. The vocabulary knowledge scale used as a research instrument in this study contains only ten words but can assess learners' knowledge of each word from two aspects and measure *levels of word mastery*. The first aspect is *morphological knowledge*, i.e. to what extent do learners know the constituents of the word? The second aspect is related to learners' *knowledge of the word's definition(s) and use*.

CHAPTER TWO

COMPUTER-ASSISTED LANGUAGE LEARNING

2.1 Introduction

Computer-Assisted Language Learning (CALL) is known to have existed in the academic literature for about the last forty years and it has continually evolved and taken on various designs and functions in parallel with technological advancements. Although giving a tight definition of CALL usually entails going through a number of acronyms, each of which suggests a different role of the computer or a distinct emphasis on special qualities of the program, Levy (1997:1), using 'CALL' as a generic term to describe all possible roles that the computer can play, defines it as "the search for and study of applications of the computer in language teaching and learning".

If one is to form a conception of CALL, he/she needs to consider some questions related to different aspects of the field and have a close look at how CALL practitioners have answered those questions so far. Those just entering the field should note that the questions listed below help to shape CALL paradigms radically:

- What should be the point of departure for a CALL project? Should it be a certain theory of learning or teaching, a mix of theories or only a specific problem in the classroom?
- What are the main components in the computer-assisted language learning classroom and what role should each component play?

Throughout the history of CALL, the extent to which the above-mentioned questions have affected CALL paradigms has never been the same since each of them has not been valued by CALL practitioners to the same degree, which in turn has caused CALL paradigms to differ both in their theoretical frameworks and

practical aspects. Changes in the approaches to language learning and teaching considerably influenced CALL practitioners' views in many ways. Furthermore, the fast and continuing introduction of new technology to the field has often changed the perspective from which CALL developers and users treat some of those questions. The relatively short history of CALL can provide an informative account of developments that are still relevant today and that is why one needs to look at CALL from a historical perspective in order to paint a broad picture of it.

Attempts to conceptualise CALL also necessitates an examination of its relations with other disciplines, such as *psychology*, *linguistics*, *computational linguistics* and *artificial intelligence*. These fields have evolved significantly for about the last fifty years and they have both had a great impact on one another and influenced the development of CALL by proposing new answers to the questions listed above.

2.2 A Historical Perspective

There seems to be a common tendency among some CALL experts towards distinguishing some phases of CALL as regards changes in theories of learning and new technologies and they label these phases by coining new terms which carry connotations of learning theories. Some other CALL specialists, such as Levy (1997), who attempt to provide typologies of the phases of CALL, prefer to focus on some selected CALL projects representative of a number of time periods which they believe reflect significant activities in the field. The historical perspective they adopt usually aims to describe CALL projects highlighting the developments and the thinking of each period including some contemporary theories of learning and teaching.

It is clear that if one needs to look at CALL from a historical perspective they should begin by examining theories of language learning and teaching. It is also necessary to raise awareness about time periods during which these theories were predominant for the sake of any historical review of CALL.

Pedagogic approaches[2] are typically informed by both a theory of language and a theory of language learning (Richards & Rodgers, 1986). Having defined the term *method*[3] as "the notion of a systematic set of teaching practices based on a particular theory of language and language learning", Rodgers (2001) asserts that "the quest for better methods was a preoccupation of teachers and applied linguists throughout the 20th century". Furthermore, Rodgers (2001) gives a brief overview of "the age of methods":

> The period from the 1950s to the 1980s has often been referred to as "The Age of Methods," during which a number of quite detailed prescriptions for language teaching were proposed. Situational Language Teaching evolved in the United Kingdom while a parallel method, Audio-Lingualism, emerged in the United States. In the middle-methods period, a variety of methods were proclaimed as successors to the then prevailing Situational Language Teaching and Audio-Lingual methods. These alternatives were promoted under such titles as Silent Way, Suggestopedia, Community Language Learning, and Total Physical Response. In the 1980s, these methods in turn came to be overshadowed by more interactive views of language teaching, which collectively came to be known as Communicative Language Teaching (CLT).

Levy (1997:14) mentions that *empiricist theory* was predominant in the 1950s and early 1960s. He also cites Stern (1983:169) to use his description of empiricist theory as "pedagogically audiolingualism, psychologically behaviourism, linguistically structuralism". Audiolingualism was informed by a structuralist model of language and by behaviourist learning (Ellis, 2005). Behaviourism is a learning theory which views language learning as similar to all other types of learning. According to this theory learning means habit-formation and habits are formed when the correct responses to stimuli are learned through repeated practice. Richards and Rodgers (1986:47) state that the audiolingual approach to language teaching emerged towards the end of the 1950s in the USA and underline the fact that students were expected to learn the language through a process of habit-formation. New vocabulary and structures were presented through dialogues and students learned them through imitation and repetition (Levy, 1997).

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[2] In this study, the terms 'pedagogic approaches', 'approaches to language teaching' and 'theories of language teaching' are assumed to be interchangeable.

[3] Rodgers (2001) stresses the distinction made between *methods* and *approaches* describing the former as a fixed language teaching system with prescribed techniques and practices and the latter as representing a language teaching philosophies that can be interpreted and applied in a variety of different ways in the classroom.

Communicative Language Teaching (CLT) was first proposed in the 1970s in response to deficiencies found in audiolingualism such as over-emphasis on repetition and accuracy. Richards (2007) maintains that the main goal of CLT was to teach *communicative competence* instead of *grammatical competence* and accounts for the rise of that approach:

> In the 1970s, a reaction to traditional language teaching approaches began and soon spread around the world as older methods such as Audiolingualism and Situational Language Teaching fell out of fashion. The centrality of grammar in language teaching and learning was questioned, since it was argued that language ability involved much more than grammatical competence. While grammatical competence was needed to produce grammatically correct sentences, attention shifted to the knowledge and skills needed to use grammar and other aspects of language appropriately for different communicative purposes such as making requests, giving advice, making suggestions, describing wishes and needs and so on. What was needed in order to use language communicatively was communicative competence.

Rodgers (2001) asserts that CLT is not a method but rather an approach as its advocates do not prescribe a set of practices but only subscribe to a broad set of principles. According to Rodgers (2001) these principles are:

- Learners learn a language through using it to communicate.
- Authentic and meaningful communication should be the goal of classroom activities.
- Fluency is an important dimension of communication.
- Communication involves the integration of different language skills.
- Learning is a process of creative construction and involves trial and error.

Nunan (1991) lists similar principles describing five features of CLT:

- An emphasis on learning to communicate through interaction in the target language.
- The introduction of authentic texts into the learning situation.
- The provision of opportunities for learners to focus, not only on language but also on the learning process itself.
- An enhancement of the learner's own personal experiences as important contributing elements to classroom learning.
- An attempt to link classroom language learning with language activities outside the classroom.

Despite the obvious popularity of CLT, Murphy (2000) argues that, "it cannot be seen as a panacea for the problems that have been faced by language

teachers". She cites Stern (1992:14) where it was claimed that CLT was overemphasizing a single concept:

> As for the communicative approach, the reliance on a single overriding concept, 'communication', is a disadvantage which prevents communicative language teaching from being entirely satisfactory as a theoretical framework. In order to account for all varieties and aspects of language teaching we either stretch the concept of communication so much that it loses any distinctive meaning, or we accept its limitations and then find ourselves in the predicament of the 'method' solution: an excessive emphasis on a single concept.

In the 1990s, there emerged a movement towards a more social or *socio-cognitive view* and teachers were moving away from the *cognitive view*[4] of communicative teaching. Warschauer (2001:138-139) accounts for this movement by arguing that a cognitive view of language learning means that learners can develop language as an internal mental system through interaction but the content of that interaction or the nature of the community is ignored although a socio-cognitive view of language learning requires that interaction "help students learn to enter new communities and familiarise themselves with new genres and discourses". He also emphasises that the content of the interaction or the nature of the community are extremely important from a socio-cognitive point of view and "it is not enough to engage in communication for communication's sake". Socio-cognitive theories are often associated with Jean Piaget who is known as the pioneer of the *constructivism*[5], which is a socio-cognitively oriented theory. Kaanselar (2002) claims that the constructivist theory "has spawned a changing view on learning and instruction since 1985" and this theory implies that "learners are encouraged to construct their own knowledge instead of copying it from an authority, be it a book or a teacher, in

[4] Williams (2002) asserts that cognitive theories of learning is concerned with the mind's role in acquiring knowledge and they were combined with a linguistic focus on syntax, in the Generative-Transformational theory, to promote competence followed by performance. Williams, by citing Omaggio (1986), states that 'cognitive-approach teachers' progress from what is already known to new ones, always in the meaningful context of existing cognitive structures and no emphasis is placed on rote memorization.

[5] Piaget maintained his focus on the individual learner, i.e. individual construction of knowledge although he knew this happened within a social context. On the other hand, social constructivism, initiated by Lev Vygotsky, places emphasis on the role of social interaction in learning and the collaborative work.

realistic situations instead of decontextualised, formal situations…". Murphy (2000) cites Fosnot (1996: ix) to describe the constructivist approach to learning:

> ... a constructivist view of learning suggests an approach to teaching that gives learners the opportunity for concrete, contextually meaningful experience through which they can search for patterns, raise their own questions, and construct their own models, concepts, and strategies. The classroom in this model is seen as a mini-society, a community of learners engaged in activity, discourse and reflection.

Computer Assisted Language Learning paradigms have been naturally influenced by all these pedagogical transitions. When we look at how CALL has been affected by such decades of major innovation and transformation that language teaching pedagogy has undergone, it seems a viable idea to analyze all possible effects against the distinct contexts of three time periods each of which represents a particular decade, i.e. the 1960s and 1970s, the 1980s and the 1990s and the last one, from the late 1990s until the present. The first decade saw CALL projects based on behaviouristic theory where the repetitive approach of extensive drill and practice, grammatical explanations, and translation tests dominates (Tokuda, 2002). The advent of the communicative approach marked a new decade and communicative CALL was based on *cognitive theory-based learning*. The last decade extending into today has witnessed a transition from a *cognitive* to a *socio-cognitive* theory, where various language skills are learned and taught in the interactive integrated social environments we live in.

Warschauer and Healey (1998) claim that it is possible to divide the history of CALL into roughly three stages which are *behaviouristic CALL, communicative CALL, and integrative CALL*, and they underline the fact that "each stage corresponds to a certain level of technology as well as a certain pedagogical approach".

When we look at CALL in the 1960s and 1970s we can easily recognize the impact of behaviourism and the audiolingual method on the field. This profound effect was partly the result of the adaptability of the principles of this method of language teaching to the CALL environment. CALL developers shortly after realized that drills advocated in the audiolingual approach were easy to be coded as a computer program because of their "systematic and routine character" and their "lack

of open-endedness" (Kenning and Kenning, 1990:53; as cited in Levy, 1997:15). Warschauer and Healey (1998) give an account of the era:

> Behavioristic CALL, conceived in the 1950s and implemented in the 1960s and 1970s, could be considered a sub-component of the broader field of computer-assisted instruction. Informed by the behaviorist learning model, this mode of CALL featured repetitive language drills, referred to as drill-and-practice (or, pejoratively, as "drill-and-kill"). In this paradigm, especially popular in the United States, the computer was viewed as a mechanical tutor which never grew tired or judgmental and allowed students to work at an individual pace. Though behaviorist CALL eventually gravitated to the personal computer, it was first designed and implemented in the era of the mainframe.

According to the typology of CALL phases proposed by Wyatt (1988; as cited in Hoven, 1997:279), this stage can be referred to as *Instructional* CALL. Wyatt, to describe Instructional CALL, lists a number of its characteristics that seem to have been informed by behaviourism and the audio-lingual method:

- Students are responders, not initiators.
- Learning paths are predetermined.
- A detailed set of high- and low-level learning objectives is provided.
- The computer instructs the student; students learn from the computer.

At the beginning of 1970s, some significant transformations in the field of language teaching were underway. Murphy (2000) cites Stern (1983:465) where it was claimed that, by the end of the sixties, "audio-lingualism had become 'the whipping boy' for all that was wrong with language teaching", and she accounts for the possible causes of this decline by highlighting the link between linguistics and language teaching:

> Not only did practical results of the approach fall short of expectations, but changes in linguistic theory in the 1960's challenged the structural view of language as well as the behaviourist view of language learning. Chomsky's (1959) theory of transformational grammar argued that language was not a process of habit formation. According to Chomsky (1966), innovation and the formation of new sentences and patterns allow for the generation or creation of new utterances from the learner's underlying knowledge of abstract rules. Chomsky's references to 'innate aspects of the mind' contrasted and conflicted with Skinner's emphasis on observable behaviours. 'Suddenly the whole audio-lingual paradigm was called into question: pattern practice, drilling, memorization' (Richards & Rodgers, 1986, p.60).

During the early 1970s the American sociologist Hymes, criticising Chomsky's emphasis on *linguistic competence*[6], put forward a new concept which he called *communicative competence*. Richards (2007:3-4) explains the difference between these two types of competence by arguing that grammatical competence refers to the knowledge we have about a language that explains our ability to produce sentences in a language whereas communicative competence means: 1) knowing how to use language to serve different functions and to achieve various purposes; 2) knowing how to change our use of language according to the environment; 3) knowing how to produce and understand texts of different types, and 4) knowing how to retain communication even if one has limitations in her/his language knowledge.

The 1970s also saw an explosion of research on language learning, and the work of Krashen (1978; as cited in Murphy, 2000) and his distinction[7] between *acquisition* versus *learning* helped to understand the important role of *communication* in second-language learning.

While these significant transformations in the field of language teaching and learning were taking place, the microcomputer was invented, which was a rapid change in computing. This meant that the computer would be able to enter the house of the ordinary individuals and the invention marked a major milestone on the road to personal computers. Levy (1997) asserts that the early 1980s saw a boom in CALL largely due to this change in the world of computers. The introduction of cheaply available microcomputers was concurrent with the rising popularity of "acquisition-oriented" language learning theory, namely *the communicative approach* and much of CALL's history was consequently lost as it was labelled "learning-oriented" (Chapelle, 2001; as cited in Karlström *et al.*, 2005). With the advent of the communicative approach to language teaching, meaningful (as opposed to the drill-and-practice pattern of the audiolingual method) practice became paramount in

[6] Also known as 'grammatical competence'.
[7] According to Krashen (1981:1), *language acquisition* is a subconscious process similar to the way a child learns language. Acquirers are not consciously aware of the grammatical rules of the language, but rather develop a "feel" for correctness. On the other hand, *language learning* or, as Krashen (1981:2) puts it, 'conscious language learning', "is thought to be helped a great deal by error correction and the presentation of explicit rules".

CALL applications. Warschauer and Healey (1998) summarize how the *communicative CALL* phase looked at that time:

> Proponents of communicative CALL stressed that computer-based activities should focus more on using forms than on the forms themselves, teach grammar implicitly rather than explicitly, allow and encourage students to generate original utterances rather than just manipulate prefabricated language, and use the target language predominantly or even exclusively (Jones & Fortescue, 1987; Phillips, 1987; Underwood, 1984). Communicative CALL corresponded to cognitive theories which stressed that learning was a process of discovery, expression, and development. Popular CALL software developed in this period included text reconstruction programs (which allowed students working alone or in groups to rearrange words and texts to discover patterns of language and meaning) and simulations (which stimulated discussion and discovery among students working in pairs or groups). For many proponents of communicative CALL, the focus was not so much on what students did with the machine, but rather what they did with each other while working at the computer.

Throughout the communicative CALL phase all CALL applications were designed to fit *communicative* learning methods. However, during the late 1980s and early 1990s, critics began to raise their voice asserting that:

- methodological demands of the communicative approach could not be met by the restricted technological capabilities and "CALL was not adaptable to modern methodologies" (Last 1989:39; as cited in Levy, 1997:29);
- "…the computer was still being used in an ad hoc and disconnected fashion and thus 'finds itself making a greater contribution to marginal rather than central elements' of the language learning process (Kenning & Kenning, 1990: 90)" (Warschauer and Healey, 1998).

The 1990s witnessed not only a radical movement[8] away from the cognitive view of the communicative approach to a *socio-cognitive* or *constructivist* view of

[8] Warschauer (2001) highlights this movement to exemplify the difference between communicative CALL and integrative CALL and states that Communicative CALL was based on communicative exercises in line with a cognitive view of language learning and what is important is how the interaction helps provide input to the learner to develop a mental system but the content of the interaction is not that important, nor is the nature of the community, nor, really is the learners' own speech or output.

learning, but also the introduction of *the Internet*[9]. Another important change in technology was the enormous development in the multimedia capabilities of computers which enabled multimedia applications incorporating graphics, sound, animation, video, and text. Hubbard (2005) emphasises "the dramatic increase in commercial multimedia for language learning" and maintains that it resulted from the fact that CD-ROMs became standard in home computers. Warschauer and Healey (1998) describe this phase as *Integrative CALL* and state:

> Task-based, project-based, and content-based approaches all sought to integrate learners in authentic environments, and also to integrate the various skills of language learning and use. This led to a new perspective on technology and language learning, which has been termed integrative CALL (Warschauer, 1996b), a perspective which seeks both to integrate various skills (e.g., listening, speaking, reading, and writing) and also integrate technology more fully into the language learning process. In integrative approaches, students learn to use a variety of technological tools as an ongoing process of language learning and use, rather than visiting the computer lab on a once a week basis for isolated exercises (whether the exercises be behavioristic or communicative).

Kanselaar (2002) cites Jonassen (1994) to list some key features of *constructivism*. With regard to these characteristics it is possible to say that the constructivist learning environment:

- provides multiple representations of reality;
- represents complexity of the real world;
- privileges knowledge construction instead of reproduction;
- emphasises authentic tasks in a meaningful context;
- provides learning environments such as real-world settings or case-based learning;
- encourages reflection on prior experience;
- enables context- and content-dependent knowledge construction, and
- supports collaborative learning.

[9] The Internet was born at UCLA on October 29, 1969 and it can be described as "a *network of networks* that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked web pages and other documents of the world wide web" (Internet, n.d.).

Murphy (2000), describing this third phase of technology use in second- and foreign-language teaching, avoids using a term which may refer to *Computer-Assisted Language Teaching* but instead adopts use of the term *Technology-Enhanced Language Learning* (TELL) as she thinks that "the computer simultaneously becomes less visible yet more ubiquitous". In TELL, according to Murphy, the computer does not *assist* but *supports* learning and this third phase is characterized by the use of *multimedia* and the *Internet*. She further asserts that it can also be characterized by "a clearly delineated move away from behaviorist, drill and practice type software and a move towards more constructivist uses of the tool", along with a certain dismissal of Communicative CALL. Murphy's "vision of language learning in the 21st century" can be said to be informed by an approach which she refers to as the *Digital Approach*:

> Whereas the approaches of the 20th century drew essentially on the principles of behaviourism, the Digital Approach will need to draw on the principles of constructivism....
>
> Whereas the approaches of the 20th century relied on Behaviouristic and Communicative CALL, the Digital Approach of the 21st century will depend on Technology Enhanced Language Learning...
>
> With TELL, technology's role becomes one which supports a constructivist, student-centred approach. Technology use becomes an integral and necessary part of the learning process and not simply an add-on designed to extrinsically motivate students. The computer is valued because of its capacity, not only to simulate reality, but to generate it. Real-world learning, authentic content and resources, a focus on global communication and collaboration all result in a blurring of the boundaries between the classroom and the realities of the world surrounding it. The computer represents a means to experiment with new practices and not simply a means to improve practices. Teaching is no longer an explicit, didactic activity because such approaches are poorly supported by online learning environments on which Technology Enhanced Language Learning relies.

Warschauer (2001:139), in order to clarify the differences between the *communicative* approach and the *socio-cognitive* or *constructivist* approach to CALL, mentions an interesting anecdote about a teacher who believed that the internet could be used to improve her students' English:

> I recently spoke to a teacher who was feeling frustrated. She kept telling her students to go onto the Internet once a week to practise English, but they were wasting their time, chatting in their own language and not really engaging in English. In my view, this reveals the limitation of the communicative approach to CALL that is to see the Internet as a medium of simple (and perhaps purposeless) communication

> practice. I suggested to the teacher that she might instead want to use the Internet to have her students perform real-life tasks and solve real-life problems in a community of peers or mentors. Students could conduct an international research project on an issue they are interested in (see Warschauer *et al.* 2000b), or perform a service for their communities such as creating an English Web site for a local organisation (Warschauer & Cook 1999). In these cases, English communication would be incidental to the main task. But as they carried out the task they would be learning important new genres and engaging in new discourses.

The brief overview of CALL history presented so far may imply that during all those decades of developments in computer assisted language learning, paradigms of CALL have always been tied to theories of learning and teaching. Nevertheless, it should be noted that there have also been, of course, many projects that do not take any theories of learning as their points of departure. Barrière and Duquette (2002) argue that "the majority of tools available are not based on any specific discernable learning paradigm" and, by citing Chapelle (1997), assert that "many if not most designers work in the absence of principles derived from theory". On the other hand, *pedagogical neutrality* is a fashionable trend in today's world of e-learning and language technology towards *standardization for reusability* and Borin (2002b) describes *pedagogical neutrality* as a proposed standard for such learning systems.

In order to provide a clearer picture of CALL, it would be wise to look at the typologies of the phases of CALL proposed by Warschauer (2001) and Murphy (2000) together. The tables below are intended to serve as a compact summary of this section:

Table 2.1
Typology by Warschauer (2001)

	1970s–1980s **Structural CALL**	1980s–1990s **Communicative CALL**	21st century **Integrative CALL**
Technology	Mainframe[10]	PCs (personal computers)	Multimedia and Internet
English-teaching paradigm	Grammar-translation & audio-lingual	Communicative language teaching	Content-based, ESP/EAP
View of language	Structural	Cognitive	Socio-cognitive
Principal use of computers	Drill and practice	Communicative exercises	Authentic discourse
Principal objective	Accuracy	and fluency	and agency[11]

[10] The term originated during the early years of computing and referred to the large mechanical assembly that held the central processor and input/output complex.

[11] Warschauer (2001) suggests that it is necessary to add *agency* as a new objective together with the previous two. By citing Murray (1997), he defines agency as "the satisfying power to take meaningful action and see the results of our decisions and choices". He also states that this new objective is really what makes students excited about using computers in the classroom. Ellis (2005) uses the term a "strong communicative approach" to describe Task Based Learning and states that it aims not just to teach communication as an object but to engage learners in authentic acts of communication in the classroom. It does not seem difficult to draw a parallel between Warschauer's (2001) account of *agency* and Ellis's (2005) description.

Table 2.2
Typology by Murphy (2000)

Point of comparison	20TH CENTURY		21ST CENTURY
	–1970	1970-	
APPROACHES & METHODS	Audio-Lingual Method, Direct Method	Communicative Language Teaching	The Digital Approach
TECHNOLOGY USE	Behaviouristic CALL	Communicative CALL	Technology Enhanced Language Learning
THEORY OF LEARNING	Behaviourism	Humanistic influences	Constructivism
ENVIRONMENT	Traditional	Traditional	Online

2.3 An Interdisciplinary Perspective

Language learning processes are inherently intricate and complex. Any study on such processes or related areas should be directed towards that complexity, which eventually has these studies adopt a multidisciplinary approach. The field of CALL reflects similar characteristics by nature and must cope with multidisciplinary principles. Tokuda (2002) puts it this way:

> CALL applies research from the fields of second language acquisition, sociology, linguistics, psychology, cognitive science, cultural studies, and natural language processing to second language pedagogy and these disciplines must be integrated with technology-related fields such as computer science, artificial intelligence, and media and communication studies.

Levy (1997) states that a consideration of the major influences from other areas is important in conceptualizing CALL. He claims that the disciplines, theories, or fields which have had an influence on CALL may be grouped into five categories: psychology, artificial intelligence[12], computational linguistics, instructional technology and design[13], and human-computer interaction[14] studies.

This chapter aims to provide an interdisciplinary perspective to set CALL in context. However, it is not feasible to focus on all the related disciplines in detail. Instead, an attempt is made to give a short description or sketch of each of the disciplines that, according to Levy (1997), surround CALL. Nevertheless, two of the fields listed by Levy, which we think have had a significant influence on the CALL software developed as a part of our study, are explored in much more detail here, namely, *psychology* and *Computational Linguistics (CL)*.

Levy (1997) puts *psychology* in the first place in his above-mentioned taxonomy and states that psychology is "a discipline that is referred to often, as providing a theoretical base for CALL work". He further asserts that psychology includes *programmed instruction*, *second language acquisition*, and *cognitive psychology*, which will now each be looked at.

The field of **programmed instruction** was originally taken forward and studied to a large extent by the behaviourist B. F. Skinner, and much of the system is based on his theory of the nature of learning. Skinner observed the effectiveness of incremental training of animals and this led him to put together the principles of programmed instruction for human students. In this system, the concept of *reinforcement* is fundamental, and "complex subjects such as mathematics are

[12] According to McCarthy (2004), "Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence". Artificial Intelligence may be said to have been influenced by three different disciplines, computer science, cognitive psychology and educational research (Levy, 1997) and it is becoming a popular field of study in CALL especially to facilitate an intelligent tutoring system which aims to transfer the teacher's pedagogical knowledge into a program in order to enable the system to respond dynamically to the student.

[13] Whelan (2005) cites Reiser (2001) to give this definition: "Instructional Technology is the problem analysis, solution design, development, implementation, management, and evaluation of instructional processes and resources to improve learning and performance in education and at work."

[14] Human-Computer Interaction (HCI) may be described as a field which explores how humans work with computers as well as technical design aspects.

broken down into simple components presented in order of increasing difficulty" (Programmed Instruction, 2001).

Programmed instruction lets students answer questions about a unit of study at their own pace, checking their own answers and advancing only after answering correctly. The first practical implementation of programmed instruction to train people was achieved in 1960 by Basic Systems, Inc. Mechner, who was the first person to implement the first practical applications of programmed instruction and to devise a technology for the development of large-scale training systems, asserts that programmed instruction can be defined "as using (1) active response by the learner; (2) immediate reinforcement of correct responses; and (3) successive approximations towards the knowledge to be learned" (Mechner, 1977:1). It should also be noted that programmed instruction was the direct antecedent to computer-assisted instruction (Schoen and Hunt 1977:72; Osguthorpe and Zhou 1989:9; as cited in Levy 1997:51). Levy (1997:52) argues that the key principles underlying programmed instruction are said to have been implemented in many computer assisted instruction materials and according to the list that Levy puts forward, it is possible to talk about five key principles: 1) breaking down complex subjects into simple components; 2) developing applications for more 'programmable' areas of language like *morphology*, *vocabulary* and *syntax*; 3) treating aspects of language in isolation; 4) allowing students to work at their own pace and 5) providing students with immediate reinforcement.

Second Language Acquisition (SLA) can be simply defined as "the process by which people learn languages in addition to their native language(s)" (Second language acquisition, n.d.). Dodigovic (2005:11) gives a longer definition of SLA originally attempted by Nunan (1992:232): "Second language acquisition is the process through which individuals develop skills in a *second* or *foreign* language in tutored or untutored environments". When one looks at these two definitions, the terminology used may sound startling and rather confusing. To establish a uniform nomenclature following the commonly accepted traditions in the field, it may be argued that the terms *language learning* and *language acquisition* are usually used

interchangeably, unless they are used to address Krashen's work[15]. The now established traditions of the discipline make us subsume both 'second language learning' and 'foreign language learning' under *second language* (L2) because the learning processes are perceived as identical (Mitchell and Myles, 1988; as cited in Dodigovic, 2005:11). Pica (2005:264) maintains that *foreign language acquisition*, often referred to as *foreign language learning*, lies within the domain of SLA and that "the study of SLA is believed to provide a particularly fruitful area for insight into the process of language learning, compared to the study of children acquiring their L1".

Having looked at the use of SLA terminology it is now time to explore the area of study focusing particularly on second language acquisition theories and what they say about *language* and *language learning*. Current theories of second language acquisition are based on years of research in a wide variety of fields, including linguistics, psychology, sociology, anthropology, and neurolinguistics (Freeman & Freeman, 2001; as cited in Reed & Railsback, 2003). It is a fact that SLA research "has always looked to *linguistics* and *psychology* to guide its questions, shape its hypotheses, and explain its findings" (Pica, 2005: 269)[16] and theories that emanated from these disciplines have taken different approaches to second language acquisition. When we examine the literature to find out a classification of theories of second language acquisition, we come across some prominent studies aiming to subdivide relevant theories as to their consideration of the nature of second language acquisition:

[15] 'Krashen's work' refers to his well-known distinction between *acquisition* versus *learning*.

[16] As opposed to Pica's argument, Dodigovic (2005:16), by citing Cook (1993), argues that "earlier SLA theories come from the background of linguistics and psychology" but, "Krashen's is the first and the most comprehensive of SLA theories arising directly from the SLA milieu (Larsen-Freeman & Long, 1991)".

Table 2.3
Classifications of Language Acquisition Theories

By Cook (1993):	By Larsen-Freeman and Long (1991):
1) Theories maintaining that language is acquired and represented by the human mind in a way which is peculiar to it	1) Nativist theories – theories claiming that all humans have innate language abilities and these abilities are different to any other mental ability, i.e. they do not fulfil any other cognitive purposes but language acquisition alone
2) Theories arguing that language learning does not constitute an exception to the way people acquire and store knowledge in general	2) Environmentalist theories – theories assuming that environmental factors are more dominant in language acquisition, i.e. *nurture* rather than *nature* is key to learning
	3) Interactionist theories – theories that encompass both the innate and environmental factors

Dodigovic (2005:12), drawing a similarity between the first group in Cook's (1993) taxonomy and the nativist theories, asserts that "Cook's (1993) first group is mainly under the influence of Chomsky's[17] Universal Grammar (UG)[18], whereas the

[17] Chomsky was a pioneer in the field of psycholinguistics, which helped establish a new relationship between linguistics and psychology. In Chomsky's view, certain aspects of linguistic knowledge and ability are the product of a universal innate ability, or 'language acquisition device' (LAD), that enables each 'normal' child to construct a sytemic grammar and generate phrases. (Noam Chomsky, 2001)

[18] Universal Grammar (UG), in Chomsky's (1976) words, is "the system of principles, conditions, and rules that are elements or properties of all human languages", and it is equated with language acquisition device (LAD) as Dodigovic (2005:14) argues. However, White (1998) claims that "it would be more accurate to think of UG as just part of an LAD (Hilles, 1991) or part of a language faculty (Radford, 1997)".

second group is recruited from a number of different psychological, psycholinguistic and sociolinguistic camps".

As an explanation of language acquisition, Chomsky argues that "the underlying logic, or deep structure, of all languages is the same and that human mastery of it is genetically determined, not learned" (Noam Chomsky, 2001). This argument opens up a question on the role of universal grammar in second language acquisition. Research into the extent of availability of UG to adult learners in second language acquisition have led to one of the current hypotheses that "when learning an L2, the learner has access to the same UG features (principles and parameters) responsible for their learning L1" (Dodigovic 2005:14). Bley-Vroman (1998), using a "task and tool" metaphor, explains the role of universal grammar in second language acquisition:

> …you are given data and have to "figure out" a grammar. UG is a source of information useful in this task. Indeed, if you have "access" to this crucial information, you will succeed in this task, but without it you cannot. Young children learning their native language have this "access," while adults learning a foreign language may or may not have access. So, learning the grammar is a task, and UG is a tool. A workman with good tools gets good results, one with bad tools gets bad results. We can look at the results and see whether the appropriate tools were used.

Another prominent theory which can be classified as nativist[19] is Krashen's (1987) comprehension hypothesis model of L2. Krashen's model may be said to have something in common with UG since, like Chomsky, Krashen believes that the human species is naturally endowed with a Language Acquisition Device (McLaughlin, 1989), but he does not account for its internal workings. Krashen's (1987) general theory is based on five hypotheses, namely Acquisition-Learning Hypothesis, the Monitor Hypothesis, the Natural Order Hypothesis, the Input Hypothesis and the Affective Filter Hypothesis. Dodigovic (2005:15) gives a very compact account of these five hypotheses:

> Krashen (1987) distinguishes between 'acquisition', which is a subconscious process and really responsible for building up the linguistic ability, and 'learning', which is conscious and contributes to knowledge about language. This knowledge

[19] "In the field of psychology, nativism is the view that certain skills or abilities are 'native' or hard wired into the brain at birth" (Psychological nativism, n.d.).

about language assumes the role of a monitor, which is used to alter and edit already subconsciously initiated utterances. Whatever one does to learn a language, the rules of that language are always acquired in the same order. Krashen (1987) argues that humans acquire languages in one way only and that is by comprehending input, hence exposure to comprehensible input (i+1, which is deemed to be slightly above the learner's current ability) is the only action leading to L2 acquisition. The acquisition from comprehensible input can however only proceed when the learner has lowered her affective filter enough to allow acquisition.

Levy (1997), to emphasize the significance of *Second Language Acquisition* in CALL research and development, cites Garrett (1988) and argues that "the potential of the computer cannot be fully exploited for CALL until decisions about its use are based on insights from theory and research into the language learning process rather than traditional teaching ideas". It is a fact that there are so many models of SLA and that is why using SLA research to guide CALL materials developments is not an easy task as one should choose a suitable conceptual framework between "at least forty *theories*, *models*, *perspectives*, *metaphors*, *hypotheses*, and *theoretical claims* [italics added] in the SLA literature" (Larsen-Freeman and Long, 1991:288; as cited in Levy, 1997:54).

Cognitive Psychology[20]**,** one of the schools of psychology, examines mental or cognitive processes such as *perceiving*, *recognizing*, *remembering*, *imagining*, *conceptualizing*, *judging*, *reasoning*, and *processing information* for *planning*, *problem-solving*. Among the many specific topics investigated by cognitive psychologists are *language acquisition*; *visual and auditory perception*; *information storage and retrieval*; and *altered states of consciousness* as well as their relationship with behaviour (Cognitive Psychology, 2001). Braisby and Gellatly (2004:8) argue that cognitive psychology did not begin at any one defining moment and among the antecedents to its evolution are *introspectionism*[21] and *behaviourism*. Introspectionism helped to develop "elaborate classifications of conscious experience" (Braisby and Gellatly, 2004:9) and fell out of favour early in the

[20] It should be noted that the term 'cognitive psychology' is not equated with 'cognitive approach' in the sense that the latter refers to the study of applicability of cognitive processes in all areas and subfields of psychology.

[21] Gale Encyclopedia of Psychology (2001:150) uses the term *structuralism* instead of *introspectionism* and says that "Wilhelm Wundt's investigations of consciousness, begun in 1879, were central to the development of psychology as a field of study and Wundt's approach, called structuralism, sought to determine the structure of consciousness by recording the verbal descriptions provided by laboratory subjects to various stimuli, a method that became known as introspection".

twentieth century. It was superseded by behaviourism, which was pioneered by John B. Watson and shifted interest from conscious processes to observable behaviour. The study of consciousness was not the main focus of attention for almost half a century, until "it was revived by the 'cognitive revolution' that began in the 1950s and 1960s" (Consciousness, 2001).

Noam Chomsky argued that linguistics should be seen as a part of cognitive psychology and became the most famous proponent of the field of psycholinguistics. Chomsky, with his theories opposing to the verbal learning theory of B. F. Skinner[22], is known to have had an extremely influential position in setting up an alternative, *cognitive conception of language* (Braisby and Gellatly, 2004:13). Although Chomsky's studies have often been seen among those carried out in the field of cognitive psychology (Cognitive Psychology, 2001), Dodigovic (2005:17) draws attention to his separation:

> While Chomskyan linguistics is interested in the rather abstract and static notion of competence (Chomsky, 1965), which almost seems detached from the learner and her cognitive efforts, the cognitivist approach is all about performance and cognitive processing of complex input the learner receives in the course of learning. As cognitive processes alone are deemed to be responsible for the attainment of knowledge, the learner's mind is seen as an active constructor and therefore the owner of knowledge.

Braisby and Gellatly (2004:17) highlight the significance of the use of computers in cognitive psychology by asserting that cognitivist psychologists use computers as a device for aiding our understanding of the mind as they reject the exclusive focus on what is observable, as is the case in behaviourism. The development of high-speed computers in the 1950s and the need for testing theories about complex mental processes through computer simulation led to the emergence of the 'information-processing theory', which is thought to have been one of several developments that ended the dominance of behaviourism in American psychology (Information-Processing Theory, 2001). Computer-oriented information-processing models could provide new insight into how the human mind receives, stores, retrieves, and uses information.

[22] Skinner was the leading proponent of behaviourism.

Levy (1997), who cites Anderson (1985:8), maintains that "the modern development of the field of cognitive psychology has been strongly influenced by developments in computer science, especially artificial intelligence, and developments in linguistics, particularly the work of Chomsky" and he also gives an account of the relations between cognitive psychology, CALL and artificial intelligence:

> Both Cook (1985) and Doughty (1991) refer to general cognitive theory as a possible model for CALL development. Block (1990) argues that a broader base than pure SLA research is needed for providing explanations of student behaviour in the classroom and that cognitive psychology might offer a valuable framework. Cognitive psychology is also a significant contributing factor to the fields of artificial intelligence and more recently to instructional design…

Having looked at the fields which make up the scope of Levy's (1997) concept of *psychology*, we now return to his list, which categorizes the disciplines, theories, or fields that have been held to have had influence on CALL, in order to study the theme placed third in the list, namely **Computational Linguistics** (CL). CL is an interdisciplinary field which concentrates on processing or producing *natural languages*[23]. Uszkoreit (2000) states that computational linguistics is a discipline between linguistics and computer science and it is mainly concerned with the computational aspects of the human language faculty. Computational linguistics is said to belong to the cognitive sciences and overlaps with the field of artificial intelligence. A number of applications have been central to the development of this field: translating from one language to another (Machine Translation), finding relevant documents in large collections of text (Information Retrieval), and answering questions about a subject area (expert systems with natural language interfaces). Uszkoreit (2000) argues that "the methods, techniques, tools and applications in *applied computational linguistics* are often subsumed under the term *language engineering* or *(human) language technology*" and highlights the importance of any effort in this field of study:

[23] In the context of computational linguistics, the term 'natural language' is often used to refer to 'human language' to distinguish it from computer languages.

> Although existing CL systems are far from achieving human ability, they have numerous possible applications. The goal is to create software products that have some knowledge of human language. Such products are going to change our lives. They are urgently needed for improving human-machine interaction since the main obstacle in the interaction between human and computer is a communication problem.

Dodigovic (2005:99) cites (O'Grady *et al.*, 1997:660) where computational linguistics is described as "the application of computers to the study of linguistic problems". According to Dodigovic, the subdisciplines of CL are: 1) computational phonology; 2) computational morphology; 3) computational syntax; 4) computational lexicology[24]; 5) computational semantics, and 6) computational pragmatics. He further asserts that the area of "linguistic theory testing", which is one of the sources of computational syntax, is responsible for Natural Language Processing (NLP). Achieving high quality natural language processing has been one of the central goals of computational linguistics[25] (Farghaly, 1989:236; as cited in Levy, 1997). Levy (1997), by citing Harmon and King (1985:4), argues that "natural language processing is primarily concerned with developing computer programs that are able to read, speak, or understand language as people use it in everyday conversation".

According to Coxhead (2001), NLP includes:

- speech synthesis;
- speech recognition;
- natural language parsing/understanding and
- natural language generation.

Natural language processing systems involving parsing[26] and/or generating natural language utterances in written or spoken form should employ *morphological components.* Trost (2003) asserts that *morphological analysis* of words is essential

[24] Dodigovic (2005:99) argues that "computational lexicology is responsible for generating electronic repositories of lexical information needed in NLP and language generation".

[25] In some sources, natural language processing is subsumed under the heading of *artificial intelligence* while Borin (2002b) suggests the common denominator of *language technology* (LT) for *computational linguistics*, *language engineering* and *natural language processing*.

[26] According to Farghaly (1989:237; as cited in Levy, 1997), "the term 'parsing natural languages' refers to computer programs that model the human process of analysing an utterance and passing judgements of grammaticality on the basis of linguistic rules".

for syntactic analysis in a parser and "properties of a word the parser needs to know are its part-of-speech category and the morphosyntactic information encoded in the particular word form".

Borin (2002a:3), having gone through the literature on the use of NLP in CALL, mentions his overall impression that it is not a recognized research area; however, he emphasizes the fact that it does have a name: Intelligent CALL (ICALL). According to Borin, "some researchers reserve this name solely for what Gupta *et al.* (2000) and Schulze (2001), among others, call *parser-based CALL*". He further expresses his view that, as there are other kinds of NLP technologies than parsers, the term ICALL could well be used in the wider sense of *CALL incorporating NLP technology or technologies*. Harmain and Shafique (2005) prefer the term "Language Technology Based Applications" and they assert that such applications employ Natural Language Processing techniques (such as grammars, lexicons, parsers, etc.) to build more sophisticated CALL systems. They argue that these techniques allow language learners to interact with the learning systems in natural language. Faltin (2003:138) avoids using a specific term to talk about CALL with NLP capabilities but, instead, would rather call it an "NLP tool integrated within CALL software":

> True communicative tasks are in need of more "intelligent" devices to provide appropriate feedback to the users. Natural language processing (NLP) tools seem to be the obvious answer. NLP tools can be advantageously used for the correction of free production exercises where they can diagnose, in a generic way, many kinds of mistakes. Besides exercise correction, NLP tools can also be used as additional help resources within CALL software, to enable the learners to get more of the content materials: written texts can be listened to with the help of a speech synthesizer, sentences can be analyzed with a sentence structure viewer, verb conjugations can be verified with a conjugation tool, to give only a few examples.

Salaberry (1996:12; as cited in Nerbonne *et al.*, 1998) has a negative view on the use of language technology for CALL and maintains that "linguistics has not been able to encode the complexity of natural language" and further argues that NLP is no different at all, which is the most important reason for the failure of ICALL. However Nerbonne *et al.* (1998:544) do not agree with Salaberry as they believe that although linguistics has not yet been able to encode the entire complexity of natural language, "this does not imply that NLP cannot be useful to CALL". He further

asserts that "phonological and morphological descriptions of many languages are quite complete and much more reliable than the analyses of most language teachers, so that their accuracy cannot be the stumbling block to effective CALL".

2.4 A Conception of CALL

In order to improve our understanding of how CALL has been conceptualized it seems to be necessary to return to the questions mentioned previously in this chapter. To shed light on what goes through a CALL practitioner's mind before and during the creation of new CALL materials and learning environments, one should know how the practitioner can possibly answer the questions listed below:

- What should be the point of departure for developing a CALL program?
- What are the main components in the computer-assisted language learning classroom and what role should each component play?

The points of departure for CALL projects tend to diversify to a large extent, depending on the distinct avenues taken by CALL practitioners to the design of CALL programs. Another factor which may be said to have caused the diversity of the points of departure is the *flexibility*[27] of the computer. As to the approaches taken by CALL projects developers, it would be feasible to characterize their positions ranging from *no theory needed* to *a mix of theories should be applied*. For those who see no necessity for a theory of language learning or teaching to develop a CALL program, the point of departure may be some specific curriculum needs or learning problems or the only incentive for them might be their wish to carry out an experiment with a new technology. When we look at the other end of the spectrum of approaches, it is possible to see that, instead of a single theory, a utilisation of a mix of theories is favoured. Mitterer *et al.* (1990:136; as cited in Levy, 1997:85), who take a stance in favour of using a mix of theories, express their point of view arguing that "for CALL materials to be developed effectively a theory of instructional design, a theory of language teaching, and a theory of language learning must be integrated

[27] What we mean by 'flexibility' here is that the computer could be used for just about anything when the programmers put their minds to it.

with a knowledge of how the technology is best applied". Between the *no theory needed* end of the spectrum and the other extreme are some other avenues supporting the idea that a single theory of learning or a model/models of second language acquisition should be the basis of CALL research and development (Doughty 1991:1; Cook, 1992:21; as cited in Levy, 1997:85).

Decoo (2003:269), in his article exploring the ties between CALL and language learning methods, maintains that "CALL never stands on its own but assists language learning, and therefore is meant to serve methods[28]". According to Decoo (2003:272), a crucial question is whether CALL can lead to new language learning methods or CALL is intended to strengthen and improve existing methods. Ma and Kelly (2006:21) maintain that, to ensure the quality of a CALL program, a sound theoretical basis is vital and "the quality of a CALL program is determined by the methodology[29] behind it rather than the computer technology itself". Ma and Kelly (2006:22) further mention the existence a dividing line in conceptualising CALL design:

> …there are those who do so according to technologies and those who do so according to methodology: each side focuses on its own aspect and plays down the other. There is therefore on both sides an inclination to view method (methodology) and media (computer technology) as two separate components. Technology alone cannot determine the design, but should it be viewed solely as a means of implementing the materials? A crucial question arises: Is there a merging point of technology and pedagogical knowledge in conceptualising CALL design? If so, where is it? We argue that computer technology could be thoroughly integrated into the design and become an inseparable part of the methodology; technology can be used to monitor and control user actions so that users can be guided in performing language learning activities and achieve high learning potential.

[28] Decoo (2003) argues that "language methods, as sets of teaching and learning procedures, can be realized on various levels" and suggests a number of method levels which he classifies as 1) the tendency method – a broad language teaching and learning philosophy, which next becomes an umbrella term for methods with the same core concept (e.g. The direct method, the audio movement and the communicative approach); 2) the label method – approaches with a specific name and a detailed description, made up by their founders, such as the natural approach by Krashen; 3) the program method – an elaborated language program which an official educational entity, on a national, regional or school district level, usually has on its own; 4) the textbook method – a method produced by authors of syllabi and aligned on the major tendency method or the program method in force; 5) the individual teacher method and 6) the student method.

[29] Here the term *methodology* is used to refer to the overall approach to the design of the program and the term *theory***,** as a very important component of methodology, "mainly means language learning theory, which is used as a general term to refer to the program designer's assumptions about the nature of language, language learning and the process of learning" (Ma and Kelly, 2006:21).

When we attempt to explore possible causes of such a dividing line between supporters of *technology-driven* and *pedagogy-driven* based projects (Colpaert, 2004; Levy, 1997), we come to a conclusion that this separation may have been caused by two factors: 1) cultural differences and misunderstandings between different groups of CALL developers, i.e. those coming from computer science background, those from general linguistics and those having their basic training in languages or applied linguistics; 2) immaturity of some CALL systems using NLP techniques and their falling short of pedagogic expectations. Borin (2002a:4) elaborates on the first factor in our list and, by citing Chapelle (2001), states that the primary question in *computational linguistics* is "how can rules of language, and language processing be used to write computer programs to recognize and produce human language?" and this question implies that NLP is not primarily concerned with *language use* while this is the main concern in SLA research. Borin (2002a:4) gives an account of the different avenues to language taken by the computer scientist and the formal linguist:

> There is a tendency for both computer scientists and formal linguists to treat language as a thing, an object both separable and separate from any of its uses. This is arguably the ultimate assumption underlying formal grammars and logical semantics, where language is seen as a kind of formal symbol game. On this view, NLP equals symbol processing. However, many linguists feel that language and its concrete uses cannot be separated, and that "language and culture always go hand in hand – they are for all intents and purposes inseparable" (Östman 2000: 39).

As regards the *immaturity* of some ICALL systems, Gamper and Knapp (2002:339) itemise some common problems that most of the CALL systems using NLP techniques have to deal with, such as the *inability to support semantics*, *pragmatics*, *cultural knowledge*, and *social abilities*, and they also express their point of view on this issue arguing that "while some systems are rather promising, additional research efforts are required in order to tackle those problems and to develop authentic learning systems". While Gamper and Knapp (2002:339) maintain that another issue is to analyze and evaluate which technology best supports which language skills and more research should also be done in improving the performance of existing systems and technologies, Cantos-Gomez (2002:160) seems to disagree with them in his comparison between the situation of CALL in the past and today.

According to him, before things started to change in the 90s, it was possible to talk about a kind of incompatibility between employed CALL techniques and 'current language teaching pedagogy'[30], and new technology being unable to fulfill teachers' expectations but modern CALL has changed partly because of the wider availability of PCs and the integration of linguistic corpora and NLP-technology and "instead of adapting it to what software can offer, an attempt is made to get it to take account of the necessary conditions of successful language learning".

In respect of the second question in the list presented at the beginning of this chapter, it is of vital importance to improve our understanding about **the main components** in a CALL classroom as well as the ways in which these components work as a team and how they contribute to the implementation of CALL activities (Son, 2002:239). When one looks at the literature on this issue he/she is very likely to come across several different conceptual models each of which has some certain focal points with regard to the basic components in a CALL classroom, the roles they play and their interrelationship; nevertheless, in order to be able to grasp the main points in these models we should first explore the roles that the teacher and the computer may take on in CALL environments.

Taylor (1980), who introduced a mainstream framework for considering the role of the computer in education, put forward the *tutor*, *tool*, and *tutee* roles. As a *tutor*, the computer presents material for the learner. The student responds and the computer evaluates the response. The evaluation of the student response then determines what to present next. To function as a *tool*, the computer assists the learner in some ways through its capabilities such as statistical analysis, super calculation, or word processing, but it "doesn't evaluate" the learner's work. The computer as a *tutee* is thought by the teacher or student to be either a tutor or a tool. In other words, the student or teacher in some way programs the computer to function as either a tutor or a tool.

Levy (1997:84) argues that while recent computer tutors are highly refined, the roots of the tradition that places the computer in the role of tutor lie in *behaviourism* and *programmed instruction*. Such a link between behaviourism and

[30] Here, 'current language teaching pedagogy' refers to 'communicative syllabus'.

tutorial CALL is called “a myth” by Hubbard and Siskin (2003) and they claim that one of the reasons why tutorial CALL has been marginalised today is that teachers believe this myth. On the other hand, they admit that tutorial CALL did not live up to expectations and is inconsistent with some contemporary learning theories and these may be thought to be some other reasons for the marginalisation.

Levy (1997:181) builds on Taylor's definition of *the computer as a tutor* and discusses two assumptions for the tutor role: 1) the computer acts as “a temporary substitute” for the teacher; 2) work with the computer occurs “in self-access mode outside the conventional language classroom”. With regard to the tutorial role where the student is generally working alone without the teacher, it is possible to talk about both *weaknesses* and *strengths* of the computer tutor. This role without doubt provides flexibility which allows students to train as long as they want, at self-paced speed and at any time or place. Nevertheless, working alone without the teacher may raise some concern about an issue that CALL has to deal with today: *reliability*. Neri *et al*. (2002:9), in their work where they present an appraisal of various computer assisted pronunciation training systems with a view to establishing whether they meet pedagogical requirements, assert that *reliability* of the computer is of vital importance and “nothing could be more confusing for a learner than a system reacting in different ways to successive realizations of the same mistake”. To deal with this “weakness” of tutorial CALL and with the aim of reaching an ideal compromise between technology and demand, they suggest that we “settle for something that is less ambitious, but that can guarantee correct feedback at least in the majority of the cases”.

Levy (1997:180) maintains that today’s computer tutoring extends much beyond activities such as *drill and practice*, *tutorials*, *simulations* and *games* and it provides much more sophisticated interactions. While Levy (1997:83) mentions that the most distinctive feature of the tutor computer is its ability to evaluate the input from the student, Hubbard and Siskin (2003) give a broader definition of tutorial CALL and say: “tutorial CALL refers to the use of computer programs (disk, CD-ROM, Web-based, etc.) embodying content, activities, and feedback specifically for improving language proficiency”. By this definition, Hubbard and Siskin challenge

another "myth" about tutorial CALL: "If it is on a disk or CD, then it is tutorial software; if it is on the Internet, then it is *communicative*".

As regards *the tool role of the computer*, Levy (1997:84) argues that it is an essential role as it underlies the computer's widespread acceptance today and he further discusses strengths and weaknesses of the computer in this role:

> The fundamental qualities of a tool largely determine the strengths and weaknesses of the computer in this role. The tool is designed to assist the human, so that tasks may be accomplished more efficiently and more effectively with the aid of the tool than without it. The human is in direct control of the tool. The tool itself is quite neutral in terms of how it is used, and it can equally be used for the wrong purpose, or in the wrong way, as for the right one. In comparison with the tutor, the tool is non-directive whilst the tutor is directive, the latter offering some form of guidance or determining structure within which interaction can take place. The tool does not have a methodology attached to it as does the tutor, and so, as with any tool, the student needs to learn how to use it effectively. The strengths of the tool, therefore, lie in the versatility and capacity to augment human capacities; the weaknesses derive from its neutrality and the fact that it offers the user no guidance on its use in context, that is, beyond the mechanics of its actual operation.

Hubbard and Siskin (2003) cite Dieter Wolff's review of Levy's *Computer-Assisted Language Learning: Context and Conceptualisation* (see Wolff, 1999:127-128) to show the extent to which tutorial CALL is stigmatised and the tool role of the computer is overvalued:

> On the basis of our present knowledge of language learning, I believe that the only defensible role for the computer in language learning is that of tool…
>
> In learner autonomy, the key concept in modern language learning and in all humanistically oriented pedagogy, the computer as tutor cannot have a place.

Hubbard and Siskin further suggest that people should try to understand what tutorial CALL is and what it can do instead of "rejecting it out of hand". They also mention the fact that many software packages contain both tutor and tool functions today. According to Hubbard and Siskin, "the future CALL" will possibly look like as illustrated in Figure 2.1:

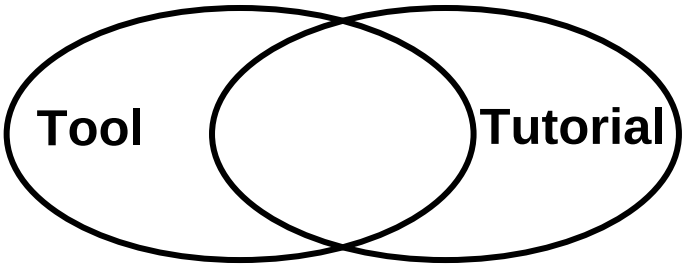

Figure 2.1 Future CALL

Among modern computer tools are word processor, database and spreadsheet programs, presentation software, text-based and video-based computer conferencing, mono and multi-lingual dictionaries, concordances[31], web search engines, e-mail programmes, and language databases or archives of various kinds (Angeli, 2007; Levy, 1997).

Before we explore the role that the teacher plays in a CALL classroom, we should look at both the *traditional roles* imposed by theories of learning throughout the history of CALL and *contemporary roles* that teachers have to adapt to in today's new language learning environments.

When we look at the traditional teacher role(s) as to the different types of methodologies, learning theories or approaches to teaching, we may discern three main categories:

[31] A concordance tool is used for studying a piece of literature when thinking in terms of a particular word, phrase or theme. It will show exactly how often and where a word occurs, so can be helpful in building up some idea of how different themes recur within an article or a collection of articles (Wu *et al*., 2003).

Table 2.4
Methods and Teacher Roles

Methods & Approaches & Theories of Learning	The role (s) of the teacher
Audio-lingual method	• *Language Modeler* • *Drill Leader* (Rodgers, 2001:2)
Communicative language teaching	• *Needs Analyst* • *Task Designer* • *Improvisor* • *Negotiator* (Rodgers, 2001:2) • *a facilitator of learning,* • *a consultant,* • *an advisor,* • *a coordinator of activities,* • *a classroom manager,* • *a co-communicator* (Littlewood, 1981:94; as cited in Murphy, 2000)
Constructivist or socio-cognitive view of learning	• *a midwife in the birth of understanding* (von Glasersfeld, 1995; as cited in Murphy, 2000); • *a learner* (Driver, Aasoko, Leach, Mortimer & Scott, 1994; as cited in Murphy, 2000).

In order to paint a picture of current tendencies in education, Grima and Fitzpatrick (2003:55) maintain that the teacher's role cannot be said to be less central although "the emphasis has shifted overall from the perspective of the *teacher* to that of the *learner*". According to Grima and Fitzpatrick (2003:57), in a radically changing language learning environment especially due to the use of new media, "teachers need to acquire and master a whole range of new skills ranging from the technical, to the organisational and the conceptual". They compare such technical skills to those that a driver needs to gain:

> Teachers need to become completely computer-literate and have the confidence to use the available technology adequately. They should be able to cope with the most common problems arising from the use of computers very much in the way that average car drivers can cope with commonly occurring problems with their motor vehicles, i.e. no specialist knowledge of the machine, but knowing what to do when routine breakdowns occur. This task would probably become easier for the teachers of tomorrow who are the learners of today.

Grima and Fitzpatrick (2003:58-62) list a number of new and important roles that teachers need to take on as well as some skills they think the teacher of today has to acquire and these roles can be summarised as in the table below:

Table 2.5
Important Roles and Competences for the Teacher of Today

The teacher as **facilitator and guide:** - must be aware of a variety of materials available for improving students' language skills; - has to be flexible, responding to the needs that students have; - needs to guide learners in the use of word-processing, graphics and presentation programmes; - should help learners to enlarge their mental and social abilities, to learn how to learn.
The teacher as **mediator**: - should act as intermediary between two cultures while they introduce learners to new linguistic and cultural concepts. - has to take into account the multilingual environment that learners live in and bring with them into the classroom.
The teacher as **researcher**: - needs to know how and where they can access information for their own and for their learners' use; - needs to keep up to date with knowledge generated in the field of modern languages and applied linguistics, not only for the sake of their learners, but also for their own professional development that is often taking the shape of 'reflection-on-action'.
The teacher as **designer of (complex) learning scenarios**: - needs to learn how to put together tasks and materials to guide their learners to successful execution and conclusion of their projects; - should be able to switch between a variety of roles such as encourager to learners in establishing learning objectives; as task-setter in providing learning tasks; as guide throughout the various stages of the learning process; as presenter when providing information and as evaluator both during and at the end of a task.
The teacher as **collaborator** (with other teachers): - should know how to share responsibilities and tasks with other teaching staff
The teacher as **orchestrator** (technology, learners, curriculum): - needs to be conversant with the learning styles of the students and able to bring the learner style and the learning method and tools into synchronization.
The teacher as **evaluator** and **self-evaluator:** - should be able to select materials, methods, and other means for the learners to work with; - has to be able to evaluate both the learning process and the product, e.g. student level of competence acquired; - can carry out self-evaluation and assessment through introspection, self-assessment of the teacher training and development programmes, self-reflection on the impact of personal professional growth on the learners' progress,

In addition to these roles, Son (2002:243) lists five teacher roles peculiar to CALL environments, namely *observer*, *designer*, *implementer*, *evaluator* or *manager*, and she says:

> CALL observers observe recent CALL activities, identify the types of CALL materials and build basic skills to deal with CALL. Teachers who are directly involved in the design, implementation or evaluation of CALL can be called CALL developers on the basis of the idea of categorising CALL software development in three modules which I refer to as design, implementation, and evaluation. CALL designers create their own computer applications by practising and utilising programming languages or authoring tools with instructional design approaches; CALL implementers use CALL software which matches with students or teachers' needs in the classroom and develop teaching methods for CALL practice; and CALL evaluators make comments on CALL materials, approaches or courses with evaluation criteria. When teachers supervise the overall use of CALL, they become CALL managers who guide other teachers to the world of CALL, facilitate CALL in self-access or classroom settings, and manage CALL resources for learning and teaching purposes.

Whichever of the above-mentioned roles the teacher adopts in the classroom, Levy (1997:232) describes the role of the teacher as "a key contributing factor" in CALL: "For CALL materials development to be successful and to make significant in-roads into mainstream language teaching practice, substantial support must be given to the language teacher. . . . Only then will the future success of CALL be assured".

Ahmad *et al*. (1985; as cited in Son, 2002:240) describe the three main components of CALL and discuss *the learner*, *the language* and *the computer* whereas Farrington's "Triangle mode" (1986:199; as cited in Levy, 1997:100) lists *the class*, *the teacher* and *the computer*. Son (2002:241) claims that both models seem to be inappropriate to reflect the actual components of the CALL classroom because Ahmad's model leaves out one important component in the classroom, *the teacher*, whereas in Farrington's model *the learner* is not described. Son suggests a new conceptual model in which the three main components in a CALL classroom are *the learner*, *the teacher* and *the computer*. For the sake of the clarity of the comparison these three models are shown together below:

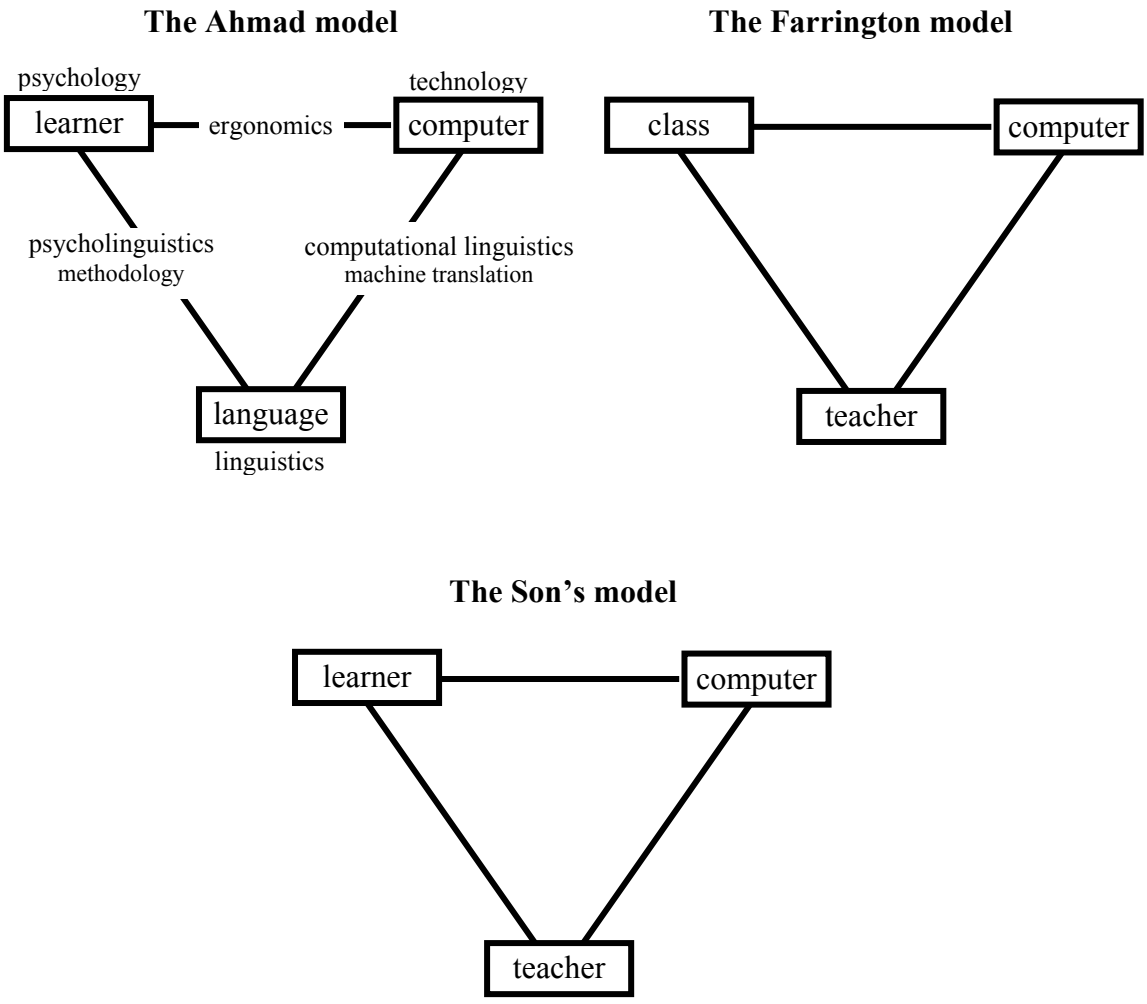

Figure 2.2 Three Conceptual Models of CALL

As regards the focal points in Ahmad's model, Son (2002:241) claims that the teacher is shown to have no role at all. However, Levy (1997:101) argues that although the computer is assigned a central role in Ahmad's model it is also possible to talk about "a minor role" that the teacher plays in managing the interaction between the learner and the computer. The presence of a teacher even with a minor role does not affect the *tutorial* role assigned to the computer in the Ahmad model of CALL. As for the language component in this model, it is said to be an indication of the particular attention paid to the complexity of natural language and the problems it causes for CALL programs (Ahmad *et al.* 1985:49; as cited in Levy, 1997).

On the other hand, the computer in Farrington's model has a less central role, which implies that the computer is used as *tool* rather than tutor and the teacher's role is more significant. In respect of the way in which the learner is treated in Farrington's model, Levy (1997:102) seems to agree with Son (2002:241):

> …in Farrington's example the whole class is interacting with the computer, thus subordinating the goal of accommodating the needs of the individual learner…The focus on the individual learner in Ahmad's model appears to be more suited to private study in the self-access centre or at another place convenient for the learner.

Unfortunately none of these three models of CALL is able to reflect the contemporary stance taken on the role of teacher which has previously been touched upon in this study. Grima and Fitzpatrick (2003:55) account for new roles that teachers have to adopt in a "drastically changing learning environments" and they maintain that the teacher is now being regarded also as a *learner*. Murphy (2000) also explores the role of the teacher as to the constructivist view to language learning today and she cites Driver *et al.* (1994) to draw attention to the *learner role* of the teacher.

Another issue that, we believe, is ignored in all these models is *physical conditions*, i.e. availability of a multimedia lab[32], the layout of the lab, the quantity and quality of computers etc. Those who attempt to use a CALL program to help their students improve their target language most often have to deal with some certain problems related to such physical conditions. Shih-Jen and Hsiao-Fang (2000), in their study where they explore how students adjust themselves in learning English with the aid of multimedia computers and the interaction between students and multimedia computers, discovered that "the student-teacher communication seemed to be blocked to some extent by the layout of the multimedia lab". They further describe some factors that they believe may have caused this problem:

> Physically, the multimedia lab is larger than the traditional classroom. The physical distance enlarged the psychological distance. It has the tendency that the two-way communication between the teacher and the students turned to be the one-way teacher to student communication…

[32] This term is equalled with 'computer lab' or 'language lab'.

> Next, the layouts of the traditional classroom and the multimedia lab look similar. The seats and computers are all arranged in a matrix. One important difference is that the teacher can easily reach students by walking in the aisle between two columns of seats and initiate the communication. Students can also easily rearrange the seats for the communicative activities in the classroom. It does not happen that way in a multimedia lab. All computers are fixed on the floor in the same matrix as the seat arrangement in a traditional classroom. All of sudden the teacher has the difficulty reaching students. A multimedia lab is far larger than a traditional classroom. Thus, the teacher needs to talk to students through the broadcasting system. The "intimacy" between the student and the teacher is gone. All students can see is a teacher hiding behind the control console…
>
> The other is the technical problems in the management of the multimedia lab. For most of teachers, it demonstrates a major challenge. In a multimedia lab, the management demands not only the fundamental knowledge of computer, but also the advanced knowledge of computer, which is almost impossible for the majority of English teachers. In other words, you need to be familiar with the computer software you are using in the class, answer students' technical questions, and diagnose the temporary shut-down of computer. In comparison with the work in a traditional classroom, managing a conversation class under the communicative framework in a multimedia lab is relatively demanding.

Especially in underdeveloped or developing countries where CALL implementations are still lacking a satisfactory financial or institutional support, problems related to 'physical conditions' often set an obstacle to the successful performance of CALL activities. The problems that a CALL practitioner might face in such countries are listed below:

- There may not be a computer laboratory to be used at all;
- There may be a computer laboratory available but it might have been designed for courses other than language teaching, so that it could prevent the teacher or the student to carry out certain language learning activities in the classroom.
- There may be a computer laboratory available but each student in the laboratory might not have access to a computer due to the insufficient number of computers;
- There may be a computer laboratory available but some CALL activities might not be satisfactorily carried out due to the insufficient quality of computers;

Bearing the new *learner* role of the teacher in mind and considering the importance of *physical conditions* in CALL, we suggest another model:

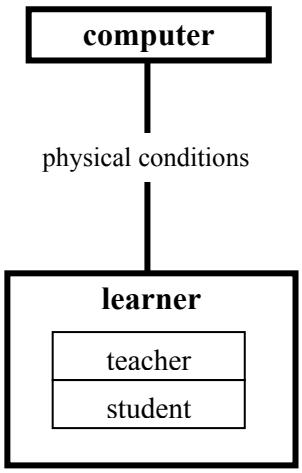

Figure 2.3 A New Conceptual Model of CALL

In this new model of CALL, we suggest two main components: 1) *the learner*, and 2) *the computer*. Both the teacher and the student are supposed to adopt the *learner* role to construct new knowledge together. The quality of the interaction between the learner and the computer largely depends on *physical conditions*. In our model, the computer's role is not central, which means that it takes on a *tool* role. The teacher and the student use this tool together to learn collaboratively.

CHAPTER THREE

A CALL PROGRAM WITH A MORPHOLOGICAL ANALYSER: YVZ

3.1 Introduction

YVZ (Your Verbal Zone) is a CALL program which is intended to help Turkish learners of English to improve their vocabulary while reading in English. It may be said to be an intelligent assistant or tool which facilitates efficient reading as well as vocabulary building in the target language. YVZ has the capability to carry out a fast and effective morphological analysis of any word that the student clicks on. It is an intelligent system because it incorporates natural language processing techniques and consists of a morphological analysis component which can:

- find the underlying lexeme[33] (dictionary form) and affix(es) of an inflected word and display each of them separately;
- provide a definition for the root both in English and Turkish through a monolingual and a bilingual electronic dictionary;
- provide examples of word use;
- inform the user about the function or meaning of each affix.

Although YVZ focuses on the acquisition of new lexical items, reading comprehension is also emphasized. Learners are assigned the task of reading a text and answer some follow-up questions displayed on the screen. If learners come across a specific word that may interrupt the reading process, they simply click on that word and as a result of a morphological analysis all the required lexical and morphological information is automatically supplied. This analysis usually takes not longer than a few seconds depending on the morphological complexity of the word.

[33] Lexeme is the fundamental unit of the lexicon of a language. *Find*, *found*, and *finding* are members of the English lexeme *find* (Lexeme, 1994).

As to various approaches taken by CALL materials developers to their work, it is possible to talk about a tradition of dividing CALL into two broad categories which are termed in Levy (1997:158) as "research-based CALL" and "practitioner-based CALL". The former is said to "tend to proceed from a higher level in a conceptual framework than practitioner-led CALL" and aims to apply a theory of language or of language learning to structure CALL materials development. On the other hand, 'practitioner-based CALL' usually begins with a specific teaching problem or an exploration into the use of a new technology. Ma and Kelly (2006:22) prefer to use different terms and mention a dividing line between *technology-driven* and *pedagogy-driven* based projects. They further assert that developers in the former category "are often accused of producing CALL materials based on their intuition instead of on research in language learning". YVZ in this respect may be said to embrace both categories as its underlying theoretical principles are rooted in *second language vocabulary acquisition models* and besides, the motivation behind it is largely based on a temptation to explore the use of a new technology that feeds off the field of *computational morphology*.

3.2 Literature Review

3.2.1 Review of Call Programs for Vocabulary Learning

Ma and Kelly (2006:18-19) categorise *lexical CALL programs*[34] into three broad groups: 1) multimedia packages with vocabulary learning activities; 2) programs made up of written texts with electronic glosses[35], and 3) programs dedicated to vocabulary learning. According to Ma and Kelly there seems to be both weaknesses and strengths of CALL programs in the first and second groups:

> This (multimedia packages with vocabulary learning activities) is perhaps the most popular type in terms of the number of products that have been sold and their wide use in educational settings…The criticism is often made that these programs lack a pedagogical basis…They are particularly vulnerable when it comes to the issue of users' needs being addressed...Given their general lack of research basis as well as

[34] Son (2001) uses this term instead of 'CALL programs for vocabulary learning'.
[35] Gloss is a brief explanatory note or translation of a difficult or technical expression usually inserted in the margin or between lines of a text or manuscript (Gloss, 1994).

> the comparatively small amount of time and space devoted to vocabulary learning, the quality of the vocabulary learning resulting from the utilization of these programs is often disappointing.
>
> This (programs made up of written texts with electronic glosses) is probably the most popular type in research-based programs, and is a reflection of the prevailing interest in incidental learning. These programs are written texts with hyperlinks and equipped with an electronic dictionary or glossary. The main emphasis is on reading comprehension and the acquisition of some new lexical items is a by-product of the reading process. The advantage of providing electronic glosses is that the lexical information can be accessed easily simply by a click (or by typing the word) with little interruption of the reading process. Moreover, glosses are made much more informative and attractive than traditional lexical entries by utilizing multimedia effects…It is reasonable to anticipate a lower learning rate at production level due to the nature of the learning task in this type of program. It is productive vocabulary learning that this type of program cannot address adequately.

In respect of CALL programs in the third group (programs dedicated to vocabulary learning), Ma and Kelly (2006:19-20) underline that they are often based on research. CALL practitioners who would like to develop such a program "choose a particular theory of language learning and implement it via computer technology". Ma and Kelly do not mention any particular weaknesses associated with this group of CALL programs in general; however, they refer to some particular computer programmes that can be subsumed under this category and they point out weaknesses resulting from the designs and implementations of these projects. CAVACO is one of these lexical CALL programmes and Groot (2000:78) argues that the CAVOCA project aims to bring theoretical ideas about word acquisition into operation and to enable us "to empirically verify the theory on word acquisition in general and its validity for L2 word acquisition in particular". Groot points out that the data collected with CAVACO indicates that there are marked differences between the L1 and the L2 word learning process and explains possible reasons:

> In particular, the fact that the L2 learner already has a system of conceptual categories at his disposal to accommodate the new L2 labels may imply that L2 word learning represents a simpler cognitive task than L1 word acquisition where new concepts and labels have to be learned simultaneously. To the extent that this is indeed the case the question arises whether attempts such as the CAVOCA programme to make L2 word learning a condensed copy of the L1 word acquisition process are cost effective, especially in the case of L2 words that have equivalent L1 counterparts. In such cases a simple bilingual presentation followed by some rehearsal practice may be more efficient. The overall conclusion must be that there is no simple answer to the key question what form the most efficient method of L2 word learning should take. It depends very much on variables like degree of L1-L2 equivalence of the words to be learned, the intensity (both qualitative and

> quantitative) of processing, the age and cognitive level of the learner, the quantity and quality of rehearsal practice etc. More experimentation systematically controlling these variables is needed to gather data that will provide more insight into their relative importance. Instruments like CAVOCA may help provide such data.

When we look at the above-mentioned typology of lexical CALL programs proposed by Ma and Kelly (2006), we can easily notice that intelligent CALL programs are not entered into at all. It is a fact that there are CALL programs, such as GLOSSER and COMPASS, which incorporate natural language processing technologies to facilitate vocabulary acquisition.

GLOSSER is a project supported by the Copernicus programme of the European commission and carried out in 1994 by John Nerbonne, Duco Dokter and Petra Smit. It can be described as an intelligent assistant for Dutch students learning to read in French and it is mainly intended to help students improve their comprehension of French texts as well as their vocabulary. It is also GLOSSER's aim to assist people who know some French but cannot read it quickly or reliably due to the presence of a number of unknown words in the text (Nerbonne and Smit, 1996; as cited in Nerbonne *et al.*, 1998:547). Nerbonne *et al.* (1998:546) maintain that "GLOSSER's stance is pedagogically sound" and they argue that GLOSSER:

> …allows students to learn language in a communication task (namely, that of reading). This approach enables the use of support tools, not merely exercises and drills, and thus shares some of the motivation for Communicative CALL within the CALL paradigm (Warschauer 1996). The choice of reading material is entirely up to the student and/or teacher, but it may include authentic materials, which Widdowson (1990) and others have argued improves the quality of learning by involving the learner more directly in the community in which the target language is spoken. Krantz (1990) emphasizes the importance of learning vocabulary words in context, and GLOSSER supports exactly and only that. Our more general point is a simple consequence of GLOSSER's success: NLP can improve CALL now.

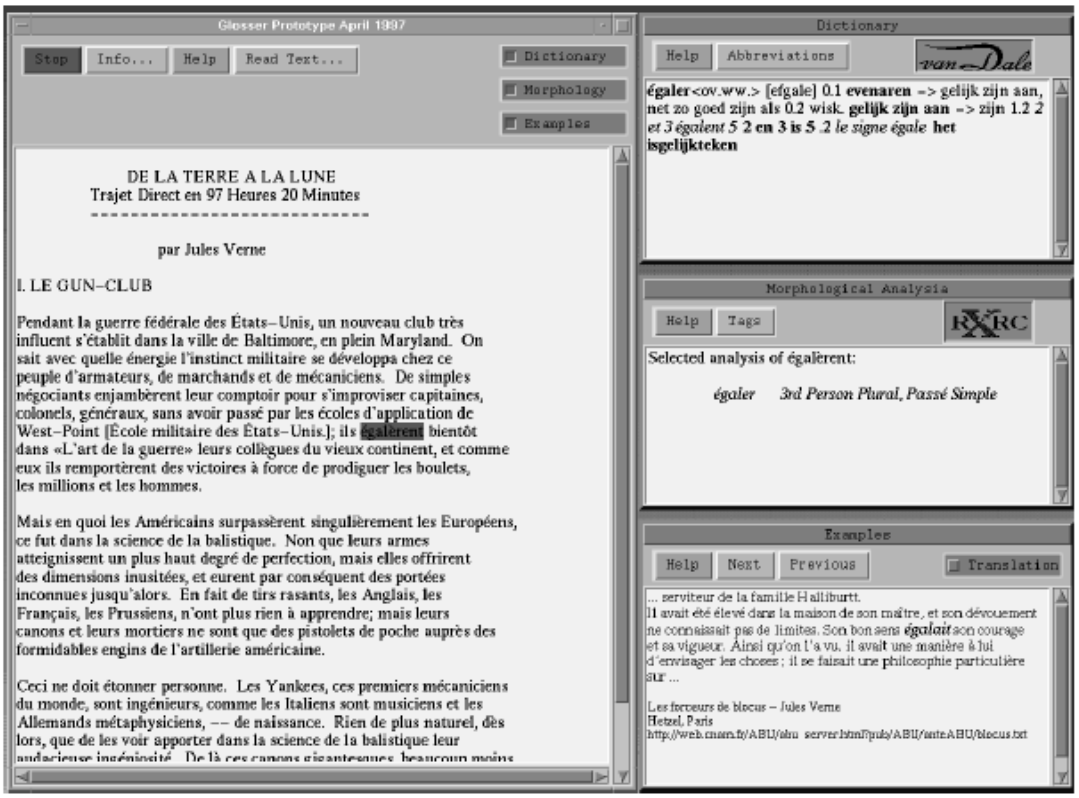

Figure 3.1 GLOSSER and Its User Interface

On the user-interface of the program, displayed in Figure 3.1, we can see four windows. The one on the left displays the text to be read and the other windows provide a definition for *any one word* clicked on by the student, morphological analysis of that word with Part-of-Speech (POS) disambiguation, and examples in both languages (L1 and L2). Morphological analysis in GLOSSER is used to find the underlying lexemes of words and this analysis also provides the part-of-speech which enables the program to find the right dictionary entry in case there is syntactic ambiguity (Nerbonne *et al.*, 1998:549). Nerbonne *et al.* (1997:137) account for the way the morphological analyser works showing how the French word *atteignissent* is morphologically decomposed:

atteindre + Subj I + PL + P3 + FinV;

The semi-regular form is recognized as a subjunctive, third-person plural finite form of the verb atteindre. The information about the stem (lemma)[36] from the morphological parse enables a dictionary lookup, and the grammatical information is directly useful. Note that, in contrast to commercially available systems, the information is generated automatically - so that it is available on-line for any text.

A performance analysis and a user study were carried out to evaluate GLOSSER though some errors occurred during the analysis, these errors cannot be said to have been crucial at all as regards the overall performance of the program. During the user study, the traditional method of text reading with a hand-held dictionary and GLOSSER were compared and it was found out that GLOSSER makes it easier for the student to approach a foreign language text by enabling them to look up more words and read the text faster.

The COMPASS (Comprehension Assistance) project (Feldweg, n.d.), which bears similarities to GLOSSER, was supported within the framework of the Linguistic Research and Engineering of the European Commission from April 1994 to March 1996. It is basically intended to help foreign language readers with a basic knowledge of the foreign language by accessing two structurally elaborated bilingual dictionaries (English-French and German-English) via an intelligent, context-sensitive look-up procedure and providing the information through an attractive graphical interface. Its morphological analyser reduces inflected words to their underlying lexeme and provides morphosyntactic information (part of speech, case, number and gender) so that the right dictionary entry can be chosen easily. The system is able to determine if the selected word is a part of a multi-word expression, such as *call someone up*, and if so, returns the translation of the whole multi-word lexeme (e.g. *call up*).

[36] In morphology, a lemma is the canonical form of a lexeme, i.e. it refers to the particular form that is chosen by convention to represent the lexeme (Lemma, n.d.). The element to which an affix is attached is called its 'base'. There are two types of bases: 'roots' are bases consisting of a single morpheme which is not an affix, and 'stems' are any type of base that remains after removing the inflectional affixes. For example, the root of the English verb form 'destabilized' is stabil-, a form of stable that does not occur alone; the stem is de·stabil·ize, which includes the derivational affixes de- and -ize, but not the inflectional past tense suffix -(e)d (Stem, n.d.).

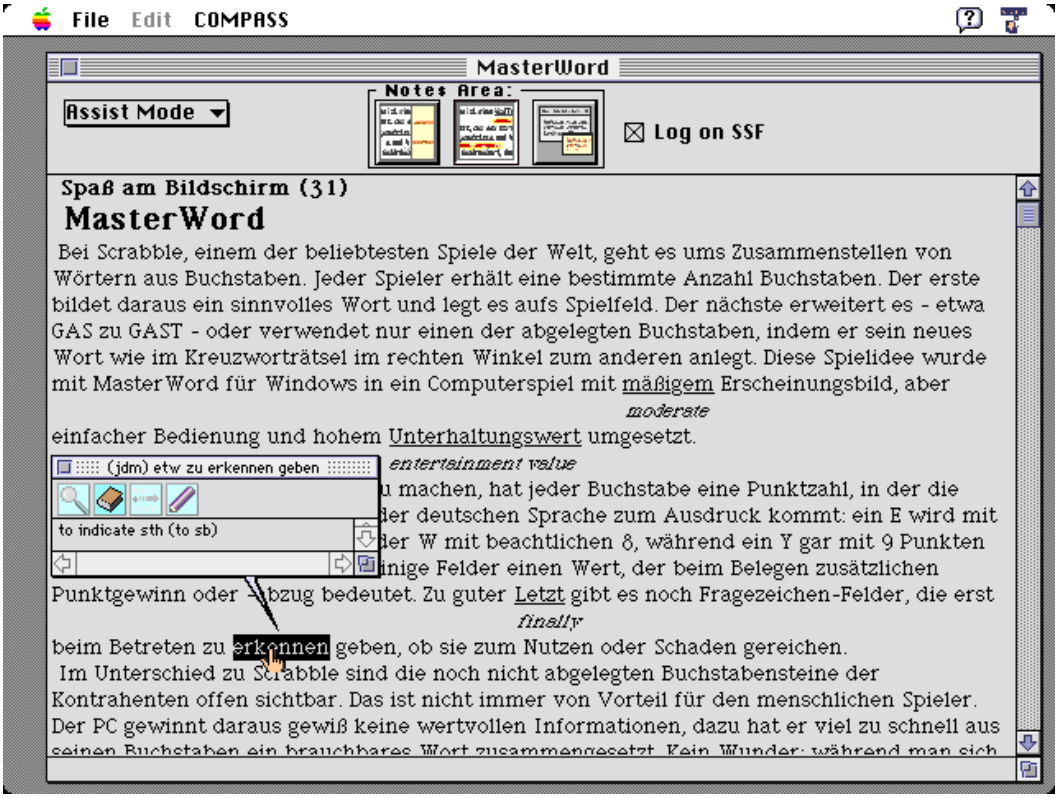

Figure 3.2 COMPASS and Its User Interface

COMPASS offers three modes to the user: read, assist and edit. In the assist mode, displayed in Figure 3.2, the user selects a word with the mouse and a look-up and analysis process is automatically activated and a help window, which suggests some translations of the selected word, appears next to the cursor. If the user selects one of the definitions it is automatically inserted (annotated) into the text. If required, the whole dictionary entry can also be displayed through clicking on a special button.

User tests were carried out to evaluate COMPASS in the summer of 1995. There were two groups of people, each of which had a basic knowledge of one of the two source languages, namely German or English. Each group was asked to read a designated newspaper article with the help of the COMPASS system and after the time for reading was up, the test users were given some comprehension questions and then, a questionnaire to assess the various COMPASS functions. The results were reported to be completely positive. The results of user tests showed that reading foreign-language texts was much easier and a better understanding of the text could be gained with COMPASS.

Having looked at GLOSSER and COMPASS we can now turn back to the typology proposed by Ma and Kelly (2006:18-19). Although the second category in their typology, namely "programs made up of written texts with electronic glosses", seems to be suitable for these two programs to be subsumed under, it is clear that the authors do not include those that make use of NLP techniques. In order to enhance the typology to the extent that it embraces all types of CALL programs we suggest adding another category: 'programs incorporating morphological analysis components'. Here is what the new typology looks like now:

- multimedia packages with vocabulary learning activities;
- programs made up of written texts with electronic glosses;
- programs incorporating morphological analysis components;
- programs dedicated to vocabulary learning.

3.2.2 Current Approaches to Vocabulary Learning

Tozcu and Coady (2004:473) cite Penno *et al*. (2002:23) to state that learning vocabulary is an important aspect of language development. They also claim that "for some scholars vocabulary knowledge is seen as the most important factor in academic achievement for second or foreign language learners (Saville-Troike, 1984)".

Ellis (1999:35) asserts that "second language acquisition (SLA) research makes a traditional distinction between *incidental* and *intentional* acquisition" and he further states that "this distinction is reflected in (although not equivalent to) a variety of terms, e.g., 'acquisition' vs. 'learning' (Krashen, 1981) and 'implicit' vs. 'explicit' learning (Bialystok 1978; Ellis 1990)".

In order to exemplify this current terminological confusion that Ellis (1999) mentions, we look at Segler (2001:21)'s study where he describes the distinction between *implicit* and *explicit* learning processes as "the most commonly drawn and pervasive distinction" in L2 vocabulary acquisition and he says:

> Implicit (or incidental) learning is often defined in negative terms, e.g. as "accidental learning of information without the intention of remembering that information" (Hulstijn *et al*., 1996)…Explicit Learning, on the other hand, refers to the application of vocabulary learning strategies on the part of the learner... It would be dangerous to infer from this, however, that incidental learning is a completely 'subconscious' process - Huckin and Coady (1999), for example, point out that implicit learning cannot be totally incidental as at least some attention must be paid to the input by the learner.

It seems that Segler (2001) equates *implicit learning* with *incidental learning*, and in his description, *explicit learning* appears to form a contrast to *incidental learning*. However, Rieder (2003:24), like Ellis (1999), seems to disagree with him in that she distinguishes *implicit learning* from *incidental vocabulary acquisition*. Rieder's study aims to investigate the reasons for this current confusion over the diverse terminology used to describe types of vocabulary learning processes and acquisition. The study is also intended to come up with a terminological framework "to disentangle and relate" these terms. The terminological framework that Rieder proposes, as shown in Figure 3.3, suggests that incidental vocabulary acquisition can be characterised by *lack of explicit learning intention* and it is composed of 1) implicit learning processes, characterised by *a complete lack of the learner's awareness*, and/or 2) explicit learning processes, characterised by *the presence of the learner's awareness*, and yet, by an *absence of learning intention*.

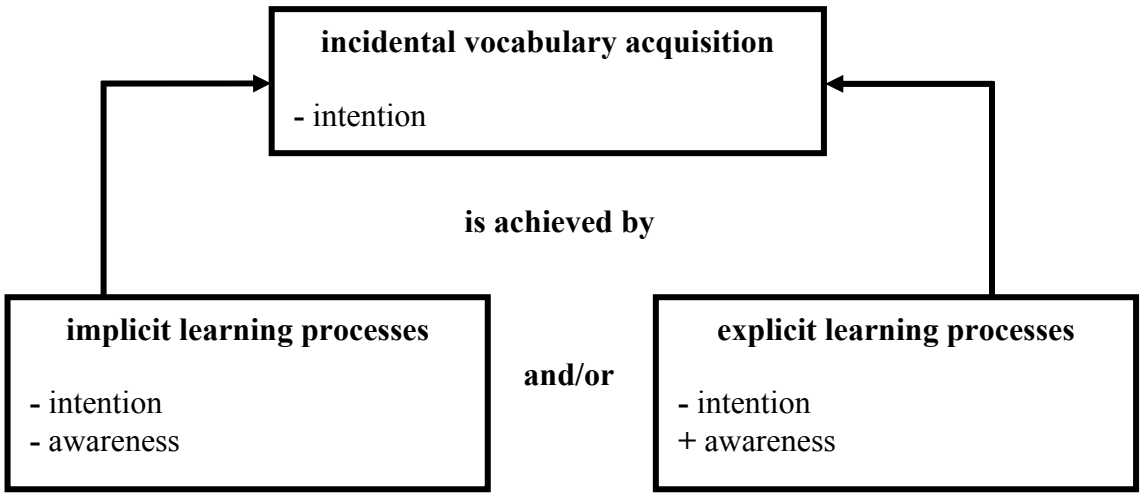

Figure 3.3 Incidental Vocabulary Acquisition as a Process Involving Implicit and /or Explicit Learning

Rieder (2003:29) claims that "the most comprehensive account of implicit/explicit learning processes in incidental vocabulary acquisition available to date is that of Ellis (1994a, 1994b, 1994c, 1997)" and she describes his view as follows:

> …both implicit and explicit learning mechanisms are involved in incidental vocabulary acquisition: while the acquisition of a word's form, collocations and grammatical class information are said to involve implicit processes, acquiring a word's semantic properties and mapping word form to meaning are claimed to result from explicit learning processes. Furthermore, Ellis argues for a complete dissociation of implicit (i.e. formal) aspects and explicit (i.e. semantic) aspects of vocabulary acquisition…

With regard to the crucial roles that *intentional* and *incidental* learning processes play in the acquisition of second language vocabulary, most scholars seem to agree that except for the first few thousand most common words which are acquired through *intentional teaching and learning*[37], much of L2 vocabulary acquisition occurs *incidentally*. Ellis (1999:36) claims that learners can never acquire a native-like vocabulary via intentional learning, and therefore, they must learn a bulk of it incidentally. He also establishes a link between incidental vocabulary acquisition and extensive reading by asserting that the former takes place through the latter. As regards this link, Rieder (2005:54) seems to argue against the established view that "vocabulary acquisition happens primarily as a side-effect of reading activities" as she maintains that this view can be said to oversimplify "the complexity of the processes and influences involved".

Pigada and Schmitt (2006:2) explore vocabulary acquisition from extensive reading and their point of view seems to be in line with that of Rieder (2005) in respect of the complexity of the processes. They mention the fact that there are many counter-arguments to the potential benefits of extensive reading for vocabulary learning. Such counter-arguments are also mentioned by Ellis (1999:36) and one of them is that of Hulstijn (1992) who points out that "the retention of word meanings

[37] According to Ellis (1999:35), "intentional learning requires focal attention to be placed deliberately on the linguistic code (i.e. on form or form-meaning connections)" while "incidental learning requires focal attention to be placed on meaning but allows peripheral attention to be directed at form". In other words, intentional learning, as opposed to incidental learning, involves *an explicit learning intention*, i.e. the learner's main goal is not text comprehension but only vocabulary acquisition.

in a true incidental learning task is very low". This whole range of arguments can be described in terms of a spectrum, at one end of which are the arguments describing incidental acquisition as "a by-product of reading second language texts" (Nation & Coady 1988, Nation 2001, as cited in Rieder, 2005:54) and at the other end are those arguing that "reading for meaning does not automatically lead to the acquisition of vocabulary" (Huckin and Coady, 1999, as cited in Pigada and Schmitt, 2006:2). In order to account for possible reasons why some studies have found little or no evidence of vocabulary learning from reading second language texts, Rieder (2005), Pigada & Schmitt (2006), Ellis (1999) and Tozcu & Coady (2004) attempt to enumerate various factors influencing the chances that a word is acquired:

- The amount of attention the learner devotes to a word is affected by the extent of this word's centrality for the text meaning, the number of times it occurs in the text, or the level of instructional focus[38].
- The degree to which a learner can guess the meaning of a word depends on the availability and nature of meaning clues[39].
- The *lexical density* (the ratio of content words to total word tokens) and the *density of unknown words*[40] (the ratio of new words to total words) in the text have an impact on both comprehension and acquisition of new words.
- Individual factors like the learner's general motivation to build up their vocabulary, their existing knowledge of L2 vocabulary, their strategies for figuring out unknown word meanings, their background knowledge

[38] Ellis (1999:48) sees instructional focus as a medium through which words can be made noticeable. He mentions Hultsijn's study (1992) in which learners were asked to read a passage containing unknown words and meaning clues were provided in the margins. Ellis (1999:48) cites Hultsijn (1992) where it is argued that "this still constituted an incidental task because the learners were concerned only with understanding the text, not learning the words". Hultsijn further states that "such focussed exposure had some, limited impact on learning".

[39] Rieder (2005:57) mention three sources for meaning clues: 1) the word form or the learner's knowledge of English (intralingual clues); 2) similarities between the word and cognates in other languages known to the learner (interlingual clues), and 3) surrounding words in the text or supplementary world knowledge of the learner (contextual clues).

[40] Rieder (2005:58) and Ellis (1999:51) mention that the optimal ratio of unknown words in a text is generally held to be 2%.

(or overall intelligence) and whether or not they possess "word schemas"[41] influence vocabulary acquisition.

- The reading situation, i.e. whether it is *intensive* or *extensive* reading, has an impact on the degree of attention that the learner devotes to individual words in the text.

Pigada and Schmitt (2006:3) discuss the importance of "extensive reading conditions" in second language vocabulary acquisition and they argue that, "although the literature provides good evidence that vocabulary is learned incidentally from reading, at least to some extent, but there are still large gaps in our knowledge of this learning in an authentic extensive reading context". They also point out that learning conditions untypical of extensive reading should be mentioned among limitations of most L2 incidental vocabulary acquisition studies failing to find little or no evidence of vocabulary learning. The limitations of such studies, as Pigada and Schmitt put it, can be listed as follows:

- the use of measuring instruments not sensitive to small amounts of learning, i.e. partial knowledge of vocabulary;
- not enough controlling of text difficulty;
- testing only a small number of target words;
- giving only one text to read which might not be interesting or motivating enough

The study carried out by Pigada and Schmitt (2006) appears to have proven that extensive reading can lead to substantial vocabulary learning, but it cannot be relied on for the acquisition of all word knowledge types. Pigada and Schmitt (2006:21) further say:

> This seems to justify the suggestion of many researchers that incidental learning should be followed up with intentional learning (Hulstijn, Hollander and Greidanus, 1996; Nation, 2001). Moreover, when we compare incidental with intentional learning, we should not generalize; rather, it seems more relevant to consider each language feature separately. Even when only vocabulary is concerned,

[41] Ellis (1999:54) describes it as various types of word knowledge that can help a learner learn new vocabulary, such as morphological knowledge or knowledge of the typical patterns of word meaning.

> various aspects of word knowledge should be treated differently. More specifically, the results suggest that spelling is a type of word knowledge that is especially amenable to exposure to comprehensible input. On the other hand, the same cannot be argued for prepositions of verbs, at least in French. Therefore, when teachers try to decide which type of learning (intentional or incidental) is more effective, they should first consider which language feature they want to focus on. As Zimmerman (1997: 122-123) states, "word knowledge involves a range of skills and word learning is facilitated by approaches that provide varied experiences," since "no single approach can address all of these skills."

Van de Poel and Swanepoel (2003:177) give a brief overview of the ways to approach to vocabulary instruction and they seem to completely agree with Pigada and Schmitt (2006) in that they also advocate a *pedagogical pluralism*[42] as "there seems to be no 'best' way to approach the teaching of vocabulary in any absolute sense". Their argument for this pedagogical pluralism mainly stems from various inadequacies of the *implicit approach to vocabulary teaching*, some of which are listed below (Sökmen 1997, 237-239; as cited in Van de Poel and Swanepoel, 2003):

- drawing inferences from context is, by definition, a slow process and becomes far too slower for beginners who do not have enough vocabulary to assist inferencing;
- inferring from context can easily lead to incorrect guessing that can have damaging effects on learning;
- focusing exclusively on inference skills means belying the fact that individual learners have different, yet successful, styles of acquiring unfamiliar vocabulary;
- guessing from context does not guarantee long-term retention of new lexical items.

Tozcu & Coady (2004:476) explore the role of explicit vocabulary teaching in vocabulary acquisition and mention some scholars' assumptions in favour of the use of both the explicit and implicit teaching approaches as opposed to some trends in foreign/second language teaching methodology such as the communicative

[42] Pedagogical pluralism implies a method determined by various variables, such as the vocabulary development goals and needs of the learners, their proficiency in the target language, their learning styles, and the nature of the lexical items to be learnt etc.

approach and Krashen's natural approach which claim that L2 learners should acquire language skills naturally and through unconscious acquisition:

> Paribakht and Wesche (1997) argue that contextualized vocabulary learning through reading is effective but that reading plus instruction is superior (pp. 195–196). Subjects who read only as well as subjects who read and studied vocabulary for a period of 3 months did significantly increase their vocabulary knowledge. However, the latter group achieved significantly greater gains…
>
> Zimmerman (1997) also found that systematic instruction results in students' learning certain target words in a way superior to simply having them read and, thus, learn words from context.

Van de Poel and Swanepoel (2003:177) mention the fact that explicit vocabulary teaching is the most appropriate method for acquiring the most frequent words in an S/FL and for the acquisition of the rest inferencing from the context together with some "other acquisition strategies" should be adopted.

In relation to the *other necessary acquisition strategies* mentioned above, Rieder (2005:59) suggests some guidelines for teacher actions or classroom activities aiming to optimize the conditions for acquiring vocabulary through reading:

1. **Choosing appropriate texts for the level and interests of the learner**: This will help to improve both reading comprehension and reading motivation.
2. **Integrating meaning information or clues for new vocabulary**: In order to help the learner to overcome the burden of handling meaning clues with only partial insights into the meaning of unknown words, text modification through adding paraphrases or synonyms or integrating glosses for unknown words constitute two alternatives to contribute to vocabulary learning but it should also be noted that glossaries may hinder the learner's abilities to tackle unknown words in non-annotated texts.
3. **Directing learner attention to unknown words in the text:** In order to have the learner focus on some specific words deemed important by the teacher reading goals should be selected carefully to draw attention to those words.

4. **Making use of complementary vocabulary activities**: Vocabulary exercises serve in two ways: 1) they direct the learner's attention to the target words, and 2) they facilitate practice of acquired knowledge.

5. **Ensuring multiple encounters with a word in different contexts**: Reading new texts with old words or encountering same words in different contexts will "not only ensure that the receptive knowledge of these words is consolidated, but will also improve learner motivation through the experience of grasping the contents" (Hulstijn 2001:284, as cited in Rieder, 2005:61).

6. **Training learners in their strategy choice and raising learner awareness**: Teaching strategies for guessing meanings as well as "recording, learning and recycling words" (Rieder, 2005:62) and raising the learner's awareness will help the learner to consciously deal with all the processes leading to vocabulary acquisition. "The importance of learner awareness is also stressed by constructivist approaches to language learning, in which comprehension and learning are seen as an active and subjective construction process on the part of the learner" (Wolff 1994, as cited in Rieder, 2005:62).

Bennett (2006:19-20) cites Schmitt (2000:133) where it is maintained that "one of the key features of successful learners is that they make use of a variety of *learning strategies*" and argues that "having a taxonomy of vocabulary learning strategies would enable teachers to select appropriate strategies for learners and instruct them in their use". Bennett also points out that Schmitt (1997:207-208) offers a taxonomy that subdivides strategies into five groups: *determination*, *social*, *memory*, *cognitive*, and *metacognitive*. Segler *et al*. (2002:410) cite Schmitt and McCarthy (1997) to claim that the success of language learning strategies depends on "the context in which they are used, their combination with other strategies, frequency of use, and the learners' proficiency level" and they show excerpts from Schmitt's Taxonomy which, they think, "is probably the most extensive, and has the advantage of being organised around an established scheme of language learning strategies":

Table 3.1 Excerpts from Schmitt's Taxonomy

Dimension	Discovery	Consolidation
Determination	• Analyse part-of-speech • Analyse affixes, roots • Check for L1 cognate • Guess from context • Consult Dictionary • Use word lists	-
Social	• Ask teacher • Ask classmates • Group work	• Group study • Teacher checks word lists • Interact with L1 speakers
Memory	-	• Image of word meaning • Connect to related words • Group words together • Study word sound/spelling • Keyword Method[43] • Use physical action • Use cognates • Paraphrase word meaning • Underline initial letter
Cognitive	-	• Verbal/written repetition • Note-taking • Put L2 labels on objects
Meta-cognitive	-	• Use L2 media • Test yourself • Continue study over time • Skip/pass new word

[43] Keyword method involves relating word form and meaning through mnemonic devices (Atkinson 1975, as cited in Rieder, 2003:36)

Segler *et al*. (2002:411-412), making use of Schmitt's study as shown in Table 3.1, attempt to establish a comprehensive taxonomy of vocabulary learning strategies in an *intelligent computer assisted language* (ICALL) environment and they seek to explore the range of strategies that should be provided by an ICALL system for vocabulary learning:

> To answer this question, Schmitt's basic distinction of discovery (DISCOV) and consolidation (CONS) strategies seems to be a useful starting point. DISCOV strategies lend themselves to reading (or listening) comprehension tasks, while CONS strategies are meant to be used in isolation from a 'meaningful' language learning activity. In an ICALL system, CONS strategies could be implemented by tools to review and consolidate partially acquired lexical knowledge, e.g. tools for note-keeping, network-building etc. DISCOV strategies, on the other hand, can be investigated in a reading/discovery-type environment with online glosses/help functions. In this scenario, learners reading texts have the opportunity to click on difficult/unknown words and choose among several explanation options, each of which exemplifies a different type of DISCOV strategy.

Ma and Kelly (2006:16) point out that vocabulary learning, nowadays, is often considered to be "a sub-component of a multimedia package or a CALL program, particularly in commercialised materials". They further mention some common characteristics favoured in today's CALL applications devoted to vocabulary teaching:

> One common feature is situating vocabulary learning in context instead of treating it as an isolated activity, as was the case before. Another important trend is for learners to be given as much freedom as possible to choose what to learn and how to learn. However, this could be problematic if learners do not know how to deal with the learning tasks and use the software effectively. Too much freedom will sometimes adversely affect the learning result. A way forward is for learners to be given some help to become 'good learners'—that is, to acquire sufficient knowledge about language learning and have the ability to take charge of their own learning effectively and efficiently. They can thus benefit maximally from the freedom of learning.

3.2.3 Computational Morphology

Computational morphology, which is a subfield[44] of Natural Language Processing (NLP), concerns itself with computer applications that use the knowledge of morphology to analyse words in a given text through *computational lexicons* as well as using some particular techniques such as *stemming* or *morphological parsing* (Daille *et al.* 2002:210, Dodigovic, 2005:99, Kiraz, 2001:15).

In some applications there is no need for morphological parsing, which can provide accurate lemmatisation[45] together with part-of-speech information. Instead, some stemming algorithms are used to remove affixes from a given word and eventually arrive at the stem, which does not have to be an actual morpheme of that language. *Stemming*, as one of the best-known techniques that perform morphological analysis, aims to find graphically and phonologically differing word stems through stripping off the endings of these words. One of the most widely used stemming algorithms was developed by Porter (1980). Daille *et al.* (2002:214) gives an account of how this stemmer works:

> Porter's stemmer relies on a set of transformational rules such as -ational→-ate which transforms a word such as relational into relate. Words are coded in pseudo-syllables so as to avoid applying the stemming procedure on words that are too short. For instance, the above rule can only transform a word into a stem containing one or more such pseudo-syllables. This constraint prevents the incorrect transformation of rational into rate, for instance. Porter's stemmer only reduces suffixes; prefixes or compounds are not simplified. Through this stemmer, comprehensibility, comprehensible, comprehension, comprehensive, comprehensively, and comprehensiveness are all reduced to the same stem "comprehens". It is important to note that contrary to morphological parsing, the stems produced by Porter's stemmer are not necessarily genuine morphemes.

Morphological analysis can be carried out through morphological parsing or using lexical databases[46] (Daille *et al.* 2002:214). *Lexical databases*, which can be

[44] Dodigovic (2005:99) subsumes it directly under 'computational linguistics'. Kiraz (2001:15), also, assumes that it is a subfield of computational linguistics but he equates 'computational linguistics' with 'natural language processing' or 'language engineering'.

[45] Lemmatisation aims to find the corresponding dictionary form for a given input word. Through lemmatisation, it is possible to map from various inflected forms of a word to a single lemma.

[46] López *et al.* (1998) assert that "a lexical database is a reference system that accumulates information on the lexical items of one of several languages". They also draw a comparison between lexical

said to be highly sophisticated forms of computational lexicons, may contain multiple lexicons each describing a different language and listing lemmas, inflected word forms or compounds of that language together with full information of their inflectional, derivational and semantic features. On the other hand, *morphological parsing* is a technique used to spot component morphemes in a word and build a representation of the word structure. *Lemmatisation* and *part-of-speech disambiguation* are the main tasks that a morphological parser has to perform. In order to successfully parse a word, the parser should be informed about this word. Necessary information can be easily provided for the parser by a lexicon listing all word forms in the target language. However, in some certain languages, such as Finnish and Turkish, constructing a lexicon with all possible inflectional and derivational word forms is not a feasible task. For example, as Oflazer (1993) points out, Turkish verbs have 40,000 possible forms without adding derived forms, which indicates that it is not possible to store all possible nominal or verbal forms in a Turkish lexicon. It is also maintained that, with regard to such languages, morphological parsing must be performed *dynamically*, i.e. during the execution of the program, instead of receiving all the necessary information from a *static* lexicon. Antworth (1995) asserts that a morphological parser may be necessary even for English despite its limited inflectional system. Such a necessity can be said to stem from the "complex and productive derivational morphology" of that language. Antworth further states that "it is impossible to list exhaustively in a lexicon all the derived forms (including coined terms or inventive uses of language) that might occur in natural text".

Computer applications that carry out morphological analysis need a morphological component which is known as *a morphological analyser*. To develop a system which uses a morphological analyser one has to consider the four crucial issues listed below:

1. building *a computational lexicon*, i.e. a module which acts as a store of information about words of the language (Ritchie *et al*., 1992:1);

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databases and computational lexicons stating that machine-readable dictionaries, i.e. computational lexicons, can also be regarded as "primitive lexical databases".

2. dealing with systematic discrepancies between the surface form of words and symbolic representations of the words in the lexicon (Black *et al*., 1987:11) through *spelling rules*, i.e. *morphographemic rules*;
3. determining which morphemes can combine with each other to form grammatical words by the specification of *morphotactic constraints*[47];
4. determining how these morphemes can be grouped and how their morphosyntactic features can be combined through *unification-based word grammar rules*.

In the following sections of this chapter, each of these issues is going to be explored after we give some basic definitions of morphology in general and a brief description of English morphology.

3.2.3.1 An Overview of English Morphology with Basic Definitions

Morphology can be described as "the branch of grammar that deals with the internal structure of words" (Matthews, 1974, as cited in Kiraz, 2001:2) – in other words, as Liddicoat and Curnow (2004:36) put it, "morphology deals with the way in which words are made up of morphemes, the smallest meaningful units of language". As is clear from these definitions, morphology treats the composition of words and this naturally leads us to the discussion of morphemes and defining what a word is.

According to Akmajian *et al.* (2001:17) *morphemes* are the basic parts of a complex word, i.e. the different building blocks that make it up. Broderick's definition (1975:26) of a morpheme is more complicated: "an abstract meaning label attached to the smallest meaningful segments of sound in a language." In order to make the reader understand his definition, Broderick mentions a number of diverse sounds in English that mean *plural* and he argues that it is possible to simply establish a label like *es* to encompass any and all sounds or combinations of sounds that invoke the idea of plurality in the mind of someone knowing English. These various sounds by which a morpheme is realised are called *morphs*. Many morphemes of a language appear in different forms, i.e. as different morphs,

[47] Gibbon (1996) describes *morphotactics* as "the compositional relation between the parts of words".

depending on the context in which they appear or their position in a word or sentence and these alternative morphs are called *allomorphs*.

None of the above definitions can be said to be flawless concerning Halle's way (1973, as cited in Lowie, 1998:7) of describing morphemes that enables him to analyse words like *brother* as consisting of two morphemes, *bro-* and *–ther*. According to Halle (1973), *-ther* is a morpheme because it can be added to some other roots like *mo-* and *fa-*. However, Lowie (1998:7) argues that such a definition is "counter-intuitive and artificial" as, he thinks, "it will be hard to attribute semantic content to these morphemes". He (1998:8) further questions whether it is always possible to attribute meaning to a morpheme and argues that this is not possible in some cases, particularly in the case of *cran-* in *cranberry.* Lowie eventually arrives at the conclusion that "the solution to this problem will have to be sought in the definition of morpheme". The solution sought for the "cranberry problem" comes from Liddicoat and Curnow (2004:36) who maintain that morphemes can be talked about in terms of their productivity and while some morphemes are highly productive there are also completely unproductive morphemes like *cran-*, which does not occur anywhere else in English.

As regards Lowie's (1998:7) criticism of Halle's concept of morphemes in terms of being *counter-intuitive* or *artificial*, there arises another question to be answered: what if a morpheme does not mean anything to a speaker, but on the other hand, it is productive? Stockwell and Minkova (2001:59) answer this question as follows:

> If we try to parse the word happy, we can easily isolate -y as a morpheme: it adds to the grammatical meaning of the word by turning it into an adjective. But what about happ-? Taken in isolation, it does not mean anything to a speaker whose knowledge of etymology does not extend to Old Norse. In Old Norse there was a noun happ, meaning "luck, chance." The word was borrowed into English in the twelfth century. That morpheme is no longer likely to appear by itself, but it has kept its ability to turn up in various words and to form the core of their meaning: mishap, happen, happenstance, hapless, unhappiness. In other words, the recyclability of hap(p)- in the language today confirms its status as a morpheme, even without the etymological information.

One of the most elaborate definitions of morphemes is attempted by Stockwell and Minkova (2001:56-61) in which they enumerate various properties of morphemes:

1. A morpheme is the smallest unit associated with a meaning;
2. Morphemes are recyclable units, i.e. they can be used again and again to form many words;
3. Morphemes must not be confused with syllables that have nothing to do with meaning;
4. One and the same morpheme can take phonetically different shapes, called different allomorphs.

As for the definition of a word, it seems that scholars do not have clear-cut descriptions. Plag (2003:8), for example, prefers to give a detailed definition of words and he suggests a number of word properties:

- words are entities having a part of speech (POS) specification
- words are syntactic atoms
- words (usually) have one main stress
- words (usually) are indivisible units (no intervening material possible)

Broderick (1975:26) asserts that a word is a unit of a language which is separated from other units by a space and he emphasizes the fact that every word contains at least one morpheme.

Stockwell and Minkova (2001:56) distinguish morphemes from words in terms of their inability to stand alone and they describe words as free-standing units:

> We think of words as being the most basic, the most fundamental, units through which meaning is represented in language. There is a sense in which this is true. Words are the smallest free-standing forms that represent meaning. Any word can be cited as an isolated item. It can serve as the headword in a dictionary list. It can be quoted. It can be combined with other words to form phrases and sentences. In general the word is the smallest unit that one thinks of as being basic to saying anything. It is the smallest unit of sentence composition and the smallest unit that we are aware of when we consciously try to create sentences.

Lowie's (1998:9) argues against using "syntactic criteria of wordhood" and describing words as the smallest unit that can exist on its own, or minimal free form. He cites Bauer (1983:207) to give the examples of some phrasal compounds such as *sister-in-law*, *lady-in-waiting*, *pain-in-the-stomach gesture* and he argues that they may also be seen as words. Lowie also mentions some languages other than English to give further evidence: "In Turkish, for instance, affixes can be added to words to create meanings for which English would need a phrase or a sentence: *ev.ler.in.de* means *in their house* (Lyons, 1968:130)".

Having attempted to shed light on how morphemes and words are defined or discussed in the literature we now turn our attention to the types of morphemes. Morphemes can be of different types and it is possible to categorise them into two classes: *roots* and *affixes*. Roots can be described as the morphemes that give the main meaning from which the rest of the sense of the word can be derived. A free root is an independent word. But roots such as *seg* in segment, *gen* in genetics, *card* in cardiac, *sequ* in sequence and *brev* in brevity cannot stand alone as words and they are called bound root morphemes, as distinct from free root morphemes (Stockwell and Minkova, 2001:61). As for affixes, they can be said to carry very little of the central meaning of a word and they serve to modify the meaning of the stem[48] in a number of ways such as by changing its part of speech. Broderick (1975:29-30) describe roots and affixes in terms of their ability to substitute other morphemes:

> …some morphemes occupy a position in words where there is a relatively unlimited potential for substituting other morphemes (linguists call such morphemes roots)…other morphemes occupy a position where there is a relatively limited potential for substitution (these are called affixes)…Consider the word traction, composed of the morpheme tract and the morpheme ion. It would be easy to show that many morphemes can replace tract in front of ion (for example tension, fusion, lesion, version, portion, plosion, fission), and thus tract is a root but that very few morphemes (perhaps only able and or) can replace ion after tract, and thus ion is an affix.

Akmajian *et al.* (2001:18) argue that not all bound morphemes are bound affixes or bound bases. They maintain that the contracted (shortened) forms of

[48] A stem is either a root or a root plus an affix, or more than one root with or without affixes (Stockwell and Minkova, 2001:62).

certain words should also be included in this category. Figure 3.4 shows a basic classification of English morphemes attempted by Akmajian *et al.* (2001:18).

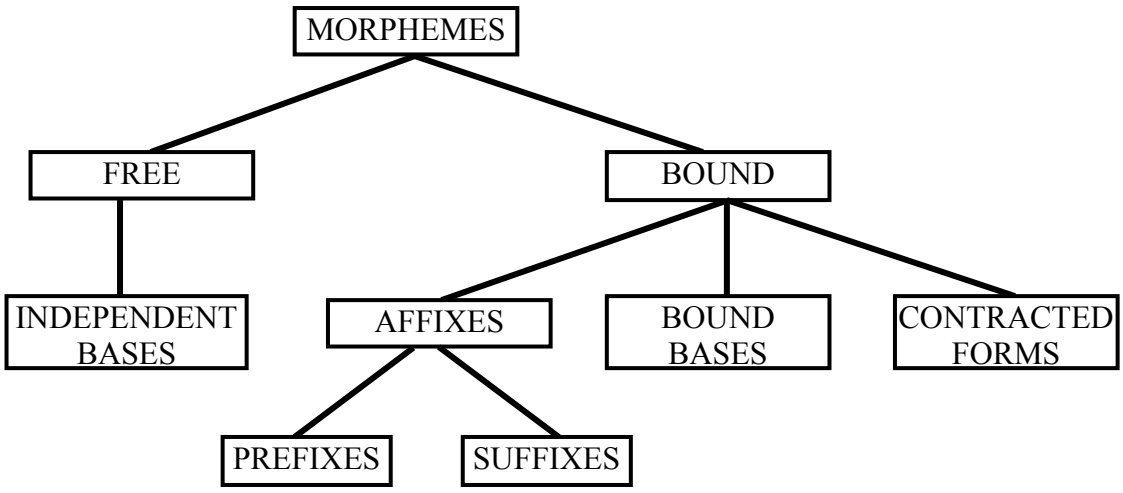

Figure 3.4 A Basic Classification of English Morphemes

Morphemes that precede the stem or root are called *prefixes* and those that follow are called *suffixes*. There are two more affix categories that do not apply much to English, namely *infixes* and *circumfixes*. Infixes are inserted inside the stem. English has very few infixes some of which are heard in colloquial speech, and a couple more are found in technical terminology (Infix, n.d.). The taboo morphemes in English, such as *bloody*, can be said to function like an infix when they are inserted in other words, e.g. *abso**bloody**lutely*. Kiraz (2001:2) talks about circumfixes and mention that they consist of two portions and the first portion acts as a prefix while the second as a suffix. English does not have any good examples of circumfixes but some other languages, such as German and Indonesian, do. The most widely known German circumfix is perhaps the German past participle which is formed by adding *ge-* to the beginning of the stem and *–t* to the end (Circumfix, n.d.).

Affixes are further classified into two groups: *Inflectional* affixes and *derivational* affixes. Derivational affixes form new lexemes[49] either by changing the meaning (e.g. aware→ unaware) or by changing the word-class (e.g. approve→ approval; large→ enlarge). Inflectional affixes, on the other hand, do not form new lexemes, but only change word-forms (e.g. hot → hotter). In English, derivational suffixes precede any inflectional suffix.

We conclude this section by looking at current *morphological typology* deemed to be based on the *classical typology* which is said to have been brought up by the 19th century German philologists August and Friedrich von Schlegel and Wilhelm von Humboldt (Helmbrecht, 2004:1247). They proposed four distinct language types[50], namely **fusional**, **agglutinative**, **isolating** and **polysynthetic**. Helmbrecht describes the main characteristics of these types:

> Languages were called **fusional** if they employ bound morphs that indicate two or three grammatical functions in one form and if this is a significant property of the morphology of that language. **Agglutinative** languages differ from fusional languages in that they come close to a one-to-one correspondence between grammatical function and bound form, one grammatical form indicating one grammatical meaning. **Isolating** languages ideally lack bound forms all together, i.e. they express grammatical meanings by means of concatenated independent words. A fourth type, the **polysynthetic** type, was added later by W. von Humboldt in order to cover also some American Indian languages in this typology. Polysynthetic languages are extreme in their morphological behaviour in that they bind all kinds of sometimes quite specific grammatical, adverbial, and even nominal meanings morphologically at the verb.

According to Shibatani and Bynon (1999:5), *fusional* languages can also be called as *inflectional* (or *flexional*) as they "encode relational meaning by modifying the lexical base by 'true' inflection (as in English *sang*)". Comrie (2001:26) objects to using such a label arguing that "this term is potentially confusing, since *agglutinating* (or *agglutinative*) languages also show the contrast between inflectional and derivational morphology, i.e. the other sense of inflectional".

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[49] Lowie (1998:9) argues that the existence of the term *lexeme* stems from the attempts to disambiguate the concept *word*. He says: "the term *word* is mostly used to refer to *word forms*, which are seen as realisations of more or less abstract underlying forms, called *lexemes*. The lexeme GIRL, for instance, is realised by *girl* and *girls* as its word forms."

[50] Shibatani and Bynon (1999:5), instead of using the term "language types", discuss three or potentially four "basic strategies or techniques in encoding relational meaning".

The classical morphological typology summarised above can be said to fall short of accounting for many forms in most languages exhibiting characteristics of different types of languages. It is now apparent that languages cannot be neatly "pigeonholed" into one of these types (Sapir, 1921:134, as cited in Shibatani and Bynon, 1999:5) and according to recent typological studies it is almost impossible to talk about *pure isolating* or *pure agglutinative* languages. Shibatani and Bynon, (1999:5) exemplify the shortcomings of the classical morphological typology:

> English shows its isolating character in the encoding of modal meanings by independent words such as *will* and *may*, its agglutinative character in the regular plural formation (e.g. *books*), and its inflectional character in the irregular plural and past tense formation (e.g. *feet*, *sang*).

Comrie (2001:26) asserts that the classical typology, as envisaged by Sapir, "can be captured by means of two indices", i.e. the *index of synthesis* focusing on the number of morphemes per word and the *index of fusion* defining the extent to which there are clear boundaries between morphemes within a word (Garland, 2006:1). If the index of synthesis of a language is higher than 1, it means this language is not a truly isolating language and allows morphemes to be combined into words. The higher the index of synthesis is, the larger numbers of morphemes are permitted. This index can be conceived of as a continuum, the end points of which are an isolating language and a (poly)synthetic language:

Figure 3.5 Index of Synthesis

As for the index of fusion, a truly agglutinating language would have an index of fusion of 1 (Comrie, 2001:26). If we also think of this index as a continuum, as illustrated in Figure 3.6, it is possible to argue that, the closer a language is to the agglutinating end of the continuum, the more easily the segmentation can be performed.

Figure 3.6 Index of Fusion

While the classical morphological typology attempted to classify languages as wholes, Sapir recognised the fact that it is difficult to classify the whole of a language into a given type. Shibatani and Bynon (1999:9) link these shortcomings to recent tendencies in morphological typology studies:

> It is because of this kind of oft-observed mixed characterisation that languages allowed that scholars began to turn away from the attempt at holistic typology and to pay increasing attention to the practice of partial typology, in which certain domain of grammar are targeted as the object of classification and characterisation… the focus of attention had shifted from the characterizations of individual languages or the specific type of languages to the drawing of cross-linguistic generalizations.

Having looked at basic characteristics of English morphology and attempted to describe some morphological phenomena, we can now turn to the main issues that have to be dealt with by those who develop applications employing a morphological analyser.

3.2.3.2 A Computational Lexicon

Hirst (2003:2) describes the *lexicon* as "a list of words in a language—a vocabulary—along with some knowledge of how each word is used" and explains the difference between *an ordinary lexicon* and *a computational one*:

> An ordinary dictionary is an example of a lexicon. However, a dictionary is intended for use by humans, and its style and format are unsuitable for computational use in a text or natural language processing system without substantial revision. A particular problem is the dictionary's explications of the senses of each word in the form of definitions that are themselves written in natural language; computational applications that use word meanings usually require a more-formal representation of the knowledge. Nonetheless, a dictionary in a machine-readable format can serve as the basis for a computational lexicon…

In respect of the role of the lexicon, Ritchie *et al*. (1992:3) maintain that it has to "associate linguistic information with words of the language". What this linguistic information conveys is solely determined by the purpose of the particular lexicon. Some lexicons, e.g. Wordnet[51], may contain little or no syntactic or morphological data and they may emphasise only semantic relationships between words whereas others may focus on morphological and/or syntactic features.

A *lexical entry* of a word in the lexicon can be described as a record that specifies the linguistic information associated with this word. According to Hirst (2003:3) "any detail of the linguistic behaviour or use of a word may be included in its lexical entry" such as "its phonetics, written forms, morphology, syntactic and combinatory behaviour, constraints on its use, its relative frequency, and, of course, all aspects of its meaning". Ritchie *et al*. (1992:4) mention *the four linguistically relevant fields* of each of the lexical entries in their study:

1. *Citation field*: This field contains *the citation form, i.e. the dictionary form* of a word. Ritchie *et al.* (1992:145) describe it as "a string[52] over the pre-determined lexical alphabet, which may contain any normal keyboard characters". The citation form can be said to be *a canonical form of a lexeme*, i.e. *a lemma*. However, it should be noted that the citation form may not always count as a single morpheme. For instance, in the analysis of English morphology carried out by Ritchie *et al.* (1992), the word *division* is listed as a separate citation form in the lexicon. On the other hand, in more complex systems, only the word *divide* is found in the lexicon and if the user asks the system to look up the word *division*, the look-up process matches *divide* against the input string *division* and the given string is decomposed as: division → divide + ion.

2. *Morphological and syntactic features*: This field serves to provide information to define valid morpheme combinations and to supply appropriate syntactic information, e.g. INFL {-, +} shows whether an item is inflectable, PLU {-, +} indicates the number of a noun or pronoun.

[51] Perhaps the best-known and most widely used computational lexicon of English is WordNet (Fellbaum 1998, as cited in Hirst, 2003:2).
[52] A string is usually "a short piece of text consisting of letters, numbers or symbols which is used in computer processes such as searching through large amounts of information" (String, 2007).

3. *Phonological field*: This is a representation of the pronunciation of the phrase, word or part word.

4. *Semantic field*: Semantic information is represented here.

As we mentioned earlier in this chapter, computational lexicons are crucial for many computer applications that perform morphological analysis. Troussov and O'Donovan (2003) emphasise the significance of the lexicon by asserting that morphological analysis can be efficiently implemented for many languages "as a simple lookup-mechanism in an exhaustive full-form morphosyntactic lexicon". The concept of being *exhaustive* is, of course, open to interpretation as the size of the lexicon and the content of the linguistic information associated with each lexical item in it are two variables that are totally dependent on the purpose of the application carried out. Daille *et al.* (2002:211-213), in their study where several technological applications using morphological information are explored, look at some lexical databases of different sizes and subdivide these lexical databases into two main categories as to the type of linguistic information included in each: 1) lexical databases with inflectional information, and 2) lexical databases with derivational information. Table 3.2 illustrates some basic features of three of the lexical databases described in their study:

Table 3.2
A Description of Three Lexical Databases

Database name	Category	Basic features	Example of code	Example of entry
DELAS	with inflectional information	• for French, English and Spanish • lists *simple* words • French version contains more than *90,000* lemmas • English and Spanish versions, about *60,000* simple word entries • linguistic information includes *inflectional* codes	• all the verbs that conjugate like *amuser* (aider, voler etc.) are associated with the code **V3** • all the nouns that take an *e* in the feminine and an *s* in the plural are associated with the code **N32** • **(+t)** for transitive verbs and **(+i)** for intransitive verbs • A special syntactic code (for example **(+4)** for *amuser*) • **+Conc** for concrete nouns, **+Hum** for human ones, **+Anim** for animate	• amuser. **V3+t+4** • cousin**. N32+Hum** • cousin**. N1+Anim**
DELAF	with inflectional information	• for French only • contains *900,000 inflected word forms* • is derived from the DELAS French lexicon • completed with inflectional information: *mood*, *tense*, *person*, *number*	• the code **C1p** for the word *amuserions* indicates that the form is conjugated in **the conditional first person plural**	• amuserions**,** amuser**. V3+t+4:C1p**
CELEX	with derivational information	• a large multilingual database that includes extensive lexicons of English, Dutch, and German • several types of lexicons are available for each language: lemma, word-form, abbreviation, and corpus type. • inflectional information is present in the word-form lexicon and derivational information is in the lemma lexicon.	• **word-form lexicon**: When the inflectional transformation is regular, a rule is given that allows one to compute the lemma form.	• the rule **@–e+ing** for the word *abiding* to reach the lemma of abiding, namely *abide*.
			• **lemma lexicon:** Derivational information is provided for each lemma through its morphological structure.	• the morphological structure of *celebration* is **((celebrate [V]), (ion) ([N|V.]) [N])**

3.2.3.3 Morphographemics

A morphological analyser, by the help of a computational lexicon, has to segment the sequence of characters in a given word into morphemes. This task seems to be straightforward in some cases:

asking → ask + ing

In this case, the analyser spots the affix and the stem in the word receiving the necessary information from the lexicon and detaches them. Nevertheless, the segmentation process is not always so simple. For example:

flies → fly +s

provability → prove + able + ity

In such cases, it is not an easy task for the analyser to reach the stem due to the alterations in spelling. Such ortographic variations between the *surface form*[53] of words and the *lexical form*[54] usually occur when basic lexical items are concatenated and these changes should be taken into consideration by the analyser. Trost (1991:426) lists three types of possible orthographic alternations:

> a. A lexical character may change to a different surface character...
> b. An elision rule may prevent a lexical character from appearing in the surface string…
> c. The third possibility is epenthesis. There a character is inserted in the surface string that has no correspondence in the lexical string…
>
> More difficult to handle are situations where more than one character is involved in a phonological (or orthographic) change. We must then define different rules for each character involved.

Morphographemics is the area dealing with such systematic changes and morphographemic rules (also called spelling rules) "are concerned with undoing spelling or phonological changes to recover the form of a word which corresponds to some morpheme entry in the lexicon" (Ritchie *et al.*, 1987:295). The formalism

[53] Surface forms of words are the ordinary orthographic realisations of these words, i.e. their actual forms as they appear in a sentence.
[54] The term 'lexical form' is used to refer to the standardised spellings of the various morphemes, i.e. the symbolic representation of the words in a lexicon.

underlying this rule system is based on the *two-level model* of morphographemics proposed by Koskenniemi (Koskenniemi, 1983, as cited in Black *et al.* 1987:11).

Two-level morphology is said to be "the first general model in the history of computational linguistics for the analysis and generation of morphologically complex languages" (Karttunen and Beesley, 2001: 1). In order to improve our understanding of Koskenniemi's model, we have to look at its origins and talk about *rewrite rules* used in the field of generative phonology of the 1960s. In Chomskian generative linguistics there has been an emphasis on spoken language, "so that rules define phonological and phonetic variation, rather than accident of spelling" (Ritchie *et al*., 1992:13). Phonological rules, also known as rewrite rules, converted abstract phonological representations into surface forms involving several intermediate levels of representation. Such rules were generally written in the form A → B / C __ D meaning "A is rewritten as B between C and D (or in the context of segments C and D)". This approach has been heavily criticised in terms of its practicality for morphological analysis. The problem mainly stemmed from the way these rules describe the correspondence between lexical forms and surface forms as they see it as "a one-directional, sequential mapping from lexical forms to surface forms" (Karttunen and Beesley, 2001:3). Trost (1991:414) states that "such an approach is suited for generation but it leads to problems if applied to analysis. Since the ordering of rule application influences the result, it is difficult to reverse the process". Koskenniemi (1983) proposed a scheme as an attempt to overcome these problems and called it *two-level morphology*. Karttunen and Beesley (2001:4-5) maintain that two-level morphology is based on three ideas:

- Rules are symbol-to-symbol constraints that are applied in parallel, not sequentially like rewrite rules.
- The constraints can refer to the lexical context, to the surface context, or to both contexts at the same time.
- Lexical lookup and morphological analysis are performed in tandem.

Antworth (1995) accounts for the reason why this model is called *two-level* stating that "a word is represented as a direct, letter-for-letter correspondence between its lexical or underlying form and its surface form". To clarify this

explanation, Antworth gives a two-level representation of the word *chased*, where + is a morpheme boundary symbol and 0 is a null character:

Lexical form:	c	h	a	s	e	+	e	d
Surface form:	c	h	a	s	0	0	e	d

To be able to account for such orthographic alternations and undo them, *two-level spelling rules* are used. For each special *correspondence* between the underlying representation of words and their realization on the surface level (e.g. e:0, +:e etc.) there is a particular spelling rule providing *contexts* in which a certain *symbol pair*[55] can occur. For example, the *i:y spelling rule* which accounts for the *i:y* correspondence between the surface form *dying* and the lexical form *die+ing* may look like:

i:y => ___ e:0 +:0 i:i

In order to understand what this rule says, we should first form a two-level representation of the word *dying*:

Lexical form:	d	i	e	+	i	n	g
Surface form:	d	y	0	0	i	n	g

When we look at this two-level representation we can easily see where the symbol pairs in the rule (i:y, e:0, +:0 and i:i) come from. The *i:y spelling rule* may be read as: *i* is realised as *y* after which *e* and the morpheme boundary (+) change into null characters (correspond to no surface characters) and the suffix begins with *i*.

So far, we have attempted to explore the area of morphographemics and spelling rules based on Koskenniemi's two-level model. To put it simply, this model can be said to specify systematic surface variations of a lexical form and counts as an accurate scheme which makes it easy for the linguist to introduce such alterations to a morphological parser. However, morphographemic rules, alone, can not guarantee a full morphological analysis of a word as it is basically a process which does not only involve spotting component morphemes in the word but also validating the legality of their order as well as determining the part of speech of the overall word.

[55] A symbol pair looks like in this form: 'lexical character – colon – surface character', e.g. **i:y**

To improve our understanding of this process we should look at how an analyser actually operates and carries out these tasks. Let's assume that our parser is asked to analyse a surface form such as *residents* and expected to return as output the underlying form divided into morphemes, namely *reside* + *ent* + *s*. The parser, during the process of decomposing, is informed by our two-level spelling rules and lexicon. The rules account for the orthographic alternations between the surface form residents and the lexical form reside + ent + s. Our lexicon informs the parser about any possible morphemes likely to occur in the word and their relative order (sequential morphotactics). The information supplied by the lexicon about the possible sequence of the morphemes in the word *residents* is rather limited and only says that:

1. *reside* is a verb;
2. the suffix *–ent* can be added to a verbal stem to turn it into a noun or adjective (assistant, expectant);
3. *–s* can be a plural suffix for nouns or the third singular suffix for verbs.

Obviously, it is not possible for the parser to successfully analyse the word due to such limited amount of information. Even if our parser is able to divide the word into its component morphemes, it is not possible, with the information at our disposal, to determine the correct function of the final suffix *–s*, which further makes it impossible to detect the part-of-speech of the whole word. If one aims to develop a system which can divide a word into its morphemes, ensure an allowed order of the morphemes and determine the lexical category (part-of-speech) of the overall word, he/she must consider the following questions and find adequate answers:

1. What can eventually enable the parser to determine that the final *-s* in *residents* is a plural suffix for nouns but not the third singular suffix for verbs?
2. How can the parser arrive at the part of speech information of the word composed of various morphemes each having distinct features?

To have our parser handle all these issues successfully we need a third component, namely *a unification-based word grammar*. The next section explores how word grammars serve in the morphological analysis process.

3.2.3.4 Unification-Based Word Grammar Rules and Complex Morphotactics

As far as word grammar rules are concerned, we can maintain that these rules are to deal with two issues of vital importance for a successful parsing: 1) specification of how morphemes' morphosyntactic features can be combined, and 2) determining legal and illegal sequences of morphemes through the specification of *non-sequential (complex) morphotactic constraints*.

In order to grasp the significance of the word grammar component we should look at the KIMMO system, which is an implementation of Koskenniemi's two-level model by Lauri Karttunen and others; at the deficiencies in the way KIMMO operated before; and at how these deficiencies have been corrected today through a word grammar. The original KIMMO had two analytical components: the *rule component* and the *lexicon*. While the rule component consisted of two-level rules that account for regular orthographic alternations, the lexicon listed all stems and affixes in their lexical form together with their morphotactic constraints. Closely following Karttunen's KIMMO, Antworth (1990) produced a new version of KIMMO called PC-KIMMO version 1, which could be run under different operating systems. Although the system was quite good at dividing a word into its morphemes, it had mainly three shortcomings: 1) over recognition; 2) over interpretation, and 3) inability to spot the part-of-speech of the whole word. *Over recognition* means accepting and analysing even non-words such as **characterizer* into the morphemes *character* + *ize* + *er*. *Over interpretation* involves generating more than one interpretation for a word. For example, the final *–s* in *encircles* can be interpreted by the system both as the plural suffix *-s* and as the verbal suffix *-s*. The third shortcoming listed above, that is, *inability to spot the part-of-speech of the whole word* is actually brought about by this over interpretation problem of the system. If the system cannot accurately interpret the appropriate function of each affix, it is impossible to arrive at the part-of-speech of the word *encircles*. Antworth (1995)

comments on the performance of PC-KIMMO saying that the system had a serious deficiency:

> For example, given the word *enlargements*, PC-KIMMO could tokenize it into the sequence of morphemes en + large + ment + s and gloss each morpheme, but it could not determine that the entire word was a plural noun…
>
> In 1993, version 2 of PC-KIMMO was developed specifically to correct this deficiency. It does so by adding a third analytical component, *a word grammar*.

Let's investigate how version 2 of PC-KIMMO, whose deficiencies have now been corrected through an additional word grammar component, operates when it is submitted a surface word. First, the rules and lexicon analyse the word by listing all the constituent morphemes in their lexical forms together with their glosses and some basic information on the category and features of each morpheme. The outcome of this first step is illustrated in Table 3.3, in which we can see the sequence of morpheme structures of the above given word *enlargements*:

Table 3.3

The Constituent Morphemes of the Word *enlargements*

Form	en+	`large	+ment	+s
Gloss	VR1+	`large	+NR25	+PL
Cat	PREFIX	AJ	SUFFIX	INFL
Feat	[from_pos:AJ head: [pos:V]]	[head: [pos:AJ]]	[from_pos:V head: [pos:N]]	[from_pos:N head: [number:PL pos: N]]

The next step is to pass the analysis illustrated in Table 3.3 to the word grammar, which is said to be a *unification-based* grammar (Antworth, 1995). To improve our understanding of the word grammar we should attempt to briefly describe the concept of *unification*. Hutchins and Somers (1992:39) assert that *unification* can be linguistically described as a formal device used in *unification grammar*[56] and the basic idea behind it is that "*feature structures*[57] can be merged if

[56] Unification grammar is the name for a number of linguistic approaches which have recently emerged, including generalised phrase structure grammar, lexical functional grammar, etc. (Hutchins and Somers, 1992:39).

[57] In a number of linguistic approaches subsumed under the term unification grammar, such as generalised phrase structure grammar, head-driven phrase structure grammar and lexical functional grammar, a *feature structure* is

the values of the features are compatible". As a computational technique, unification is used to merge the content of two structures or reject it when the two structures to be unified are incompatible. Antworth (1995) gives an example to make it clear how unification works:

> Feature structures are manipulated using an operation called unification. Two feature structures can unify if none of their constituent features have conflicting values; the resulting structure is a union of all their features. For example, feature structures (a) and (b) unify as (c):
>
> (a) [a: P
> b: Q]
>
> (b) [b: Q
> c: R]
>
> (c) [a: P
> b: Q
> c: R]

In order to explain how unification actually operates in version 2 of PC-KIMMO system, we should turn back to the analysis of the word *enlargements* and attempt to account for the phenomenon which changes the adjective *large* into a verb. The prefix *en-* has a *from_pos* feature which indicates the part-of-speech of the stem to which it can be attached, i.e. *AJ* meaning *Adjective*; and a *pos* feature which is the part-of-speech of the resulting derived stem, i.e. *V* meaning *Verb*. The word grammar rule, **Stem_1 = PREFIX Stem_2**, clearly requires that a derived stem should be a combination of a prefix and another stem following the prefix. One of the feature constraints under this rule, <*PREFIX from_pos*> = <*Stem_2 pos*>, says that the *from_pos* of the prefix (AJ) must unify with the *pos* of the stem (AJ) and this allows the prefix *en-* to attach to the root *large*. Another feature constraint, <*Stem pos*> = <*PREFIX pos*>, implies that the *pos* of stem, which has not been determined yet after the attachment of the prefix, must unify with the pos of the prefix (V). As a result, the part-of-speech of the derived stem *enlarge* is V (verb).

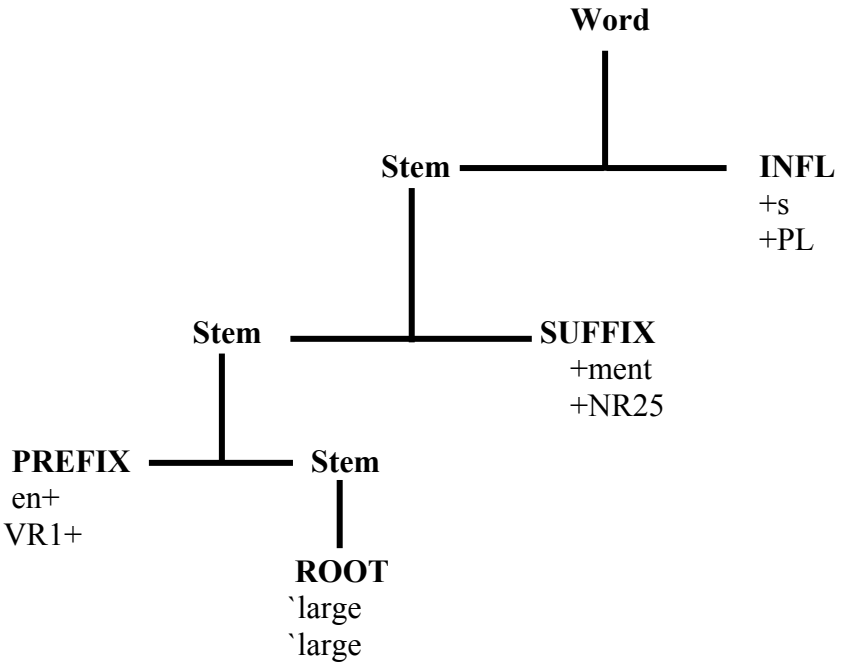
---

essentially a set of attribute-value pairs which can replace an entire tree structure. Features can be represented as attributes with corresponding values, for example, the attribute named *category* might have the values *noun*, *verb*, etc. or the attribute named *number* might have the value *singular* (Hutchins and Somers, 1992:25).

In exactly the same way as the prefix *en-* unifies with the stem *large*, the suffix -ment changes the part-of-speech of the derived stem *enlarge*. The grammar rule, **Stem_1 = Stem_2 SUFFIX**, requires a derived stem should consist of another stem and a suffix following it. Being controlled by this grammar rule and under the feature constraint, <*Stem_2 pos*> = <*SUFFIX from_pos*>, the *from_pos* of the suffix *-ment* (V) must unify with the *pos* of the stem (V), thus allowing the suffix to combine with the stem *enlarge*. There is another feature constraint under the same grammar rule: <*Stem_1 pos*> = <*SUFFIX pos*>. This rule says that the *pos* of stem, not yet determined after the attachment of the suffix, must unify with the *pos* of the suffix (N), which adds [pos: N] to the feature structure for the stem category.

After we have briefly described the concept of *unification* and discussed the way it operates, we now look at the last step in the analysis of the word *enlargements* carried out by version 2 of PC-KIMMO. The word grammar, having received the sequence of morpheme structures of the word, returns a *parse tree*[58] and *feature structure* as can be seen in Figure 3.7:

[58] i.e. a tree that represents the syntactic structure of a string according to some formal grammar (Parse Tree, n.d.).



Word:

[head: [pos: N

number:PL]]

Figure 3.7 Parse Tree and Feature Structure for the Word *enlargements*

In this section, we have attempted to give an overview of the word grammar component of a morphological analyser by focusing on the KIMMO system and its later versions. All the above sections in this chapter are intended to review the critical points of current knowledge on lexical CALL programs, morphology in general, English morphology and computational morphology. The last section below looks at YVZ, i.e. the CALL program developed as a part of this study with the aim of helping Turkish students of English to acquire new vocabulary through a morphological analyser.

3.3 Design of YVZ

We believe that the quality of a CALL program largely depends on the design decisions taken *before* and *during* the development process. What is needed to ensure *efficacy* is an appropriate design model which suggests parameters that determine the pedagogical effectiveness as well as the technological quality of a CALL program. However, employing a certain design model does not always lead to the realisation of the same product as it is conceptualised in the developer's mind at the outset. This is the reason why design is described as a dynamic process which can be easily transformed under the influence of various factors such as pedagogical considerations, limitations of technology and a search for reconciliation between methodology and what technology can do.

The design of YVZ is going to be examined in the light of the ideas mentioned above and how the design parameters shaped the final outcome is going to be discussed on the basis of the literature review presented in the preceding sections.

3.3.1 The Point of Departure

YVZ is an intelligent CALL application with a morphological analyser and has been developed to help Turkish learners of English to improve their vocabulary while reading English texts. The initial motivation for the design of the YVZ system can be said to derive from two sources: *a second language vocabulary acquisition (SLVA) strategy* and *the exploration of a natural language processing technology*, i.e. *morphological parsing*. We support the stance that "pedagogy and technology are equal partners" (Levy, 1997:164) and have tried to establish a "fit" between the SLVA strategy which forms a theoretical basis for YVZ and the capabilities of the NLP technology used for the technical realisation of the program. The following two sections look at these two points of departure, respectively.

3.3.1.1 A SLVA Strategy as a Point of Departure

We have previously mentioned the distinction between *incidental* and *intentional* vocabulary acquisition. Incidental learning does not involve an explicit learning intention but allows peripheral attention to be directed at form whereas intentional learning requires the learner to devote her attention deliberately on form or form-meaning connections rather than attempt to comprehend second language texts. It is a fact that much of L2 vocabulary acquisition occurs incidentally except for the first few thousand most common words. Incidental vocabulary acquisition occurs through extensive reading but the chances that a word is acquired during extensive reading are affected by some factors. In this respect, *morphological knowledge*, as a type of word knowledge, is one of the factors that influence vocabulary acquisition from reading.

Pedagogical pluralism is a currently favoured trend towards the integration of explicit and implicit teaching approaches as opposed to sole implicit (unconscious) vocabulary learning through reading. This trend requires inferencing from the context to be combined with some acquisition strategies. Making use of a variety of learning strategies enables learners to consciously deal with unknown words which eventually leads to vocabulary acquisition and teachers are expected to train learners in their strategy choice.

Schmitt (1997) proposes a taxonomy classifying vocabulary learning strategies along two dimensions. The first dimension subdivides strategies into five groups: *determination*, *social*, *memory*, *cognitive* and *metacognitive*. Determination strategies, whose primary purpose is *the discovery of word meanings*, can be listed as follows:

- analysing the unknown word to spot its constituent elements, i.e. affixes, roots, and its part-of-speech;
- analysing the context to determine the meaning;
- checking for L1 cognate;
- consulting a dictionary (monolingual or bilingual) and,
- using word lists.

Learners can be helped to acquire the skill of using these determination strategies by ICALL applications that provide reading environments where comprehension tasks are carried out through glosses or dictionaries and learners have the opportunity to click on the unknown word to see its constituent morphemes and definitions both in L1 and L2. In this regard, the YVZ system has been designed to enable learners to acquire vocabulary in context and train them to use *determination strategies* to learn as many words as possible. YVZ has the *tool role* in the classroom and facilitates a student-centred learning environment where each learner has the opportunity to click on any word on which he/she wishes to get information. If the learner asks the system to analyse the word, an analysis process is automatically activated and the constituent affixes and the stem are displayed. Furthermore, the learner can also determine the type of the information he/she needs by clicking on the same word again and selecting one of the two options in a small menu appearing next to the unknown word, namely 'Analyse this word..' for the *definition in English* or 'Translate the stem..' for the *translation into Turkish*.

YVZ, by automatically dividing the unknown word into its constituent elements, shows the student the importance of morphological knowledge in the discovery of word meanings. Learners become more aware of different functions of affixes and various meanings they add to the word. YVZ also has the student take up the habit of using dictionaries in reading. Learners learn how to relate a number of different definitions of the same word to its contextual meaning.

3.3.1.2 A Natural Language Processing Technology as a Point of Departure

As we mentioned previously in this chapter, there are four issues to be handled in order to develop a system incorporating a morphological analyser:

1. building a computational lexicon;
2. dealing with orthographic variations between the surface form of words and their lexical forms in the lexicon occurring as a result of morpheme concatenation;
3. determining which morphemes can combine with each other;

4. determining how these morphemes can be grouped and how their morphosyntactic features can be combined so that the part of speech of the overall word can be arrived at.

The YVZ system, whose primary function is to help Turkish learners to read English texts and improve their vocabulary, has been specifically designed to address the issues listed above. YVZ, has two basic components: 1) the lexical component, and 2) the segmentation module. In the framework we propose (see Figure 3.13) for the morphological treatment, there is not a word grammar to carry out morphosyntactic analysis or a separate component for morphographemic (spelling) rules. The lexical component of the YVZ system is composed of a stem dictionary, suffix and prefix dictionaries, a bilingual (English-Turkish) dictionary and a monolingual (English definitions) dictionary. The stem dictionary is made up of around 8,500 lexical items but it can recognize several times this number of English words since the system analyzes productive morphology. The YVZ stem dictionary can be said to be an exhaustive lexical source in the sense that each entry in the dictionary contains linguistic information specifying two-level spelling features as well as morphosyntactic feature constraints to control morphotactic phenomena and unification. The prefix and suffix dictionaries in the YVZ system not only provide morphosyntactic information for English prefixes and suffixes in the same way as the stem dictionary does for stems but also specify the functions and/or meanings of the English prefixes and suffixes. The other two dictionaries, namely the monolingual and bilingual dictionaries, are used to find the definitions of the stems that have just been spotted through morphological analysis. Building such a comprehensive lexical component excludes the necessity for a 'word grammar' component or a separate module that handles orthographic variations. The segmentation module in YVZ is intended to scan the given word and divide it into its constituent morphemes making use of the rich information supplied by the dictionaries. Another important task carried out by this component is related to feature-combination. The segmentation module checks the unification codes of the lexical items in the dictionaries and allows them to unify if none of their constituent features have conflicting values.

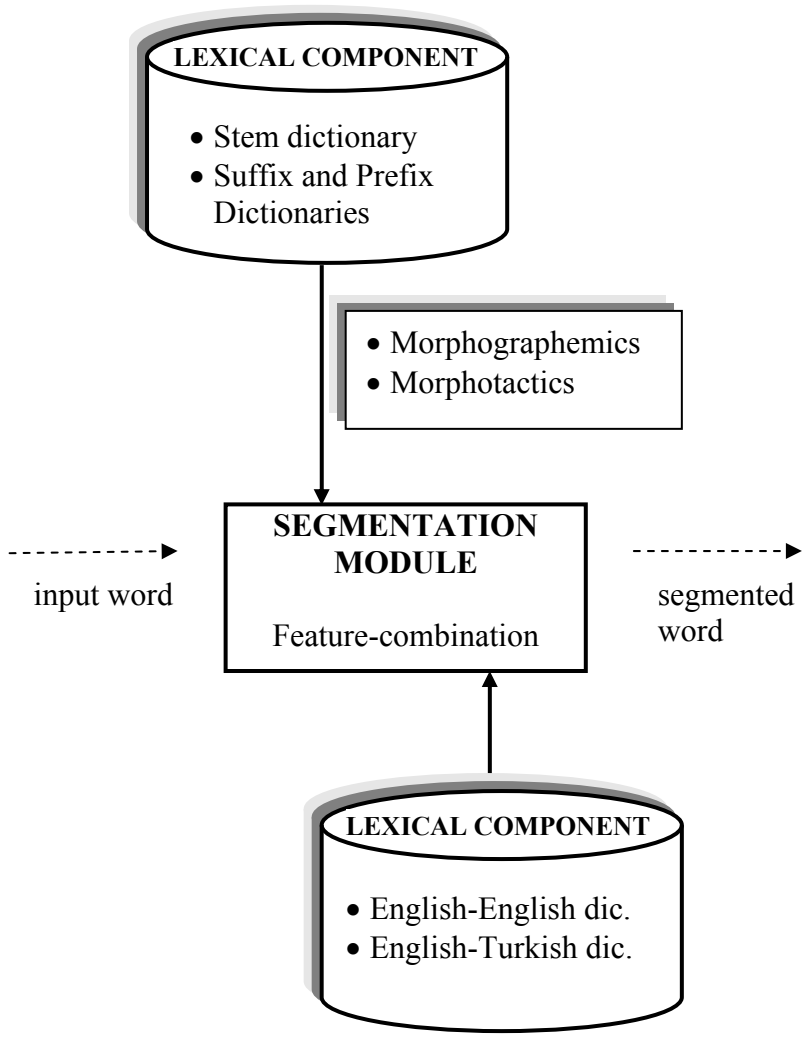


Figure 3.8 The YVZ Architecture for Morphological Analysis

A typical lexical entry for verbs in the YVZ stem dictionary has four fields separated by a comma as can be seen in the example below:

(1) "appl","y2i;+2c","v2101","apply"

The first field in the entry contains the stem *appl* which is not actually an English morpheme; however, the verb *apply*, as a result of various concatenation processes, undergoes orthographic changes on the surface and it is not possible for the segmentation module to spot the root in such surface forms of the verb if the

dictionary has only lemmas (canonical forms of lexemes). For example, the word *application* is the surface realisation of the lexical form *apply + ation*. In order to account for the mechanism leading to this underlying representation from the surface form of the word we should first form a two-level representation:

(2) Lexical Form: a p p l y 0 + a t i o n

Surface Form: a p p l i c 0 a t i o n

As can be seen in the example (2), the lexical character *y* is realised as *i* in front of an epenthetic *c* after which the morpheme boundary (+) changes into a null character (0). To have the analyser apply this spelling rule the second field of the relevant lexical entry has the representation *y2i;+2c*.

The third field of the verbal lexical entry given in the example (1) contains the feature specification code *v2101*. The first character in the code (v) stands for the part-of-speech of the item, namely *verb*. The second character is a number which allows control of affixation as to whether the stem can be attached certain suffixes such as *–ation*, *–ative*, *–ion*, *–ive*. For example the word *activation* can be taken to be the concatenation of *active*, *–ate* and *–ion*, which allows the existence of *activate* as an independent word. However, in the case of the word *presentation*, the suffix *–ation* should be taken to form the word, thus not allowing the existence of an independent word **presentate*. The second character in the feature specification code can be either *2* meaning the suffixes *–ation*, *–ative* and *–atory* are allowed to be attached to the relevant stem, or *1* placing a constraint on this affixation. The third character (1) in the code indicates whether the verbal item is inflectable. The fourth character (0) gives information about the form of the verbal item with regard to *tense* and *finiteness*, i.e. whether it is the base form, simple past form or the past participle form. The last character in the feature specification code says whether the verbal item has regular past forms.

The fourth field in the example (1) shows the citation form (lemma) of the verbal item in the entry. The stem found after the morphological parsing may not always be an independent morpheme and in that case it is to be replaced with the relevant canonical form. For example, the word *application* will be segmented into a stem *appli* and a suffix *–ation*. However the YVZ system, which is basically

intended to serve as a CALL application, should be able to show to the user that the noun *application* is derived from the root *apply*.

The suffix and prefix dictionaries use similar notation to inform the segmentation module about the morphotactic constraints and unification codes associated with each lexical item, which eventually enables the module to carry out *unification*. Each entry in these dictionaries specifies two additional features. One of these features is the part-of-speech of the stem to which the affix can be attached and the other is the part-of-speech of the resulting derived stem. For example, the feature specification code of the suffix *–ity* is *san*, which indicates that it is a suffix (s), it can be attached to an adjective (a) and the stem it is attached to becomes a noun (n).

3.3.2 Limitations of the Software

YVZ's stem dictionary is made up of around 8,500 lexical items, which is much smaller than a full dictionary but it can recognize several times this number of English words since the system analyzes productive morphology. However, it has some certain limitations, some of which simply arise from a number of pedagogic decisions. All the limitations of the dictionary can be listed as follows:

- Homonyms that have different parts of speech such as the noun *colour* and the verb *colour* cannot be distinguished. When the user clicks on the word *colours* in, for example, 'Do you think she colours her hair?', the systems returns *colour* + *s* showing that the nominal stem has been added the plural -s.
- If a word has taken on new meanings since it was regularly derived from a root such as *compute*r (compute + er), *govern*ment (govern + ment) or *busi*ness (busy + ness), it is not decomposed and listed in the lexicon in its full form. We think that decomposing such words is of virtually no pedagogic use and very likely to confuse the learner.
- If a word can only be etymologically related to its root which may be a free morpheme such as *calculus* (in calculate) or *letter* (in literal), a bound morpheme such as *ceive* (in deceive), a word that is no longer in

wide currency such as *resile* (in resilient) or a word having an archaic meaning such as *import* (in important), the word is not decomposed as we see little pedagogic value in revealing such etymological relations to the student.

- While hyphenated compounds (e.g. *quick-tempered)* or solid compounds (e.g. *bedroom*) are handled by YVZ, open compounds (e.g. *distance learning*) as well as phrasal verbs (e.g. *look up*) cannot be analysed by the system.

3.4 A Model for the Integration of YVZ into the Language Classroom

In a *constructivist learning environment*, the focus of instruction is no longer on the transmission of knowledge from the teacher to the learner as supported by the proponents of the behaviourist approach incorporating explicit and didactic teaching activities. Constructivism is basically 'a learner-centred approach to learning' that encourages learners to freely and actively construct their own knowledge and understanding. Howard (2003) explains how the constructivist theory encourages knowledge construction:

> … a constructivist learning environment provides multiple perspectives and realities, a 'real-world' environment that emphasises 'real-world' complexity and multiple solution paths, social collaboration between peers and the teacher to 'develop and shape' knowledge structures...

In a CALL environment informed by the constructivist view of learning, the teacher takes on the *learner role* and works with the student to construct new knowledge together while the computer serves as a *tool* that the teacher and student can use collaboratively to achieve their aim. Similarly, we propose an ICALL environment with YVZ where learners can work collaboratively with both the teacher and their classmates to construct their own knowledge and are allowed to "pace their own learning" and actively participate in the learning process (Howard, 2003). In our model, the teacher plays the role of a *learner* as a *meaning-constructor* and serves as a *motivator* who provides students with incentives to build up their

knowledge. We suggest that the following tasks be performed in an ICALL environment with YVZ:

- Learners use YVZ as a tool to carry out morphological analyses while reading English texts.
- The system provides learners with all possible definitions of the stem whose affixes have just been stripped off.
- In order to arrive at the contextual meaning of the word, students have to rely on the context where the analysed word occurs and check all the possible definitions of the stem one by one.
- They discuss with their teacher and peers to discover what the relevant definition of the stem might be by considering all the possible definitions (both in English and Turkish) supplied by the system.
- Discussions may take place in pairs, in groups or in a whole-class setting, with the teacher participating in the activity as *a meaning-constructor* with interest and enthusiasm to discover the stem's 'correct' definition specific to the context. The teacher, behaving like *an eager learner* who is seeking an answer to satisfy his/her curiosity, will *motivate* students and encourage them to continue whatever they are doing to achieve their aim.

Figure 3.9 illustrates 'the suggested ICALL environment with YVZ' informed by the constructivist view of learning:

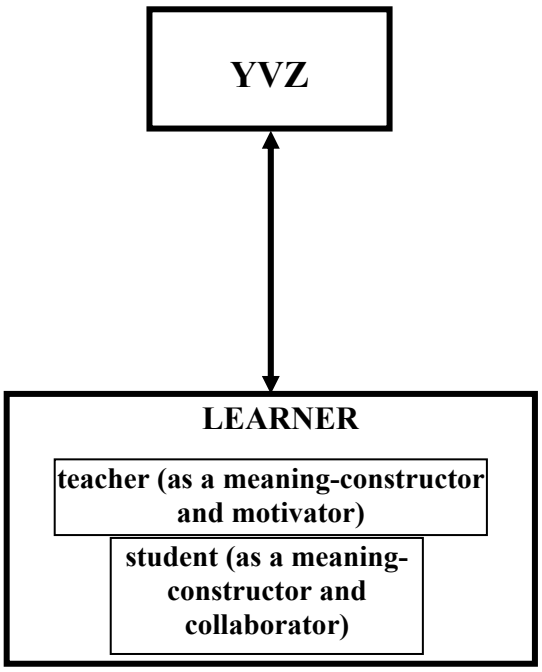


Figure 3.9 The Proposed ICALL Environment with YVZ

To improve our understanding of the way the YVZ system works, we should look at the following imaginary CALL scenario where it is illustrated step by step how YVZ can be used in a language classroom:

Step 1: The teacher asks learners to open a text file. Having carried out a number of pre-reading activities, he/she gets them to read the text to answer some comprehension questions by allocating a time slot. In the course of the warm-up activities the instructor does not take on the 'learner role' yet but leads the way. As soon as the main reading task begins, his/her role 'as a class leader' comes to an end. The learner begins reading and if he/she comes across with an unknown word which may prohibit the comprehension of the text, he/she clicks on this word and then sees a small menu that displays a text saying 'Analyse this word..'. The text is clicked and a morphological analysis process is automatically activated (see Figure 3.10).

Step 2: The stem and affixes are displayed in the bottom window on the left. Font colours and size of the characters used to show the outcome of the morphological analysis are specially chosen to draw the learner's attention to this window. The top window on the right shows the meaning of the root in English. If

the root has more than one definition, all the definitions are provided in the same window each accompanied by an example. If the learner has difficulty in understanding the definition(s) of the root, he/she can also click on any unknown word in the definition window to get it analysed by the system. The smaller window under the definition is intended to describe the function (or the meaning) of each affix in the decomposed word. Spelling rules for the root and suffixes can be seen in the two small bottom windows on the right, respectively. Students discuss with their peers and/or their instructor with the aim of discovering the relevant definition of the stem or the possible function(s) of the affix(es). They check the context and all the definitions carefully and try to come to a conclusion (see Figure 3.11).

Step 3: The learner is given the opportunity to see the translation of the word only if the same word is clicked twice. The reason why the translation option is not in the menu which appears on the first click is that we do not want to encourage the learner to see the Turkish definition immediately. When the learner clicks on the same word again, a menu with the additional option 'Translate the stem..' is seen near the word and if this new option is selected, the definition window on the right shows the relevant translation (see Figures 3.12 and 3.13).

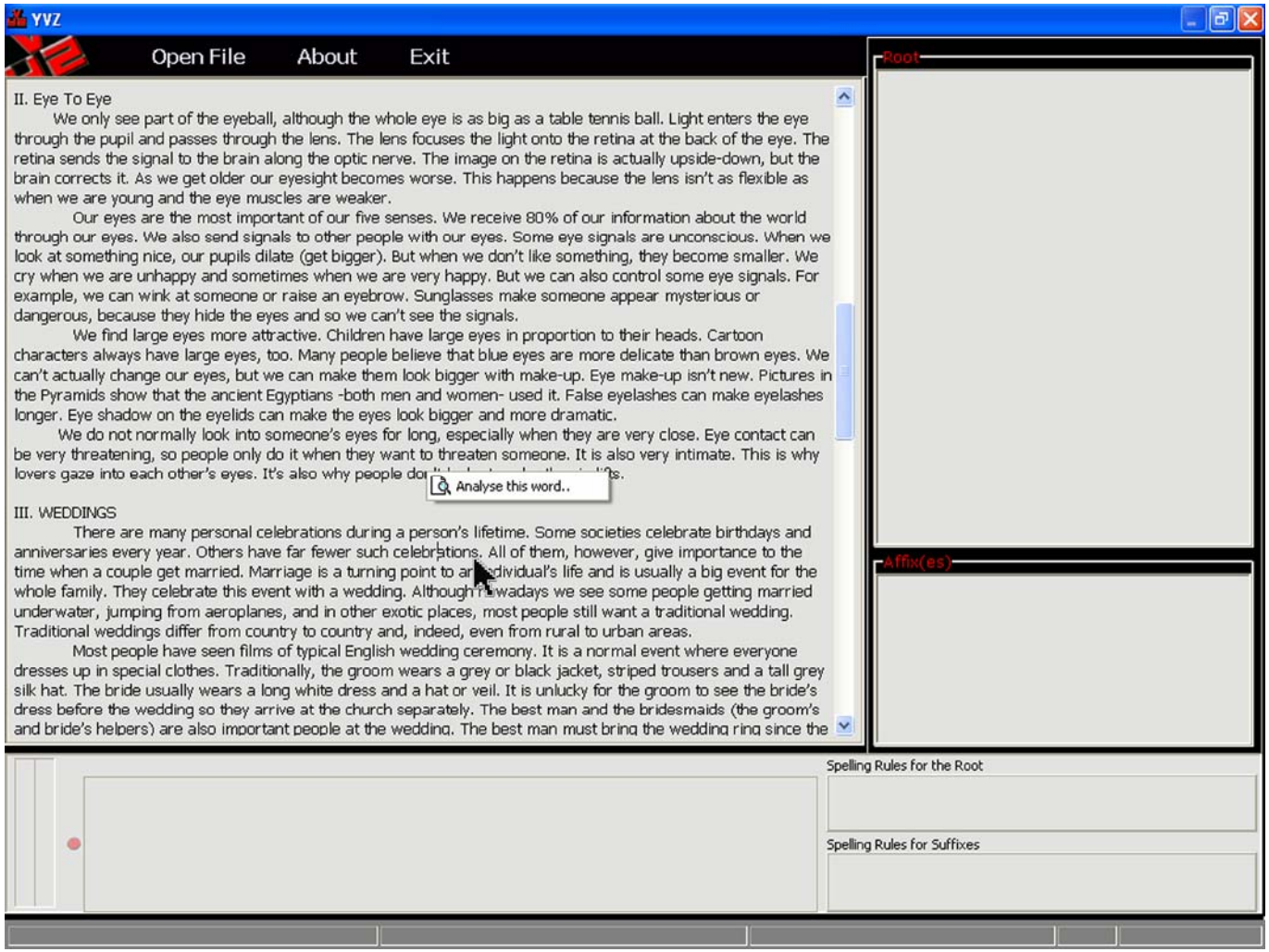


Figure 3.10 YVZ user interface – I

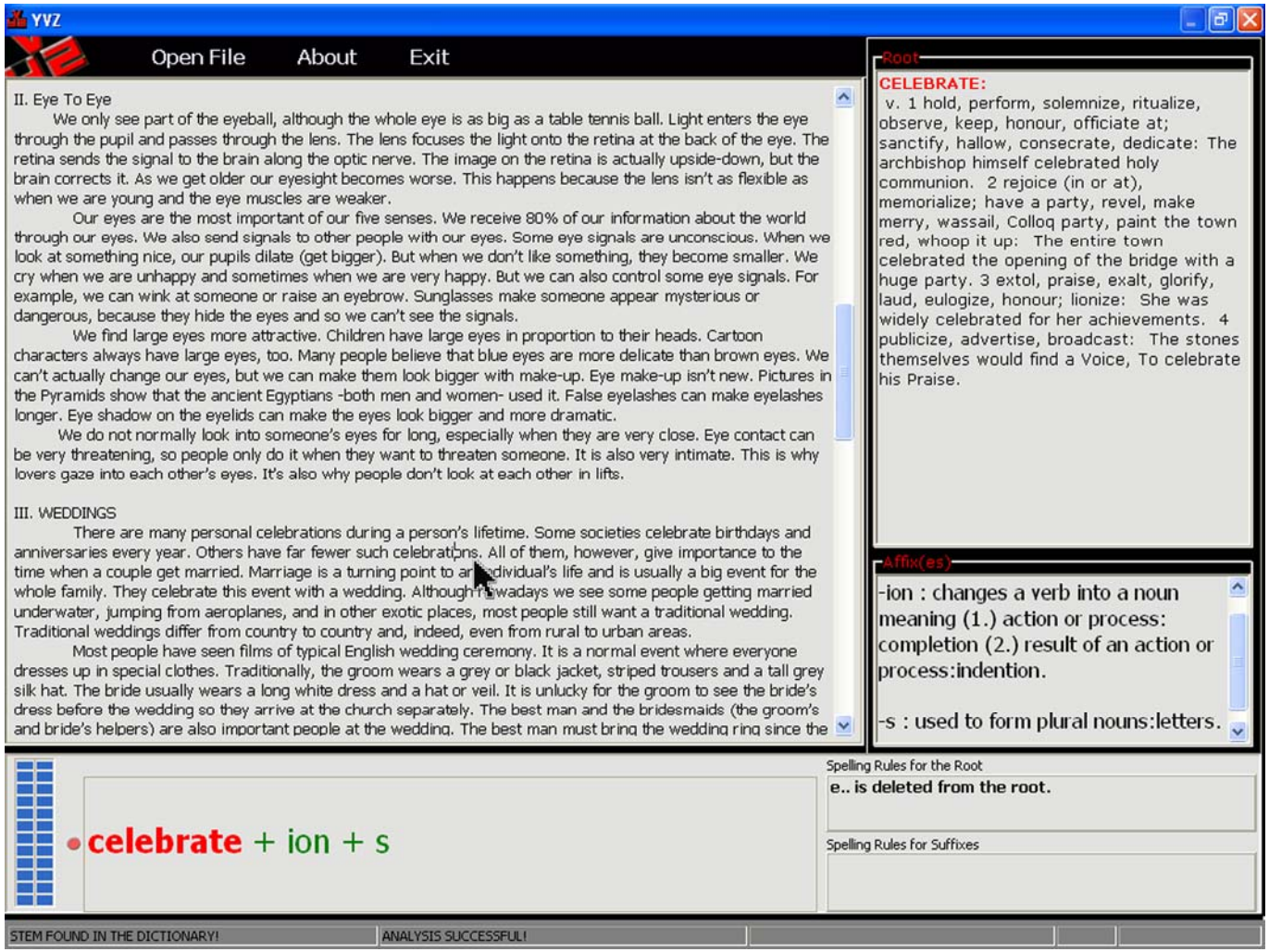


Figure 3.11 YVZ user interface – II

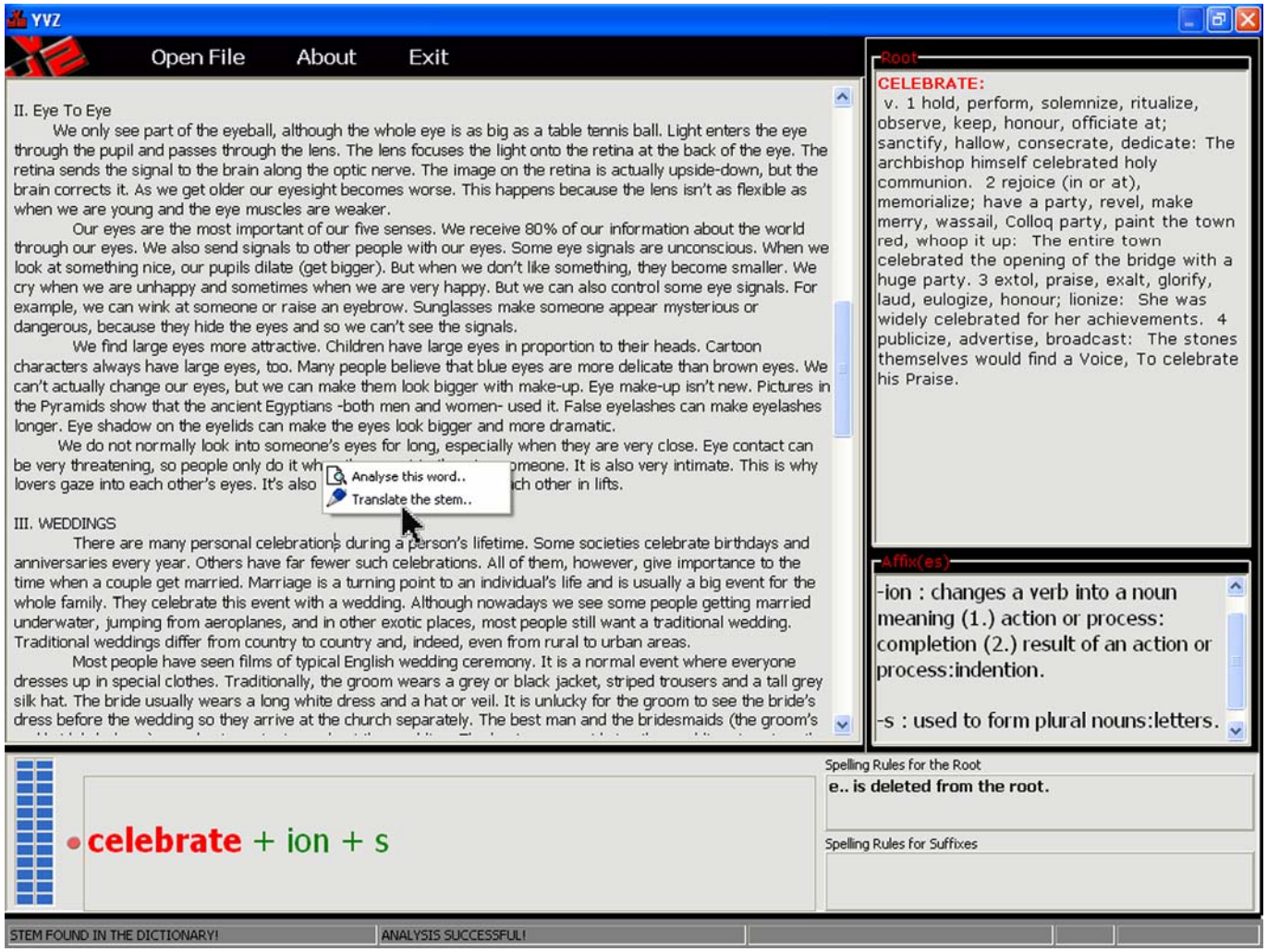


Figure 3.12 YVZ user interface – III

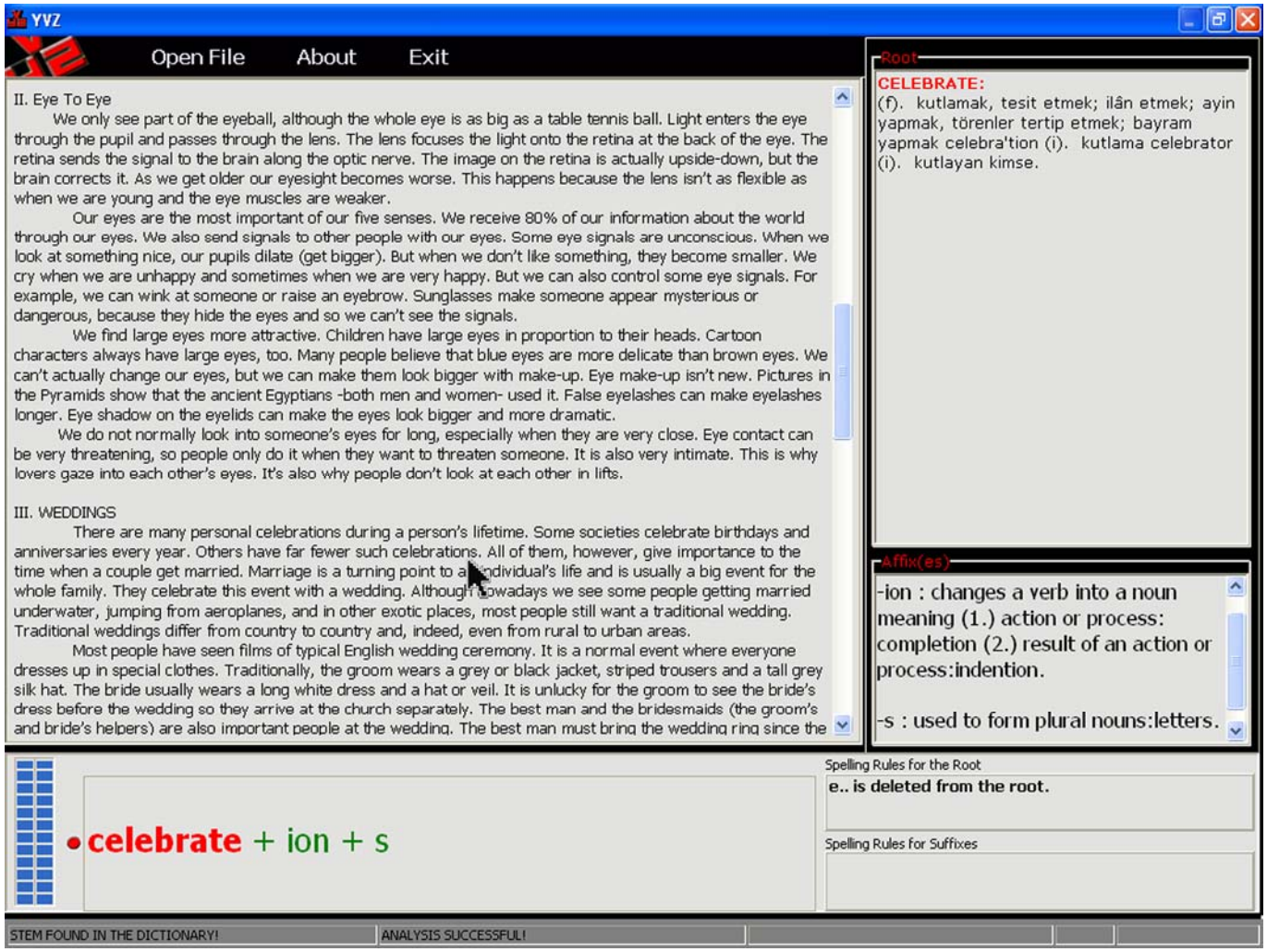


Figure 3.13 YVZ user interface – IV

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

In this chapter, the methodology used in the current study is described. The chapter first details the research design and experimental task. Next, descriptions of the universe and the sample of the study are given. Finally, the procedures, data collection methods and data analysis techniques are delineated.

4.2 Research Model

Two groups of English preparatory class students at Izmir Institute of Technology (IZTECH), Turkey, participated in the study. Their language level was determined through a multiple-choice proficiency test delivered at the beginning of the 2006-2007 academic year. They were 42 low intermediate learners studying English full time for university academic preparation and had randomly been divided into two classes by the administration, namely C8U and C2U. C8U contained 19 students while there were 23 students in C2U.

This study employed a pretest-posttest control group design. The experimental group members in the first group (C8U) were exposed to reading activities in the computer lab with YVZ, i.e. the ICALL application developed for this research. The control group (C2U) followed a conventional reading program through traditional techniques, such as the use of monolingual and bilingual dictionaries or guessing word meaning from the context. Both groups used the same reading book written by the instructors at IZTECH but the experimental group saw only the electronic version.

The *Self-Report Vocabulary Mastery Scale* (SVMS), developed by the author out of the model proposed by Paribakht and Wesche (1993), was delivered as pre- and post-tests of the study. The reliability of this scale was measured using Cronbach's alpha. The content validity was determined via the opinions of three experts who had used similar scales before.

Learners' attitudes towards YVZ were measured through the *ICALL Attitude Scale* which was also developed by the author. It is a 6-point Likert-type scale and consists of 10 items for *the usefulness of ICALL*, 5 items for *ICALL anxiety* and 4 items for *the perception of an ICALL classroom*. It was administered before and after the experimental period. The reliability of this scale, like that of the SVMS, was measured using Cronbach's alpha after the content validity was determined via the opinions of experts working in the Department of Foreign Languages at IZTECH and Dokuz Eylul University.

4.3 The Universe and the Sample

The universe of the study is English preparatory class students at Izmir Institute of Technology. The sampling of the study was chosen from among these students who were 42 low intermediate learners randomly divided by the administration as follows: C8U, 19 students; and C2U, 23 students. The students in C8U were assigned to experimental group, and those in C2U to control group. These assignments were not random but made under some constraints in the schedule: the instructor' schedule did not fit the timetable of the computer lab except for Tuesday afternoon when he teaches C8U.

All the students from C8U volunteered to participate in the experiment but only 17 of them took both tests. With regard to C2U, six students did not take the *Self-Report Vocabulary Mastery Scale* while four students did not take the *ICALL Attitude Scale.* As a result, pre- and post-tests of the *Self-Report Vocabulary Mastery Scale* were delivered to the same 34 students (17 from C8U, 17 from C2U) whereas those of the *ICALL Attitude Scale* were administered to 36 students (17 from C8U and 19 from C2U).

Table 4.1

The Distribution of the Participants

Groups	Classes	Number of Students
Experiment	C8U	19
Control	C2U	23

4.4 Data Collection

In this study, data were collected through the following two scales:

1) *Self-Report Vocabulary Mastery Scale*: It is maintained that the use of standard measuring tools such as multiple-choice tests or matching tests may not be very fruitful to assess both receptive and productive vocabulary (Waring, 1999) besides their other shortcomings. Self-report vocabulary tests, on the other hand, require learners to rate their own vocabulary knowledge on a scale by selecting a pre-defined response representing the level of their knowledge of a word. There are no right or wrong answers to these tests as each response selected indicates a stage of knowing the word. A wrong answer in a standard vocabulary test means that the item is 'not known' and a right answer shows that the learner 'knows it' but says nothing about 'to what extent it is known'. However, this cannot be the case in actual vocabulary acquisition because there are various intermediate levels between the extremes of *thorough mastery of a word* and *complete lack of knowledge*. Waring (1999:chapter 4) states that "Vocabulary Knowledge Scales are used to assess developments or changes in word knowledge" and itemises a number of scales of this type. Segler (2001:16) argues that "tests of depth of lexical knowledge" can be classified into two groups: (a) those investigating the different aspects of vocabulary knowledge, and (b) those attempting to measure levels of knowledge representing the stages in vocabulary acquisition. He further asserts that Vocabulary Knowledge Scales (VKS) mainly fall in category (b) and gives one of the best-known Vocabulary Knowledge Scales, namely that of Paribakht and Wesche (1993), as an example:

I. I don't remember having seen this word before.
II. I have seen this word before, but I don't know what it means.
III. I have seen this word before, and I think it means:_____ (synonym or translation)
IV. I know this word. It means:_____ (synonym or translation)
V. I can use this word in a sentence:_____ (Write a sentence)

Waring (1999:chapter 4) expresses a number of criticisms about 'the present forms' of Vocabulary Knowledge Scales on the following grounds:

- These tests assume that the levels in the scale correspond to acquisition stages and *receptive vocabulary*[59] should be lower on the scale than *productive vocabulary*, which "is still a matter for theorists to show".
- "The tests are very heavily balanced in favour of the Receptive ability."
- They "suffer from description difficulties which make them internally inconsistent in several ways. There are a variety of keywords used as knowledge prompts such as *know*, *have seen*, *means* and *can use*. A learner could know a word but have never seen it in writing, but know the pronunciation of it".
- "…the assignment of ordinal numbers to the stages of the scale makes interpretation rather difficult." The problem is that it is not always clear what construction should be put on differences between the mean scores on a pre-test and a post test. Would a gain of 0.5, for example, mean that "the word is better known, or more often recognized, or better used?"
- "In Wesche and Paribakht's scale the knowledge required is multi-faceted and thus not linear, but the scoring is linear. This conflict…means that their scoring method makes the non-linear nature of the knowledge into a linear scale, and thus misrepresents the nature of the knowledge provided by the learner."

The *Self-Report Vocabulary Mastery Scale* (SVMS) has been developed by the author in an attempt to refine the Vocabulary Knowledge Scale devised by

[59] Segler (2001:12) defines productive word knowledge as "what one needs to know about a word in order to use it in speaking or writing" while he describes receptive word knowledge as "the word knowledge needed to understand a word while reading or listening".

Paribakht and Wesche (1993) in the light of the criticisms listed above (see Appendix II). The main features of the SVMS and the underlying theoretical framework that make it different from the VKS can be listed as follows:

- Even though the SVMS assumes that the levels in the scale correspond to vocabulary acquisition stages, it is different from VKS in that it does not regard receptive vocabulary as lower on the scale than productive vocabulary. Although it is logical that receptive vocabulary usually precedes productive vocabulary, it is maintained that the borders between receptive and productive vocabulary knowledge are not fixed and "each of the different types of word knowledge is arguably known to different receptive and productive degrees" Segler (2001:12-13). Consequently, learners are required to verify both types of knowledge together at each level of the scale, which further enables the scale to be evenly balanced.

- To facilitate an objective interpretation of any possible differences between the mean scores on a pre-test and a post test two different aspects of word knowledge are measured within the same scale. The VKS is said to assess "the initial recognition and use of new words" (Wesche and Paribakht, 1996:29, as cited in Waring, 1999) whereas the SVMS can measure the extent of comprehension and use as well as morphological knowledge.

- The scoring method adopted by the SVMS (see Appendix III) lends itself to the assessment of the multi-faceted knowledge required in the scale, thus preventing any possible misrepresentations of that knowledge.

The SVMS used in this study is intended to measure learners' depth of knowledge of ten words as to two different aspects of lexical knowledge. In fact, it requires learners to scale their own knowledge with actually twenty test items, i.e. ten words from two aspects (10 X 2 = 20).

The SVMS was administered to 101 pre-intermediate level students at the Department of Foreign Languages, Izmir Institute of Technology and its reliability

was tested measuring the internal consistency. An item with a low item-total correlation was changed. The instrument's reliability was tested again using Cronbach's alpha, which was found to be 0.72.

2) *ICALL Attitude Scale*: This scale has been developed with the aim of revealing changes in learners' attitudes towards using an ICALL program that helps them to develop their vocabulary (see Appendix VI).

The scale consisted of 20 items but an item with a low item-total correlation was excluded. The modified version contains 10 items for *the usefulness of ICALL*, 5 items for *ICALL anxiety* and 4 items for *the perception of an ICALL classroom*. The reliability coefficient of the scale is 0.89.

4.5 The Procedure

The procedural steps of the study are presented as follows:

1. The instruments for data collection were developed;
2. Experiment and control groups were assigned;
3. The Self-Report Vocabulary Mastery Scale (SVMS) and the ICALL Attitude Scale were administered to both groups;
4. Data gathered from the administration of the scales were analysed;
5. Both groups were taught by the same instructor during the research period of six weeks;
6. The Self-Report Vocabulary Mastery Scale (SVMS) and the ICALL Attitude Scale were administered to both groups again within one week after the experiment was completed;
7. Data gathered from the post-tests were analysed and compared with the results of the pre-tests.

4.6 Data Analysis Techniques

The quantitative data collected throughout the study were analyzed using SPSS Package Program for Windows, Version 13.0. Mean scores and standard deviations for each variable were calculated and given in tables. The independent samples *t* test was used to study the differences in continuous variables between the experiment and control groups.

CHAPTER FIVE

FINDINGS AND COMMENTS

5.1 Introduction

In this chapter, the findings of the study in response to the following research questions, as stated in Chapter One, are presented:

1. Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' *vocabulary knowledge*?
    a. Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' vocabulary with regard to *the development of morphological knowledge*?
    b. Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' vocabulary with regard to *the learning of words' definitions and use*?
2. Do 'reading activities with YVZ' affect learners' *overall attitudes* to ICALL compared with 'traditional reading activities'?
    a. Do 'reading activities with YVZ' affect learners' opinions of *the usefulness of ICALL programs* compared with 'traditional reading activities'?
    b. Do 'reading activities with YVZ' affect learners' *anxiety about ICALL programs* compared with 'traditional reading activities'?
    c. Do 'reading activities with YVZ' affect learners' *perceptions of ICALL lessons* compared with 'traditional reading activities'?

5.2. Research Question I

- Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' *vocabulary knowledge*?

Table 5.1

Mean scores and Standard Deviations for Research Question I

Scale Type	Group Type	N	Mean	Std. Deviation	Std. Error Mean
Pre-test (vocabulary knowledge)	experiment	17	2.1582	.41451	.10053
	control	17	2.0259	.38688	.09383
Post-test (vocabulary knowledge)	experiment	17	2.7506	.55325	.13418
	control	17	2.2429	.42061	.10201

As can be seen in Table 5.1, the experimental group seems to have a slightly higher mean score in the pre-test compared to that of the control group. However, the mean performance scores in the post-test indicate a much more significant difference between these two groups. In order to determine whether this is a real difference (statistically significant) we need to examine the next table that shows the independent samples *t* test results.

Table 5.2

T-test Results for Research Question I

Scale Type	t	p	Mean Difference
Pre-test	.962	.343	.13235
Post-test	3.012	.005*	.50765

*p<.05

The results in Table 5.2 indicate that there is a statistically significant difference between the mean *vocabulary knowledge* scores in the post-test for the experimental and control groups (t = 3.012, p = .005). To put it differently, the experimental group has a statistically significantly higher mean score (2.75) than the control group (2.24) in the post-test while the pre-test scores do not reveal such a statistically significant difference (t = .962, p = .343) between the two groups. This means that the students who followed the traditional reading program did not show as great of gains as the students in the ICALL classroom as to their pre- and post-test scores.

5.3. Research Sub-Question I-a

- Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' vocabulary with regard to *the development of morphological knowledge*?

Table 5.3

Mean scores and Standard Deviations for Research Sub-Question I-a

Scale Type	Group Type	N	Mean	Std. Deviation	Std. Error Mean
Pre-test (morphology)	experiment	17	2.3294	.47271	.11465
	control	17	2.1765	.41160	.09983
Post-test (morphology)	experiment	17	2.8794	.49783	.12074
	control	17	2.4029	.51035	.12378

As is clear in Table 5.3, the experimental group's mean increased from 2.32 to 2.87. This increase seems a lot higher than the increase in the mean scores of the control group. To statistically analyze and compare both groups' gain in achievement between pre- to post-test we need to examine the next table that shows the independent samples *t* test results.

Table 5.4

T-test Results for Research Sub-Question I-a

Scale Type	t	p	Mean Difference
Pre-test (morphology)	1.006	.322	.15294
Post-test(morphology)	2.756	.010*	.47647

*p<.05

The t-test results in Table 5.4 indicate that there is a statistically significant difference between the mean *morphological knowledge* scores in the post-test for the experimental and control groups (t = 2.756, p = .010). In other words, the t-test for group differences between the experimental group and control group is t = 2.756, p = .010, which is significant at .05 level; therefore, we can conclude that the students in the ICALL classroom outperform their peers who had traditional instruction. The use of YVZ in enhancing vocabulary leads to higher student achievement with regard to *morphological knowledge*.

5.4. Research Sub-Question I-b

- Do 'reading activities with YVZ' and 'traditional reading activities' differ in enhancing EFL learners' vocabulary with regard to *the learning of words' definitions and use*?

Table 5.5

Mean scores and Standard Deviations for Research Sub-Question I-b

Scale Type	Group Type	N	Mean	Std. Deviation	Std. Error Mean
Pre-test (definitions and use)	experiment	17	1.9824	.42937	.10414
	control	17	1.8706	.41835	.10147
Post-test (definitions and use)	experiment	17	2.6147	.69457	.16846
	control	17	2.0794	.47337	.11481

As evident in Table 5.5, the experimental group has a far higher mean score in the post-test compared to that of the control group and the experimental group's mean increased from 1.98 to 2.61 whereas the control group's mean does not seem to have increased so sharply. Table 5.6 shows the independent samples *t* test results.

Table 5.6

T-test Results for Research Sub-Question I-b

Scale Type	t	p	Mean Difference
Pre-test (definitions and use)	.769	.448	.11176
Post-test (definitions and use)	2.626	.013*	.53529

*p<.05

As seen in Table 5.6, there is a significant difference between the experimental and control groups, with the experimental students having a lot higher mean scores in the post-test (t = 2.626, p = .013). In other words, the use of YVZ in the classroom leads to higher student achievement with regard to their learning *words' definitions and use*.

5.5. Research Question II

- Do 'reading activities with YVZ' affect learners' *overall attitudes* to ICALL compared with 'traditional reading activities'?

Table 5.7

T-test Results for Research Question II

Scale Type	t	p	Mean Difference
Pre-test (overall attitudes)	1.786	.083	.31512
Post-test (overall attitudes)	2.844	.007*	.45147

*p<.05

The results of the t-test (Table 5.8) denote that a significant difference is present between groups in favour of the experimental group (t = 2.844, p = .007), with regard to their *overall attitudes towards ICALL*.

5.6. Research Sub-Question II-a

- Do 'reading activities with YVZ' affect learners' opinions of *the usefulness of ICALL programs* compared with 'traditional reading activities'?

Table 5.8

T-test Results for Research Sub-Question II-a

Scale Type	t	p	Mean Difference
Pre-test (ICALL usefulness)	1.443	.158	.28789
Post-test (ICALL usefulness)	2.100	.043*	.41063

*p<.05

The t-test results in Table 5.9 indicate that there is a statistically significant difference between learners' opinions of *the ICALL usefulness* (t = 2.100, p = .043). The difference between the attitudes of the groups with regard to *the ICALL usefulness* does not seem to be statistically significant before the experiment. It can be inferred from the results that the experiment with YVZ generated more positive attitudes towards ICALL programs.

5.7. Research Sub-Question II-b

- Do 'reading activities with YVZ' affect learners' *anxiety about ICALL programs* compared with 'traditional reading activities'?

Table 5.9

T-test Results for Research Sub-Question II-b

Scale Type	t	p	Mean Difference
Pre-test (ICALL anxiety)	1.192	.241	.23839
Post-test (ICALL anxiety)	2.340	.025*	.42353

*p<.05

As evident in Table 5.10, there is a significant difference between the two groups (t = 2.340, p = .025) as to their *anxiety about ICALL programs*. These results suggest that the students involved in the ICALL program with YVZ had positive attitudes about the experience and they did not feel as much anxious towards ICALL as their counterparts in the control group.

5.8. Research Sub-Question II-c

- Do 'reading activities with YVZ' affect learners' *perceptions of ICALL lessons* compared with 'traditional reading activities'?

Table 5.10

T-test Results for Research Sub-Question II-c

Scale Type	t	p	Mean Difference
Pre-test (perception of ICALL lessons)	2.027	.051	.47910
Post-test (perception of ICALL lessons)	2.228	.033*	.58359

*p<.05

The t-test results in Table 5.11 indicate that there is a statistically significant difference between learners' *perceptions of ICALL lessons* (t = 2.228, p = .033). Considering the insignificant difference between the two groups with regard to their *perception of ICALL lessons* before the experiment, it can be concluded that the experiment with YVZ affected the experimental group's perception more positively.

CHAPTER SIX

CONCLUSIONS, DISCUSSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study was conducted to investigate the effectiveness of 'a CALL program with a morphological analyser' on Turkish students' vocabulary learning. In order to achieve the objectives of the study, *YVZ*, which is an intelligent CALL application, was developed by the author. Empirical analyses were carried out to provide evidence in favour of the pedagogical effectiveness and technological quality of YVZ. Students' attitudes towards using the CALL application in the classroom and what they have achieved in terms of vocabulary acquisition were carefully measured by selecting an appropriate empirical research method. This study employed a *pretest-posttest control group design* and the following research hypotheses and sub-hypotheses were raised before the research:

Hypothesis 1: 'Reading activities with YVZ' enhance EFL learners' *vocabulary knowledge* more than 'traditional reading activities' can do.

Hypothesis 1a: 'Reading activities with YVZ' enhance EFL learners' vocabulary with regard to *the development of morphological knowledge* more than 'traditional reading activities' can do.

Hypothesis 1b: 'Reading activities with YVZ' enhance EFL learners' vocabulary with regard to *the learning of words' definitions and use* more than 'traditional reading activities' can do.

Hypothesis 2: 'Reading activities with YVZ' positively affect learners' *overall attitudes* to ICALL compared with 'traditional reading activities'.

Hypothesis 2a: 'Reading activities with YVZ' positively affect learners' opinions of *the usefulness of ICALL programs* compared with 'traditional reading activities'.

Hypothesis 2b: 'Reading activities with YVZ' positively affect learners' *anxiety about ICALL programs* compared with 'traditional reading activities'.

Hypothesis 2c: 'Reading activities with YVZ' positively affect learners' *perceptions of ICALL lessons* compared with 'traditional reading activities'.

All the hypotheses were tested and confirmed experimentally (see the findings in Chapter Five). The results indicate that 'reading activities with YVZ' have proved to have positive effects on both learners' vocabulary learning and their attitudes towards the use of an intelligent CALL application in the classroom. The improvement in the vocabulary knowledge of the participants was measured as to two different aspects, i.e. *morphological knowledge* and the *knowledge of words' definitions and usage*. The t-test results indicate that the experimental and control groups have significantly different mean scores for *knowledge of morphology* ($t = 2.756$, $p = .010$) and *that of words' definitions and usage* ($t = 2.626$, $p = .013$), with the experimental students scoring higher as to both aspects. As for Turkish learners' attitudes towards the use of an ICALL application in the classroom, the t-test results clearly show that the experimental students had significantly higher mean scores on *the usefulness of ICALL programs* ($t = 2.100$, $p = .043$), *anxiety about ICALL programs* ($t = 2.340$, $p = .025$) and *perceptions of ICALL lessons* ($t = 2.228$, $p = .033$) than did the students in the control group.

6.2 Discussions

The YVZ system aims to enable learners to acquire vocabulary in context and train them to use *determination strategies*. YVZ plays the role of a *tool* in the classroom and facilitates a student-centred learning environment where each learner has the opportunity to click on any unknown word, which, then automatically

activates an analysis process. As a result of the analysis, the stem of the word and its constituent affixes are displayed on the screen. YVZ, by automatically dividing the unknown word into its constituent elements, has the student see the importance of morphological knowledge in the discovery of word meanings and makes them more aware of different functions of affixes and various meanings they add to the word. YVZ also enables the student to take up the habit of consulting dictionaries in reading. Learners figure out how to relate a number of different definitions of the same word to its contextual meaning.

We propose *a constructivist ICALL environment with YVZ* where learners are active participants who construct their own knowledge working collaboratively with both the teacher and their classmates. In our model, the teacher is both a *learner* as a *meaning-constructor* and a *motivator* who provides necessary incentives for students to build up their knowledge. We suggest the following tasks be performed in 'the constructivist ICALL model with YVZ' that we propose:

- Learners use YVZ as a tool to carry out morphological analyses while reading English texts.
- The system provides learners with all possible definitions of the stem whose affixes have just been stripped off.
- In order to arrive at the contextual meaning of the word, students have to rely on the context where the analysed word occurs and check all the possible definitions of the stem one by one.
- They discuss with their teacher and peers to discover what the relevant definition of the stem might be by considering all the possible definitions (both in English and Turkish) supplied by the system.
- Discussions may take place in pairs, in groups or in a whole-class setting, with the teacher participating in the activity as *a learner* with interest and enthusiasm to discover the stem's 'correct' definition specific to the context. The teacher, behaving like *an eager learner* who is seeking an answer to satisfy his/her curiosity, will *motivate* students and encourage them to continue whatever they are doing to achieve their aim.

The findings of the research to measure the effectiveness of the suggested model are very encouraging and we believe that this study can provide language teachers with necessary knowledge and enthusiasm to incorporate an ICALL application intended to teach vocabulary in their language classrooms. However, in many countries, including Turkey, where CALL implementations are still lacking a satisfactory financial or institutional support, 'poor physical conditions' such as *lack of computers* or *lack of access to computers* may constitute an important obstacle to the successful integration of CALL applications into school curricula.

With regard to the findings of the research and the overall performance of the program within the educational context delineated in the first chapter, it can be concluded that the morphological analyser of YVZ has proven to be *technologically mature* and *pedagogically effective*. We maintain that its significance does not only lie in its ability to establish a *fit* between technology and pedagogy but also in its potential to set an example of an intelligent CALL program *developed by a language teacher*. Ideally, language teachers, linguists and engineers should work together to develop ICALL programs. However, this *ideal cooperation* cannot be easily realised largely due to incompetence in the field or various conflicts stemming from cultural misunderstandings of each other's worlds.

6.3 Recommendations

This study could be expanded to other universities having English preparatory classes with access to a computer lab. We believe that this is important especially to remove any bias that may have been introduced by the university selected for the present study.

Another version of YVZ may be created for the World-Wide Web in an attempt to show the flexibility of the support for CALL. A new study could be carried out to measure the effectiveness of this web version of YVZ on Turkish learners in order to prove its pedagogical value.

YVZ's stem dictionary has some certain limitations that can be removed or reduced through further improvements in the design of the lexicon. Some of the

limitations do not stem from any incompetence of the system but arise from a number of pedagogic decisions.

- Homonyms that have different parts of speech such as the noun *colour* and the verb *colour* cannot be distinguished by the YVZ system. This can be overcome by either providing the user with all possible analyses together or enabling the system to recognise the relevant part of speech by making use of contextual information.
- If a word has taken on new meanings since it was regularly derived from a root such as *comput*er (compute + er) or can only be etymologically related to its root such as *important* (import + ant), it is not decomposed and listed in the lexicon in its full form. Decomposing such words is thought to be of virtually no pedagogic use and very likely to confuse the learner.
- While hyphenated compounds (e.g. *quick-tempered)* or solid compounds (e.g. *bedroom*) are handled by YVZ, open compounds (e.g. *distance learning*) as well as phrasal verbs (e.g. *look up*) cannot be analysed by the system.

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APPENDIX I

THE SELF-REPORT VOCABULARY MASTERY SCALE

Bölüm I- Sözcüğün Anlamı ve Kullanımı

a. Bu sözcüğün anlamı ya da tümce içerisinde nasıl kullanıldığı hakkında hiç bir fikrim yok.

b. Sözcüğün anlamını az çok anımsıyorum ama tümce içerisinde kullanamam. Bu sözcüğün anlamı SANIRIM şudur (İngilizce anlamını ya da Türkçe karşılığını yazınız):

.....

c. Sözcüğün anlamını çok iyi anımsıyorum ama tümce içerisinde kullanamam. Bu sözcüğün anlamının şu olduğundan EMİNİM (İngilizce anlamını ya da Türkçe karşılığını yazınız):

.....

d. Sözcüğün anlamını çok iyi anımsıyorum ve sözcüğü bir tümce içerisinde rahatlıkla kullanabilirim. Bu sözcüğün anlamı şudur (İngilizce anlamını ya da Türkçe karşılığını yazınız):

.....

Sözcüğü, aşağıdaki gibi bir tümce içerisinde kullanabiliriz: (İngilizce bir tümce yazınız)

.....
.....

Bölüm II- Sözcüğün Yapısı

a. Bu sözcüğün kökü ve eki (ya da ekleri) hakkında hiç bir fikrim yok.

b. Bu sözcüğün eki (ya da ekleri) hakkında bir şey söyleyemem ama kökün ..... olduğunu biliyorum.

c. Her ne kadar ekin (ya da eklerin) işlev ve anlamları hakkında bir fikrim olmasa da sözcüğü kök ve ekine (ya da eklerine) rahatlıkla ayırabilirim:

..... +	..... +	..... +	..... +	.....
(varsa) ön ek	**Kök**	**son ek1**	**(varsa) son ek2**	**(varsa) son ek3**

d. Sözcüğü kök ve ekine (ya da eklerine) rahatlıkla ayırabilirim ve ekin (ya da eklerin) sözcüğe kattığı anlamı ve/ya da taşıdığı işlevi açıklayabilirim:

..... +	..... +	..... +	..... +	.....
(varsa) ön ek	**Kök**	**son ek1**	**(varsa) son ek2**	**(varsa) son ek3**

(Aşağıdaki boşluklara, her bir ekin sözcüğe kattığı anlamı ve/ya da ekin işlevini yazınız):

(varsa) ön ek.....

son ek1 :.....

(varsa) son ek2 :.....

(varsa) son ek3 :.....

APPENDIX II

THE SELF-REPORT VOCABULARY MASTERY SCALE (in English)

Part I- Definition and Usage

a. I have no idea what this word means or how it can be used in a sentence.

b. I remember what this word means but I cannot use it in a sentence. I THINK the word means (in English or Turkish):

.....

c. I clearly remember what the word means but I cannot use it in a sentence. I am SURE that this word means (in English or Turkish):

.....

d. I clearly remember what the word means and can easily use it in a sentence. This word means (in English or Turkish):

.....

The word can be used in a sentence as follows: (in English)

.....
.....

Part II- Morphological Structure

a. I have no idea what the word's root and affix(es) might be.

b. I cannot say anything about the word's affix(es) but I know that the root is: .....

c. I have no idea about the function(s) and meaning(s) of the affix(es) but can easily decompose the word into its root and affix(es):

.....	+	.....	+	.....	+	.....	+	.....
(if any) prefix		**root**		**suffix1**		**(if any) suffix2**		**(if any) suffix3**

d. I can easily decompose the word and explain what the function and/or meaning of the affix(es) is/are:

.....	+	.....	+	.....	+	.....	+	.....
(if any) prefix		**root**		**suffix1**		**(if any) suffix2**		**(if any) suffix3**

(Write the function and/or meaning that each affix has in the blanks below):

(if any) prefix.....

suffix1 :.....

(if any) suffix2 :.....

(if any) suffix3 :.....

APPENDIX III

THE SCORING RUBRIC FOR THE SVMS

SVMS-PART I

	1	1,5	2	2,5	3	3,5
a						
b						
c		Definition is close but not quite right				
d		1) Definition is close but not quite right while example is meaningless or ungrammatical 2) Example is OK but no word definition given 3) Definition is wrong but example is not bad	1) definition is wrong but example appropriate and interesting 2) definition not as expected but example appropriately structured to express that meaning	Example is appropriate and interesting but no word definition given	Word definition is perfect but sentence is meaningless	1) Definition is perfect but example is not as good 2) Example is without fault but definition is not at the same level of perfection

SVMS-PART II- Sections a, b and c

	1	1,5	2	2,5	3
a					
b					
c		Not the exact root form but affix(es) correct	3) Root found but no suffix(es) indicated 4) Root and prefix given together but suffix(es) correctly detached 5) Prefix correct but root and suffix(es) not divided	Root (and prefix) found correctly but one of the affixes wrong	

APPENDIX IV

THE SCORING RUBRIC FOR THE SVMS

SVMS-PART II-section d

vocabulary mastery scale PART - II section - d									
grade	prefix form	prefix function	suffix1 form	suffix1 function	suffix2 form	suffix2 function	suffix3 form	suffix3 function	root
3,5	♦	♦	✓	✓	×	×	♦	♦	✓
3,5	♦	♦	✓	✓	✓	×	♦	♦	✓
3,5	♦	♦	✓	✓	✓	✓	×	✓	✓
3,5	♦	♦	✓	✓	✓	×	✓	×	✓
3	♦	♦	×	✓	♦	♦	♦	♦	✓
3	♦	♦	✓	✓	×	✓	×	×	✓
3	♦	♦	×	✓	×	✓	♦	♦	✓
3	♦	♦	✓	×	✓	×	♦	♦	✓
3	♦	♦	✓	✓	✓	✓	×	×	✓
2,5	✓	✓	?	?	♦	♦	♦	♦	with suffix
2,5	?	?	✓	✓	♦	♦	♦	♦	with prefix
2,5	♦	♦	✓	×	×	×	♦	♦	✓
2,5	♦	♦	×	✓	×	×	×	×	✓
2	♦	♦	?	?	×	✓	♦	♦	with first suffix
2	♦	♦	?	?	✓	×	♦	♦	with first suffix
2	♦	♦	✓	✓	♦	♦	♦	♦	×
1,5	♦	♦	×	✓	♦	♦	♦	♦	×
1,5	♦	♦	✓	×	♦	♦	♦	♦	×

♦ Empty (nothing to be assessed)

✓ Correct

× Wrong

APPENDIX V

ICALL ATTITUDE SCALE

	İngilizce okuma derslerinde, bilmediğim sözcüğü otomatik olarak analiz edip kök ve eklerine ayırarak bana o sözcüğün anlamını verecek akıllı bir bilgisayar programı ...	**Kesinlikle katılmıyorum**	**katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle katılıyorum**
1)	yeni sözcükleri öğrenmeyi daha eğlenceli kılar					
2)	sözcük öğrenme alanındaki başarımı artırır					
3)	kullanılması güç olacağından beni zorlar					
4)	bana, sözlüğümün yanımda olmasının verdiği güven duygusunu vermez					
5)	dersleri sıkıcı yapar					
6)	sözcük öğrenme konusundaki sıkıntılarımı aşmama yardımcı olur					
7)	kulağıma çok karmaşık ve içinden çıkılması zor bir şeymiş gibi geliyor					
8)	derse olan ilgimi daha da artırır					
9)	sözcüklerin aklımda daha kalıcı olmalarına yardımcı olur					

	İngilizce okuma derslerinde, bilmediğim sözcüğü otomatik olarak analiz edip kök ve eklerine ayırarak bana o sözcüğün anlamını verecek akıllı bir bilgisayar programı …	**Kesinlikle katılmıyorum**	**katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle katılıyorum**
10)	kullanım zorluğu açısından gözümü korkutmaz					
11)	sözlüğümün yerini alamaz					
12)	derslere hareket ve neşe getirir					
13)	sınavlardaki sözcük bilgisi sorularını daha rahat çözmeme yardımcı olur					
14)	kulağıma hiç de ürkütücü gelmiyor					
15)	sözlüğümün ve öğretmenimin yerini alamasa da onlardan daha yararlı olur					
16)	dersleri daha kuru ve renksiz kılar					
17)	yeni sözcükleri öğrenmemde olumlu herhangi bir katkıda bulunmaz					
18)	ilk olarak aklıma " acaba kullanmayı becerebilir miyim?" sorusunu getiriyor					
19)	bana, öğretmenimin yanımda olmasının verdiği güven duygusunu vermez					

APPENDIX VI

ICALL ATTITUDE SCALE (in English)

	An intelligent computer program which can automatically analyse the unknown word and give me its definition by decomposing it into its root and affix(es)…	**Strongly disagree**	**Disagree**	**Neutral**	**agree**	**Strongly agree**
1)	will make it enjoyable to learn new words					
2)	can help me to have more success in learning vocabulary					
3)	may put me into trouble due to possible difficulties of use					
4)	cannot give me as much confidence as my dictionary can					
5)	will make lessons boring					
6)	can help me to overcome any difficulties about learning vocabulary					
7)	sounds too complex					
8)	may make me more interested in lessons					
9)	can help to retain words better					

	An intelligent computer program which can automatically analyse the unknown word and give me its definition by decomposing it into its root and affix(es)…	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
10)	does not make me feel intimidated in terms of difficulties of use					
11)	cannot replace my dictionary					
12)	will make lessons more active and fun					
13)	can help me to solve vocabulary tests more easily					
14)	does not sound frustrating					
15)	may be more useful than my teacher and dictionary even if it cannot replace them					
16)	will make lessons dull and boring					
17)	cannot contribute to my learning new words					
18)	makes me feel concerned about whether I can possibly use it					
19)	can never give me as much confidence as the presence of my teacher can					