Extensive Reading and Evolving Student Prototypes

Leah Gilner * ・ Franc Morales **

Abstract

This paper discusses the role of extensive reading in English language education. Extensive reading (ER) approaches have generated much interest over the past few decades as demonstrated by the annotated bibliography compiled by the Extensive Reading Foundation. The paper has two primary objectives: 1) to acquaint the reader with ER approaches by providing a basic and elementary characterization of such approaches; and 2) to outline how an Expert System based on *evolving student prototypes* can be used to better inform teachers and program coordinators about material selection and student performance.

Introduction

This paper discusses the role of extensive reading in English language education. Extensive reading (ER) approaches have generated much interest over the past few decades, as demonstrated by the annotated bibliography compiled by the Extensive Reading Foundation (http://www.erfoundation.org/erf/). While educators such as Michael West and Harold Palmer recognized the relevance of ER in English language teaching early in the twentieth century, the well-known book flood studies (Elley, 1991; Elley and Mangubhai, 1983) generated renewed interest in ER approaches. These large-scale, controlled, longitudinal investigations provided empirical evidence that young English foreign language learners who engaged in extensive reading outperformed those in matched control groups who received form-focused instruction on various measures of proficiency.

As research findings continue to accumulate, the benefits of ER are becoming better defined and more clearly understood. Furukawa (2006), for example, reports that extensive reading helped junior high school students in Japan increase their reading levels to match those of students two years ahead of them on the ACE test, a nationwide exam developed by the English Language Proficiency Assessment Association. Day (n.d.) provides "an overview of representative studies conducted in both ESL and EFL

＊准教授／Applied Linguistics

＊＊語学教育 IT 研究開発者／Applied Linguistics

environments with diverse populations, from young children to adults." Taken together, findings suggest that ER helps students improve, not only reading speed and comprehension, but also expressive fluency in both written and spoken language.

This paper has two primary objectives: 1) to acquaint the reader with ER approaches by providing a basic and elementary characterization of such approaches; and 2) to outline how an Expert System based on *evolving student prototypes* can be used to better inform teachers and program coordinators about material selection and student performance.

Part 1: Extensive reading

Reading fluency in L1

Before discussing extensive reading in English language teaching (ELT) in particular, it will be helpful to consider the role that reading extensively plays in education in general.

Throughout formal schooling and from a very early age, children are exposed to large amounts of written text, that is, they do a lot of reading. As they progress through elementary school to junior high school to high school, the reading children do increases in both quantity and complexity. In other words, as students, we read to learn. And as time goes on, reading becomes the primary means of knowledge acquisition. Yet, reading fluency is not directly taught in schools. Rather it is a skill that is developed through the activity of reading itself. The more one reads, the more fluent a reader one is likely to become. On the other hand, those students that do not develop the ability to read fluently struggle to keep up. The result is that reading fluency can make or break an academic career.

For those that continue on to tertiary education, the reading demands increase exponentially. Academic success at the university level is largely dependent on one's ability to manage copious amounts of reading; that is to say, students need to be able to read fluently. It is not uncommon, for example, for university students to be expected to do supplemental reading in addition to studying the material in textbooks which, in and of themselves, often contain tens of thousands of words, if not more.

Reading fluency rests on certain cognitive processes that allow readers to decode and comprehend printed texts in a timely fashion (see Day and Bamford, 1998 for an easily accessible discussion). One of them is the ability to recognize and process words and structures quickly. The reading we do as children promotes this ability as the activity allows us to learn new words and build up a large *sight vocabulary*. Nagy and Herman (1987) propose that in the case of the L1, incidental learning of vocabulary through reading may be the "easiest and single most powerful means of promoting large-scale vocabulary growth" (p. 27).

Another cognitive process that influences reading fluency is one's ability to comprehend the text, to connect what is being read to one's previous knowledge, to make sense of the words and structures being processed. This aspect of reading is cumulative in nature and it follows that the more one reads, the broader one's knowledge and experiences are likely to be.

Reading fluency in L2

At this point, we will turn out attention to reading in a foreign language. The underlying processes do not change. Reading fluently in any language requires the ability to recognize and process words and structures quickly enough that the text can be comprehended holistically. What does change is the learning experience. As Waring (2006) points out, most foreign language instruction is designed to teach students about the foreign language rather than how to use it. This is certainly true in Japan as it is in many other environments where English is studied as a foreign or second language.

Within this *learning about language* scenario, reading instruction tends to take an intensive approach. Most class time is spent on the presentation and practice of new language features which are isolated, explained, and examined. Instruction trains students to analyze and often translate written texts at the word, phrase, and sentential levels. Materials often contain a large proportion of unknown words and expressions making reading fluently impossible and comprehension tedious. Even if students learn the features they are taught, the resulting knowledge amounts to a set of inanimate, discrete characteristics devoid of pragmatic application. In other words, students may know about the language but they have not had a chance to consolidate the information as well as to observe and reflect on how to use the language purposefully. And, importantly, they are not given the opportunity to develop reading fluency in the L2. It is no surprise that for most students reading in the foreign language is, perhaps rightly, perceived as a difficult and time-consuming. The result is that students cannot read to learn in a foreign language as they do in the L1.

Importance of extensive reading for Japanese university students

This is particularly challenging when it comes to university education in Japan. The purpose of higher education is to provide students with skills and knowledge that will help them become productive professionals, perhaps even specialists, in their chosen field. Given the widening spread of English as an international tool of communication, one of the required skills is functional fluency (encompassing reading, written, spoken, and listening fluency) in English. It is becoming more and more common place for individuals working in Japanese companies to find themselves faced with having to use English to communicate with international counterparts (e.g. Honna, 2008) in order for companies to remain economically viable.

However, when it comes to English education, students do not have the foundational abilities required to handle academic and technical material. The result is that most university English language programs target basic, general skills development. Students are likely to graduate from university without attaining the proficiency, confidence, and disposition required to manage in professional and academic settings. This is particularly problematic since the majority of academic and professional publications, conferences, and forums use English as a medium of communication. Lack of English ability equates to limited access to knowledge and information imparted by academic and professional communities (Duff, 2010).

Intensive approaches simple do not prepare students to use the language purposefully. Students spend too much time and energy trying to understand the individual words (that is, they have not developed a large sight vocabulary) and are unable to move beyond word-level analyses. Word-by-word processing inhibits the ability to see the connections between and across ideas, to understand how the information is organized, to grasp the intention of the author.

This is one reason why L2 reading experts state that extensive reading needs to be an integral part of any English language curriculum (Day and Bamford, 1998; Grabe, 2010; Waring, 2009). As we will discuss shortly, extensive reading is a means to develop reading fluency, and reading fluency provides the foundation upon which learners can acquire specialized knowledge required for managing technical and academic situations. As Day and Bamford (1998) explain, unless students are "… reading with fluency and confidence in the second language, they are unlikely to read broadly and deeply enough to achieve the mass of background knowledge on which speculative thinking depends" (p. 45). Students who do not develop this kind of literacy in English will be at a disadvantage when they find themselves interacting as working professionals.

A basic and elementary characterization of ER approaches

With these ideas in mind, we will move on to a basic and elementary description of extensive reading (ER) approaches. Simply put, extensive reading involves students doing as much meaning-focused reading as possible at the *i minus 1* level. That is to say, students read a lot of material that is *well within* their current proficiency level, focusing on the content of the reading.

Day and Bamford (1998, 2002) present ten characteristics of ER approaches that are widely accepted by researchers and educators. In the discussion that follows, each characteristic is presented and briefly expanded upon.

Students read as much as possible, perhaps in and definitely out of the classroom.

An ER approach to reading instruction is one way to increase the amount of exposure students have to the language. Most of the input students receive in foreign language settings is limited to the classroom; students necessarily need to engage more with the language if they are going to become fluent language users. They simply need more input. Usage-based theories of language acquisition propose that input is the driving force of acquisition; the input received provides a means of creating a cognitive database of language samples that the brain continuously analyzes for patterns. The identification of patterns allows us to “figure out” the language, categorizing and classifying the language into chucks that can be more readily accessed for use (Ellis, 1996, 2001; Tyler, 2010).

How much reading is actually done or required will vary from student to student and from program to program. However, the benefits obtained will directly correspond to the amount of reading done (Furukawa, 2005; Nation, 1997). A recommended target is one book per week (Hill, 1992; Nation and Wang, 1999). Naturally beginning readers will be reading shorter and simpler books than more experienced and fluent readers. This is to be expected and students should be encouraged to read material that is easily comprehensible.

Reading materials are well within the linguistic competence of the students.

This characteristic differentiates ER approaches from others in an important and impacting way. As previously mentioned, the idea is that students read material at the *i minus 1* level; that means not more than 2%-5% unknown words per page (Day and Bamford, 1998).

As Waring (2006) observes, the ease of reading material marks the difference between learning to use the language and studying about the language. ER supplements intensive approaches by rounding out learning. Working with comprehensible materials gives students a chance to reinforce previous-learned, partially-known features of language. It provides for the strengthening of cognitive connections and associations with each encounter and fortifies the cognitive database of linguistic samples. This results in a larger sight vocabulary, deeper knowledge of word senses as well understanding of how words combine with other words (i.e. collocational and colligational knowledge). Textbooks, by their very nature, are not designed to reinforce learning. Rather they aim at introducing new features; without opportunity to see and experience language features in various easily comprehensible contexts, resultant learning will necessarily be incomplete.

Reading speed is usually faster rather than slower as students read books and other materials they find easily understandable.

Research findings consistently indicate that extensive reading is a way to increase reading speed and fluency of EFL students (e.g. Bell 2001; Iwahori, 2008; Kusanagi 2004; Masuhara et al. 1996; Taguchi et al. 2004; Tanaka and Stapleton, 2007). As students receive more comprehensible input, the natural process of cognitive restructuring takes place (McLaughlin, 1990). As previously mentioned, the brain works to figure out the language and organize it into the internalized lexical phrases and chunks. It is believed that the ability to process, access, and produce lexical chucks underlies fluent language production and processing (Lewis, 2002; Nation, 2001; and Schmitt and Carter, 2004). Reading speed and fluency increase as restructuring allows students to recognize, process, and access chunks faster. Furthermore, since the most frequent words provide the foundation for communication, even short books with a narrow vocabulary and basic grammatical structures will reinforce knowledge of the lexical core of the language, the very words that comprise the large majority of fluent speech and writing (Adolphs and Schmitt, 2003; Gilner and Morales, 2008; Schonell, and Meddleton, 1956), regardless of regional variety (Gilner, 2010).

The purposes of reading are usually related to pleasure, information, and general understanding. These purposes are determined by the nature of the reading and the interests of the student.

Within intensive approaches to reading, the L2 is perceived as an object of study and analysis, exemplified by the difficulty and complexity of the reading texts used for instruction; it is easy to forget that L1 reading is our primary means of gathering information as well as learning about the world; it is also easy to forget that reading can be an engaging form of entertainment. An ER approach helps students understand that L2 reading can serve various purposes, just as reading in the L1. If students are reading at the *i minus 1* level, it provides opportunity to focus on meaning and the content covered within the pages of the material, to learn from and be entertained by what they read.

A variety of materials on a wide range of topics is available so as to encourage reading for different reasons and in different ways.

Ideally, a wide range of reading material representing different genres and levels is available to students in ER programs. This helps encourage the idea that reading in the L2 is a way for students to follow and explore their own interests. Actual implementations of ER approaches necessarily reflect institutional circumstances (i.e. curricular, economic, administrative). Various researchers have reported on program design and the compromises reached in order to get their students engaged in extensive reading (for case studies in Japan, see Oxford University Press, 2007; Takase, 2007; Tanaka and Stapleton, 2007; Wilkinson, 2009). It is interesting to note that minimalist implementations (i.e. those carried out by individual teachers with access to a relatively small reader library) can have equally positive influences on learning outcomes and motivation as those that are fully integrated into the curriculum. Obviously, the percent of the student body that benefits will directly correspond to the type of implementation.

Students select what they want to read and have freedom to stop reading material that fails to interest them.

The aspect of self-selection has far-reaching consequences. First, it puts students in charge of their learning and facilitates the transfer of responsibility from teacher to student. The relevance of this process should not be underestimated; language learning is a long-term process that requires initiative, determination, and patience. Success demands that students (at some point or another) develop autonomy and take responsibility for their own learning. If students do not take this step, their learning is likely to end when their schooling does. Research findings suggest that self-selection of ER materials is, indeed, one way to promote learner autonomy (Imrie, 2007; Mason, 2006).

Next, students learn to gauge their proficiency level, develop reading strategies, and are made aware of the range of language input sources that are available to them. Choosing what to read is a process that usually involves looking through various titles, scanning through books, and skimming over a few pages to check to see if it is accessible and likely to be interesting to read. In accepting or rejecting reading material, students develop internal judgment criteria that they use to assess language input. As time goes on, they are able to monitor changes in their language skills and interests; material that was too difficult becomes manageable and what seemed boring or uninteresting might take on new appeal. The few minutes spent skimming and scanning at selection time embody purposeful and authentic reading strategy application, reading for real-world reasons just as is done in the L1 (de Morgado, 2009; Masuhara et al., 1996; Nishino, 2007).

Reading is individual and silent, at the student's own pace, and, outside class, done when and where the student chooses.

Extensive reading offers students the opportunity to experience language study in a very personal way. Not only do students have the chance to choose what they read based on their own interests, they can also work at their own pace, when and where they want to. In most classes, the pace is imposed by the teacher. This is understandable given the need to balance time constraints and curricular objectives. However, a consequence is that the pace at which material is covered cannot possibly match all the students in the class; while, in the best of cases, most students will feel comfortable with the pace, there will naturally be some students who could handle more material while others who would be more successful if given more time.

Reading is its own reward. There are few or no follow-up exercises after reading.

Evaluation is an integral part of formal instruction. Grades often drive the quantity and quality of students' work. The focus is on the product, not the process. Within ER approaches, however, the goal is that students recognize the value of reading in the L2 in and of itself, without reference to external evaluations. That is to say, reading is its own reward. As students read more, they feel more successful and confident. These feelings encourage them to continue reading. Day and Bamford (1998) use the term the *bookstrapping* effect to describe the process.

While the bookstrapping effect may satisfy students, administrative and curricular demands generally require that teachers evaluate, or at least monitor, student activities. That means a compromise must be reached between the ideal and the reality. In some cases, students keep a simple log of dates, titles, number of pages/words. In other cases, students provide short answers to general questions regarding the story line or characters. The collection of activities compiled by Bamford and Day (2004) provide various examples of how teachers can monitor or assess without detracting from the ER experience. The Moodle Reader Module is another means of assessing students' reading activities (http://moodlereader.org/index.html/).

Teachers orient students to the goals of the program, explain the methodology, keep track of what each student reads, and guide students in getting the most out of the program.

For most students, extensive reading will be a novel experience. The teacher's role therefore is particularly important. Teachers need to be able to guide, advise, and encourage students so that they work to make the most of their ER experience. This implies familiarity with a wide-range of factors including a given student's linguistic capacity and interests as well as the level and type of reading material available.

The teacher is a role model of a reader for students – an active member of the classroom reading community, demonstrating what it means to be a reader and the rewards of being a reader.

Because the very premises of extensive reading do not coincide with traditional ideas about language education, students need to be enveloped in an environment that promotes reading on various levels. Teachers also need to demonstrate an active interest in and appreciation for reading extensively. We can go farther and say that, if students perceive that extensive reading is valued and taken seriously within the institutional community (by both administration and faculty), they are more likely to develop not only the habit of reading but a positive disposition toward the activity.

While Day and Bamford's ten principles have provided the basis for the present discussion, there is no empirical evidence that indicates ER approaches need be limited or restricted to these parameters. What the evidence does indicate is that extensive reading is a powerful way to increase exposure to the language, increase reading speed and fluency, while at the same time improving student motivation and disposition to L2 study.

As educators, we have to constantly adjust and adapt to setting, students, and society. That implies molding instructional approaches, methods, and techniques to fit the needs of our particular situation at a given time. In fact, perusing the literature so far accumulated on extensive reading indicates that that is what is happening; more and more educators are documenting their attempts to engage their students in extensive reading. As time goes by and research findings continue to accumulate, we will be in a better position to describe optimal parameters of implementation.

Part 2: Evolving student prototypes

The second part of this paper proposes an approach to the formalization of the management of an extensive reading program (ERP). The objective of the formalization is to provide instructors and program coordinators with insights into students' performance and ERP development. The approach is necessarily interdisciplinary, borrowing constructs from what can be generally referred to as the field of Artificial Intelligence. Since the intended readers of this paper are applied linguists and researchers, every attempt has been made to make the material accessible.

Fundamentally, the approach referred to as extensive reading is an input driven method to language learning. This characteristic makes it an excellent candidate for formalization in the context of student management and material selection. This section will introduce a basic Expert System that employs a knowledge base in order to determine as early as possible what the best/optimal path a student should follow in order to obtain maximum benefit from the extensive reading approach.

The discussion will proceed as follows. First a hypothetical ERP will be outlined to serve as basis of exemplification. The characteristics of this ERP will show the kind of specific choices that program designers might make, that is, the ERP will follow the guidelines presented in Part 1 while, at the same time, diverging within a reasonable range. This will help illustrate that compromises regarding ERP implementations can be made without necessary loss of pedagogical value. Second, a basic Expert System will be gradually presented. Only elementary mathematics will be used. It is important to keep in mind throughout the discussion that, perhaps contrary to intuition, the Expert System does not aim to generalize students. Rather, the Expert System aims to individualize the program.

Let us consider an extensive reading program with the following characteristics. Students are enrolled for several semesters in this ERP and are given each semester a list of, for example, 100 texts from which to choose what to read. Let us say that students are expected to read a text every week so that by the end of each semester each student has read from 10 to 15 texts. The ERP has at its disposal a library of, for example, 2,000 texts. These texts have been analyzed and graded so that, as students move from semester to semester, they are presented with texts adequate to their increasing level of reading fluency. Last, the ERP coordinators and instructors collect data regarding the performance of students. In principle, this data gathering could be as simple as giving final grades to students each semester depending on their performance, whatever "performance" is deemed to be. However, the experienced language instructor(s) and ERP coordinator(s) collect far more data than just the final grade given to students. For example, as time goes on, they become aware of what texts work better with certain students depending on interest, ability, learning style, and so on. The bottom line is that, as generations of students complete the ERP, the experienced language instructor(s) and coordinator(s) modify the ERP to better suit their student population. They do this by means of the accumulation of information which will be generally described as *historical data*, that is, the collection of information regarding past students, the additions made to the library as well as the types of analyses carried out on the texts it contains, and the improvement of performance of the students as the ERP is adjusted over time.

Let us also propose for the sake of exemplification that, through the interaction of instructors and coordinators with students, recommendations and advice as to which texts would be most appropriate for given students will take place. In other words, let us take into account that one of the objectives of the ERP is to eventually be able to best guide individual students to particular texts for this guidance is considered to better suit the students. The task, as a whole, is of considerable difficulty but impossible to object to from a pedagogical point of view. Being able to monitor each student implies being able to better serve the needs of each student. A personalized approach is always more desirable than a generalized approach since, ultimately, there is only an individual learning, then another individual, and so. A program is designed for a student body. It is not designed for the idiosyncrasies of specific individuals. While ideal, having a different program per student is impossible. Let us keep in mind that, while teachers might have infinite patience, they do not have infinite cognitive capacity. Expert Systems can provide that infinite capacity (potentially) and, possibly, help the experienced language instructor(s) and coordinator(s) to individualize a program.

Having proposed this simple ERP, it is now possible to start its formalization. First, the ERP library is entered into in a database, for it not only contains information regarding the texts' titles and identification numbers. Rather, the texts have been analyzed, be that basic grading or other kinds of analyses. Ultimately, the ERP library database differs from an ordinary library database in that it contains information regarding the length, breath, and depth of language each text contains. This information can take the form of analyses regarding structural complexity, topic/genre, vocabulary reinforcement (i.e. amount of repetition of target words), number of types and tokens, level of difficulty, type of different collocations where target vocabulary occurs, and so on.

The ERP database allows for storage of more than just the characteristics of the texts in the ERP library. An online system can be developed to interface with the students. A simple approach would be to give each student an account in the ERP. Once students are logged in, they are presented with a list of the 100 texts they can choose to read that semester. The advantages of an electronic approach to the ERP are many, starting from the automatic storage of student choices of texts in the ERP database.

Moreover, the online system can be used to store all sorts of information regarding student performance by means of, for example, students' reports entered online once they finish reading a text. This information can include degree of interest, time spent reading a particular text, degree of reading comprehension of a given text, student evaluation of a given text, comprehension of vocabulary introduced in previous readings, and so on. Additionally, the ERP database can also include information regarding student scores on TOEIC/TOEFL/EIKEN (or similar standardized tests) as well as scores on institutional tests and quizzes, whether given in the ERP itself or in other language courses students are enrolled in at the department or university.

Ultimately, the objective is to collect as much information from the students as possible. In this manner, the ERP database can be additionally complemented with information regarding the students themselves via observations made by the experienced language instructor(s) and coordinator(s). Special online accounts in the ERP can allow instructors and coordinators to enter information (for each student) regarding base vocabulary, learning style, ability, degree of initiative, experience, motivation, attitude towards reading in L1, attitude towards reading in L2, age, and so on.

At this point, the ERP database has grown significantly and it has done so by the collection of data from various origins. Some variables can be quantitative (i.e. number of types and tokens) while others can be qualitative (i.e. attitude towards reading in L2). The ERP database is a mesh of information with different degrees of interrelatedness across variables. In order to obtain relevant information from the ERP database, it is necessary to elevate the database to a knowledge base. We are in need of, at least, an additional layer of formalization. We need the data in the database to become knowledge so that it is possible to query the system and, hopefully, obtain insights into the ERP and students. These insights are to complement the decisions made by the experienced language instructor(s) and coordinator(s) when they find it necessary to fine-tune the ERP in order to improve the fluency gains made by students.

The presentation of the Expert System provided henceforth is but one possible approach to the complex subject of data classification in the context of language learning and pedagogy. The presentation centers on the concept of the *evolving student prototype* and, although described conceptually, the discussion will detail the mechanics of a specific kind of Expert System, namely, a system that evolves through time (rather than through simulated evolution). For simplicity of exposition, the discussion will focus on students and how to personalize the program to each individual. It should be noted that other information could be obtained by means of similar mechanisms (i.e. relative value and relevance of texts). Naturally, a full description of an actual implementation is beyond the scope of this paper. Still, this presentation of an Expert System based on evolving student prototypes aims to be sufficient for computer architects and programmers (and, hopefully, a technically savvy audience) to consider possible implementations. Last, it should be noted that the concept of evolving prototypes is not new and, in the case of this presentation, it owes direct inspiration to the work of Kasabov (1998) in connectionist systems and adaptive intelligent systems.

We will start the exposition by formalizing the experience of students (E) as a collection of variables that characterize their progress through and completion of the ERP. In particular, we can explicitly describe a given student's experience as E, where $E = \{x_1, x_2, x_3, \ldots, x_N\}$. We present the number of variables as N because their amount can change from student to student and over time. For the sake of simplicity, let us assume that all students' experiences are described by the same number (N) of variables and that these variables are the same, namely (and for example), x_1 could represent the amount of texts read by each student, while x_2 could stand for the learning style of each student, and so on.

In this manner, the experiences of three students can be represented as E_1, E_2, and E_3, where each E stands for individual student values corresponding to the same variables. Again, a variable is any one of the above mentioned, namely and for example, student scores on standardized tests, attitude towards reading in L2, or the number of tokens read throughout the course of the entire ERP.

As it is described (and defined), one could consider E to be a point in an N dimensional space of variables. A collection of students' experiences could be considered a set of points in N dimensional space. For the sake of simplicity of illustration, we will reduce the number of variables to 2, that is, N = 2. These two variables will simply be named x and y. One can consider both x and y to stand for any of the variables presented so far so that, for instance, x could contain the total number of tokens read through the course of the entire ERP while y could contain student scores on a standardized test. Figure 1 provides a visual example of the *historical data* contained in the knowledge base after a group of students have completed the ERP.

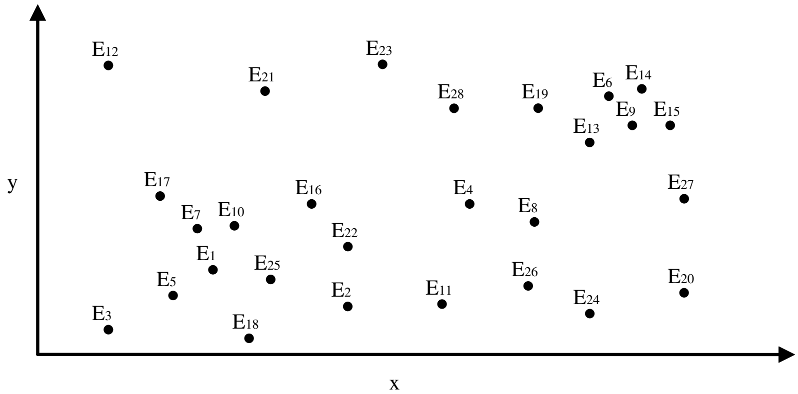

Figure 1 – Display of historical data representing the experience of group of students.

There are 28 student experiences plotted in Figure 1. These experiences correspond to students that have completed the ERP, that is, they represent historical data. At a glance, the experienced language instructor(s) and coordinator(s) can see that, beyond the apparent chaos, there are two densely populated areas in Figure 1, one in the bottom left and another in the top right. Figure 2 delineates these areas.

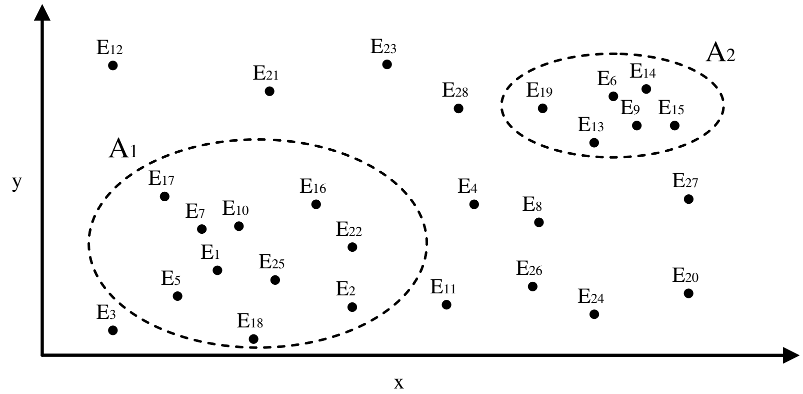

Figure 2 – At-a-glance analysis of historical data for a group of students.

If x and y were to stand for the variables mentioned earlier (amount of reading and test scores, respectively), we can conclude that, indeed, students that read more obtained better scores. That is, area A_2 contains the desirable *kind* of student experiences (benefited the most from the ERP) while the area A_1 contains the undesirable *kind* of student experiences (benefited the least from the ERP). Interestingly, and within the limits of this example, neither experienced language instructor(s) nor coordinator(s) require this plot in order to come to the same conclusions. However, x and y could stand for any other variables in which case the information in the plot could be revealing. Moreover, student experiences that fall outside of these areas are considered atypical (or noise, in computational terms) and contribute nothing but confusion to any inspection of the ERP. It is therefore worthy of interest to find venues that will allow us to extract information out of all students' experiences.

Let us again restate that the aim of this basic Expert System is to determine as early as possible what the best/optimal path a student should follow in order to obtain maximum benefit from the ERP or, in other words, what is the best program for a student to follow. In this case, the program is the choice of 100 texts given at the beginning of each semester. The Expert System seeks to determine which 100 texts are the most appropriate for each student each semester.

Historical data yields patterns that provide experienced language instructor(s) and coordinator(s) with information regarding where and how to improve the ERP. Properly handled, historical data can provide more. In particular, it can allow us to classify students according to patterns (represented as areas in Figure 2) so that students heading in the wrong direction can be redirected while students heading in the right direction can be encouraged to improve further. The key to this insight relies on early classification (or identification) of students based on the experiences of previous students.

It is important to understand that these two areas (A_1 and A_2) represent kinds of student experiences rather than students' experiences themselves, that is, the former are conceptualizations while the latter correspond to concrete students' experiences. The formalization of these conceptualizations into *evolving student prototypes* will yield the final pieces with which to ensemble the basic Expert System this section aims to describe.

Let us build this simple Expert System from the ground up. At first, there was nothing and the Expert System was blank. Then, the first student experience was recorded in the knowledge base as this student completed the ERP. Figure 3 shows E_1 as well as two new concepts, classification volume E_1^C and assimilation volume E_1^A. The classification volume E_1^C will be used to determine if a future student experience (i.e. E_2) is similar to the one of E_1. This will allow the instructor and coordinator to determine if a student classified as similar to E_1 is or is not on the right path. Consequently, and for example, automatic modification of the list of texts that the student (whose experience corresponds to E_2) can choose from could take place.

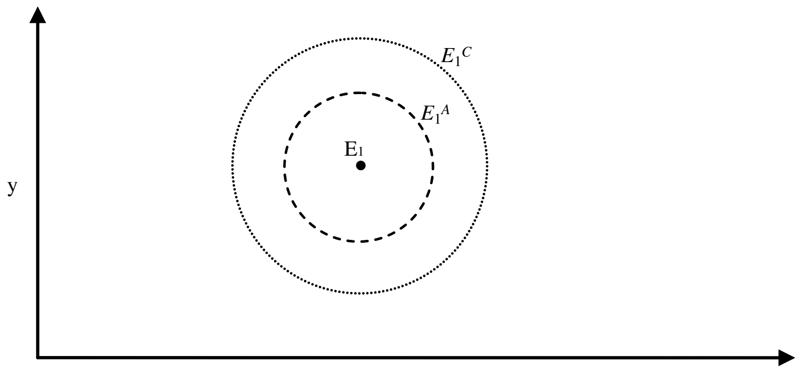

Figure 3 – E_1, its classification volume E_1^C, and its assimilation volume E_1^A.

In contrast, the assimilation volume E_1^A will be used to determine if future students' experiences are so alike to E_1 as to be considered of the same *kind*, that is, if a future E_2 is to be considered to represent the same *kind* of student experience. It is important to highlight two observations regarding the mechanics of this proposition. First, while students are going through the ERP, their experiences can only be classified but not assimilated. The reason is that the student experience of an E_2 is not yet complete and not all variables contain values. Rather, the degree of similarity between E_2 and historical data allows the Expert System to speculate as to what would be the complete student experience of an E_2. It is on account of this capacity that the Expert System has prediction capabilities. Second, having two students' experiences that have completed the ERP and fall within one or the other assimilation volumes implies that they are so alike as to be considered a *kind*. This requires a further (and last) construct, namely, the *evolving student prototype*. Its definition and mechanics are shown in Figure 4.

As mentioned earlier, a *kind* is an abstraction and so is an *evolving student prototype*. The *evolving student prototype* no longer corresponds to an actual student's experience. Rather, it stands for several of them and it does so according to *weight* and *influence*. *Weight* refers to the amount of students' experiences that have been assimilated by a prototype. *Influence* refers to the growth of the radiuses of the classification and assimilation volumes as students' experiences are assimilated. In other words, an *evolving student prototype* (i.e. a *kind* of student) is modified by assimilation of students' experiences over time and this modification implies its assertion (or settling) in a particular location in N space as well as an increase in its ability to predict (and assimilate) alike student experiences. The procedure will be spelled out in the following paragraphs.

Figure 4 shows the creation of an *evolving student prototype*. First, as both students' experiences have equal worth, the prototype P settles its location mid way between the two of them. Second, since the prototype P now represents two students' experiences, there is an increase in the radiuses of the classification P^C and assimilation volumes P^A (as compared with the radiuses of the volumes assigned to students' experiences).

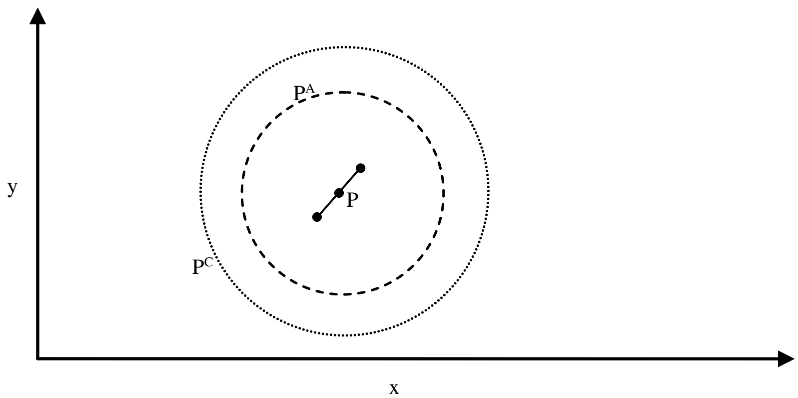

Figure 4 – Assimilation of student experiences.

In general, we say that the prototype settles in a region of N space because its location changes proportionally. What this means is that if P stands for 9 students' experiences and a new student experience E_m is assimilated, the location of P does not move mid way between its present location and the location of E_m. Rather, the location of P is moved a tenth of the way between its present location and E_m. This is what is meant by *weight*. For an *evolving student prototype* to be useful in terms of classificatory capacity, it cannot be changing its location wildly. If it did so, the historical data that constitutes a prototype would eventually be voided.

The *influence* of the prototype (the radiuses of the classification and assimilation volumes) increases accordingly, for a prototype P_1 that stands for 10 students' experiences represents a less frequent and a less certain *kind* of student experience than a prototype P_2 that stands for 40 students' experiences. Let us not forget Figures 1 and 2 where we could see a great deal of students' experiences falling outside of any sort of classification. In some cases, however, this computational noise or atypical students' experiences could now be taken into account by a system that employs *evolving student prototypes*. After all, the mechanics of prototypes do not disregard any kind of student experience. For one, students' experiences such as E_3 and E_{11} in Figure 2 could fall within a prototype P_k taking the place of area A_1. This could be possible because a prototype P_k would have a degree of influence corresponding to the 10 students' experiences it stands for (from area A_1).

As described (and defined), *evolving student prototypes* are dynamic constructs that behave within certain parameters in an N space of variables. The values of these parameters have not been explicitly assigned because they are for the administrators of the Expert System to decide on. That is, it is the task of the system administrators to discover which radiuses of classification and assimilation volumes arise from and account for historical data. Similarly, it is for the system administrators to decide to which extent the degree of influence of a prototype increases as students' experiences are assimilated. In fact, the whole formula regarding the relationship between students' experiences, their variables and values, is open for the system administrators to implement as they see fit, be that arithmetically, geometrically, exponentially, or by means of fuzzy logic if such is considered adequate.

Briefly, it is evident that computer architects and programmers must design this kind of software as they do, for example, administrative software, where faculty and administration are simply users. It is also interesting to note that, when conversing with colleagues over this kind of Expert System, questions arise regarding which variables or values to use, which relationships variables should have and how these should be managed, etc. As explained above, the Expert System is a step forward towards the individualization of a program and not an attempt to reinvent the pedagogical wheel. The same variables that educators now use, the same data they now collect as they interact with students and materials, are the backbone of the Expert System. The value of the Expert System (as a resource) is relative to the amount of detailed information it is provided with as well as the nature of judgments experienced instructors and coordinators now make. The Expert System provides infinite capacity and a modicum of crude simulated cognition.

Evolving prototypes have been around for a decade (see Watts, 2009) while static (not evolving through time) classification methods have been around for decades (see Arabie *et al*., 1996). For those interested in the implementation of this kind of formalization, there are a plethora of algorithms available in the literature of various fields, from philosophy to mathematics, from statistics to medicine. The social, cognitive, and pedagogical maelstrom underpinning language learning is a problem of high complexity. The formalization of input, treatment, and output as well as their organization into knowledge bases - together with Expert Systems to query them - could provide a future stepping stone in the development of more effective and adaptive extensive reading programs, in particular, and language programs, in general.

References

Adolphs, S., & Schmitt, N. (2003). Lexical Coverage of Spoken Discourse. *Applied Linguistics*, 24(4), 425-438.

Akio, F. (2006). SSS Extensive Reading Method Proves to be an Effective Way to Learn English. Retreived November 25, 2009 from http://www.seg.co.jp/sss/information/SSSER-2006.htm

Arabie, P., Hubert, L. J., & de Soete, G. (1996). *Clustering and classification*. Singapore; River Edge, NJ: World Scientific.

Bell, T. (2001). Extensive Reading: Speed And Comprehension. *The Reading Matrix 1*(1).

Day, R. R. (n.d.). The Benefits of Extensive Reading (ER) [Electronic Version] from http://www.oupe.es/es/ELT/Readers/bookworms/Recursos%20Destacados/the%20benefits%20of%20extensive%20reading.pdf.

Day, R. R., & Bamford, J. (1998). *Extensive reading in the second language classroom*. Cambridge, U.K.; New York: Cambridge University Press.Day, R., & Bamford, J. (2002). Top Ten Principles for Teaching Extensive Reading. *Reading in a Foreign Language, 14*(2).

Day, R., & Bamford, J. (2002). Top Ten Principles for Teaching Extensive Reading. *Reading in a Foreign Language, 14*(2).

de Morgado, N. F. (2009). Extensive reading: Students' performance and perception. *The Reading Matrix, 9*(1), 31-43.

Duff, P. A. (2010). Language Socialization into Academic Discourse Communities. *Annual Review of Applied Linguistics, 30*, 169-192 doi:110.1017/S0267190510000048.

Elley, W. B. (1991). Acquiring literacy in a second language: The effect of book-based programs. *Language Learning and Communication*, 41*,* 375-411.

Elley, W. B., & Mangubhai, F. (1983). The impact of reading on second language learning. *Reading Research Quarterly*, *19*, 53-67.

Ellis, N. (1996). Sequencing in SLA: Phonological Memory, Chunking, and Points of Order. *Studies in Second Language Acquisitio*n, 18, 91-126.

Ellis, N. (2002). Frequency Effects in Language Processing: A Review with Implications for Theories of Implicit and Explicit Language Acquisition. *Studies in Second Language Acquisition*, 24(2), 143-188.

Furukawa, M. (2005). Another Look at Extensive Reading: A Study of Japanese University EFL Students. Hyogo University of Teacher Education.

Gilner, L. (2010). *Lexical common ground across international varieties of English*. Paper presented at the The 26th Annual Japan Association for Asian Englishes (JAFAE) National Conference.

Gilner, L., & Morales, F. (2008). Corpus-based frequency profiling: Migration to a word list based on the British National Corpus. *The Buckingham Journal of Language and Linguistics*, 41-58.

Grabe, W. (2010). Fluency in Reading--Thirty-Five Years Later. *Reading in a Foreign Language*, 22(1), 71-83.

Hill, D. R. (1992). The EPER *guide to organising programmes of extensive reading*. Edinburgh: Institute for Applied Language Studies, University of Edinburgh.

Honna, N. (2008). *English as a multicultural language in Asian contexts: Issues and ideas*. Tokyo: Kuroshio

Publishers.

Imrie, A. (2007). *Exploring theory, enhancing practice: Autonomy across the disciplines*. Paper presented at the Independent Learning Association, Chiba, Japan.

Iwahori, Y. (2008). Developing Reading Fluency: A Study of Extensive Reading in EFL. *Reading in a Foreign Language*, 20(1), 70-91.

Kasabov, N. (1998). The ECOS framework and the ECO learning method for evolving connectionist systems. *Journal of Advanced Computational Intelligence*, 2(6), 195-202.

Kusanagi, Y. (2004). The class report 2: Course evaluation of Pleasure Reading Course. *Journal of Rikkyo University Language Center*, 11, 29–42.

Lewis, M. (2002). *The lexical approach: the state of ELT and a way forward*. Australia; Boston, Mass.: Thomson/Heinle.

Mason, B. (2006). Free voluntary reading and autonomy in second language acquisition: Improving TOEFL scores from reading alone. *The International Journal of Foreign Language Teaching*, 2(1), 2-5.

Masuhara, H., Kimura, T., Fukada, A., & Takeuchi, M. (1996). Strategy training or/and extensive reading? In T. Hickey & J. Williams (Eds.), *Language, education, and society in a changing world* (pp. 263–274). Clevedon, UK: Multilingual Matters.

McLaughlin, B. (1990). Restructuring. *Applied Linguistics*, 11(2), 113-128.

Nagy, W., & Herman, P. (1987). Breadth and depth of vocabulary knowledge: Implications for acquisition and instruction. In M. G. McKeown & M. E. Curtis (Eds.), *The Nature of vocabulary acquisition* (pp. 19-35). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Nation, I. S. P. (2001). *Learning Vocabulary in Another Language*. Cambridge: Cambridge University Press.

Nation, P. (1997). The language learning benefits of extensive reading. *The Language Teacher*, 21(5), 13-16.

Nation, I. S. P., & Wang, K. (1999). Graded readers and vocabulary. *Reading in a Foreign Language*, 12(2), 355-380.

Nishino, T. (2007). Beginning to read extensively: A case study with Mako and Fumi. *Reading in a Foreign Language*, 19(2), 76-105.

Oxford University Press (2007). Graded Reading Programs: The Experience of School and University Teachers in Japan. Retrieved Sept 19, 2010 from http://www.oup-readers.jp/teachers/resources/media/gradedreadersprograms_en.pdf

Schmitt, N. & Carter, R. (2004). Formulaic sequences in action: An introduction. In Schmitt, N. (Ed.). (2004). Formulaic Sequences, pp. 1-22. Amsterdam: John Benjamins Publishing Company.

Schonell, F. J., & Meddleton, I. G. (1956). *A study of the oral vocabulary of adults*. Brisbane: Queensland University Press.

Taguchi, E., Takayasu-Maass, M., & Gorsuch, G. J. (2004). Developing reading fluency in EFL: How assisted repeated reading and extensive reading affect fluency development. *Reading in a Foreign Language*, 16(2), 70-96.

Takase, A. (2007). Japanese High School Students' Motivation for Extensive L2 Reading. *Reading in a Foreign Language*, 19(1), 1-18.

Tanaka, H., & Stapleton, P. (2007). Increasing reading input in Japanese high school EFL classrooms: An empirical study exploring the efficacy of extensive reading. *Reading Matrix*, 7(1), 115-131.

Tyler, A. (2010). Usage-Based Approaches to Language and Their Applications to Second Language Learning.

Annual Review of Applied Linguistics, 30, 270-291.

Waring, R. (2006). Why Extensive Reading should be an indispensable part of all language programs. *The Language Teacher*, 30 (7), 44-47.

Waring, R. (2009). The inescapable case for extensive reading. In A. Cirocki (Ed.), *Extensive reading in English language teaching* (pp. 93-111). Munich, Germany: Lincom.

Watts, M. J. (2009). A Decade of Kasabov's Evolving Connectionist Systems: A Review. *IEEE transactions on systems, man and cybernetics. Part C, Applications and reviews: A publication of the IEEE Systems, Man, and Cybernetics Society*., 39(3), 253.

Wilkinson, D. (2009). *Implementing an Extensive Reading Program and Library for ESL and EFL Learners in a Small Academic Setting within Japan*. Unpublished manuscript.

（2010.10.1 受稿，2010.11.18 受理）