Reading, writing, and assistive technology: 
An integrated developmental curriculum 
for college students

Ellen Urquhart Engstrom

A developmental skills program uses an integrated reading and writing curriculum for college students with low reading scores. Two case studies illustrate the efficacy of this approach in preparing such students for postsecondary education.

In the United States, educators are increasingly concerned about the numbers of students in secondary schools who do not read well. The findings of the National Reading Panel (National Institute of Child Health and Human Development, 2000) encouraged educators and legislators to address the gaps in school curricula and teacher training in order to effect substantial change in reading outcomes for elementary school-age children. While educators and lawmakers debate the merits of code-based versus meaning-based instruction for beginning readers, vast numbers of children continue to move through the schools and are often placed in remedial reading classes that teach skills in isolation. As important as it is to address the needs of young children entering the schools, their older counterparts leave secondary school without the skills necessary for stable and satisfying employment and often encounter failure. Ideally, these students should make the leap from learning to read to reading to learn and should be capable of reading to solve complex and specific problems. In fact, numbers of students arrive at middle school, high school, or even college unable to access the complex texts they encounter. Recent National Assessment of Educational Progress (NAEP) test results indicated that few American students gain the literacy knowledge and skills that would allow them to successfully engage in higher level problem solving required in an information age economy (Donahue, Voekl, Campbell, & Mazzeo, 1999).

Failure to acquire academic literacy has many causes. The following are some of them:

- Reading instruction stops once students move into middle school, even if students had elementary school instruction that included phonics, fluency training, and comprehension strategies. Instead, middle school teachers are focused on teaching subject area content (Greenleaf, Schoenbach, Cziko, & Mueller, 2001).
- Some reading difficulties are characterized by slow and halting processing of text, but they are not captured on tests of single-word decoding. As a result, these students

Engstrom teaches at Landmark College. She may be contacted there, at 1 River Road South, Putney, VT 05346, USA. E-mail to eengstrom@landmark.edu.
go undiagnosed and receive no remedia-
tion (Berninger, Abbott, Billingsley, &
Nagy, 2001).

• Students with poor single-word decoding
skills or poor fluency read far less than
their reading-enabled peers, which results
in a deprivation of background knowledge.
Comprehension research has shown that
background knowledge provides a scaffold
for the acquisition of new knowledge
(Mastropieri & Scruggs, 1997). Poverty of
background knowledge limits future
learning.

• A lack of prior reading experience affects a
student’s ability to learn academic writing.
Expressing concepts in writing requires the
coordination of multiple language systems.
Poor decoding leads to poor spelling,
which becomes a barrier to fluent writing.
Lack of experience with texts deprives stu-
dents of the models they need to organize
and structure their writing.

The recent emergence of assistive technology
e ncourages researchers and educators to explore
its possible benefits for students who lack the
reading and writing skills necessary for success in
higher education (Anderson-Inman & Szymanski,
1999; Higgins & Raskind, 1997). Two major re-
views of the research in assistive technology
(MacArthur, Ferretti, Okolo, & Cavalier, 2001;
Okolo, Cavalier, Ferretti, & MacArthur, 2000) con-
firmed the utility of computer-assisted instruction
and synthesized speech feedback to improve stu-
dents’ phonemic awareness and decoding skills, as
well as the benefits of electronic texts to enhance
comprehension by compensating for reading diffi-
culties. Assistive technologies include text-to-
speech software, word-processing programs,
voice-recognition software, and software for or-
ganizing ideas. While these technologies are rela-
tively new, they hold the promise of bridging the
gap between a student’s needs and abilities. They
may let a student with relatively low decoding
skills access course texts through a text reader. A
student with very low writing output but good
oral language can use voice recognition software.
Technology offers students the opportunity to ac-
cess higher education that their previous school
experience had denied them.

Research on the outcomes of developmental
education in community colleges has indicated
that developmental reading and writing courses
improve student achievement in postsecondary
courses (Napoli & Hiltner, 1993). A study of a col-
laborative effort between English and reading
courses at a California community college sug-
gested that integrating these two developmental
courses had a positive effect on student academic
outcomes in subsequent semesters (Office of
Institutional Research and Planning, 1995). In
their comprehensive review of the literature on
teaching comprehension strategies, Mastropieri
and Scruggs (1997) documented the positive ben-
efits of multipass reading strategies on students’
reading comprehension.

This article explains how a combination of
sound instructional strategies for improving read-
ing comprehension, accuracy, fluency, and writing
with assistive technology helped students make
gains beyond what they had achieved previously.

The context

At Landmark College, a college designed exclu-
sively for students with learning disabilities and
attentional disorders, many students are able and
motivated to get a college education, but they lack
the fundamental reading and writing skills neces-
sary for success. Thus, the education program
that they receive at Landmark College includes a
precredit developmental skills program, where
students learn academic skills in small classes that
teach specific strategies for active reading, note
taking, and writing. The developmental skills cur-
riculum is designed to develop a broad range of
skills in students whose learning profiles vary.
Some students have weaknesses in comprehen-
sion or decoding. Students with attention-deficit disorder may have gaps in their decoding, encoding, and comprehension performance due to inconsistent focus or poor executive coordination of multiple language processes (Berninger et al., 2001). Some students in the precredit curriculum are limited by inaccurate or slow reading. Students entering the developmental skills program frequently have reading scores between grade levels 5.0 and 8.0, as measured by the Gray Oral Reading Test (GORT–3). In addition, the reading rate of these students frequently falls below grade level 5.0. It is common for students to express frustration about their problems with reading, and how these problems have limited their prior academic progress. Although students receive intensive instruction in reading and study skills strategies as well as the writing process, direct instruction in word-level skills (decoding) and selective use of assistive technology could be expected to help students increase their reading accuracy, speed, and comprehension of the course material.

The curriculum

The purpose of the integrated curriculum was to address the multifaceted task of building language skills through three strands of instruction. Students needed access and experience with a variety of texts in order to build background knowledge and improve their comprehension skills. Also, they needed to develop further their understanding of text structures through writing. Students with poor decoding or fluency skills needed the opportunity to use text-to-speech software to assist their reading. Learning technology to support their study skills could remove the typical barriers to writing and organization that plague students with language-based learning disabilities. Students whose test results indicated specific deficits in phonological awareness, decoding, and fluency needed direct instruction to address these difficulties. The precredit curriculum consisted of a developmental reading course, a developmental writing course, and skills support sessions (tutorials).

The reading course

A primary objective of the reading course was teaching the strategy of active reading (Arieta, 2001). Active reading combines a series of strategies into a process for comprehending and retaining information in written text. The active reading process mirrors the brain’s memory process, offering the reader an effective system for comprehending and remembering text. Active reading steps include prereading, reading, highlighting, margin noting, chunking sections of text, and summarizing the text. By strategically combining a text reader with a visual organizer and a word processor, the software helps a student to accomplish active reading by eliminating the need for word-by-word decoding, freeing active working memory for comprehension. Students have the benefit of (a) hearing and seeing their texts, (b) visually organizing the concepts within the reading in a concept map, and (c) transferring those concepts into essay form.

Students were able to use Kurzweil 3000, a text-to-speech software program, for prereading, reading, highlighting, and margin noting. They used Inspiration software for mapping or outlining key elements of the text. Exporting these elements into a word processor facilitated drafting of a summary, while the word processor, combined with Kurzweil 3000, assisted in editing and proofreading the summary. The reading course taught the reading and study skills described in Table 1.

The writing course

The purpose of the developmental writing course was to teach explicitly the writing skills and strategies that students need to know in order to read and write more effectively in academic settings (see Table 2). The course was designed to incorporate thematic connections from one unit to another, as
well as to include the forms, structures, and process strategies introduced in the reading course.

The integration of the reading and writing courses

The reading and writing courses were organized so that students would learn text patterns simultaneously. Therefore, while students learned how to write a narrative essay, they also learned how to read narrative essays for content and structure. The timeline of the two courses were coordinated as shown in Table 3.

The skills support systems

Finally, the skills support sessions provided a menu of practices individualized to fit student profiles and skills needs. This menu included word recognition; fluency; spelling; and activities to reinforce sentence, paragraph, and essay writing. The Wilson Reading System (Wilson, 1988) provided the materials for instruction in word recognition, spelling, and fluency. In addition, Great Leaps Reading (Campbell, 1998) was used for students who needed to increase their reading rate.

The lessons

Lessons to improve reading skills were designed to be multifaceted. Because the active reading strategy was taught at the beginning of the course, its use was reinforced with every reading that was assigned. In addition, the characteristics of each text pattern needed to be emphasized. All of the readings were available in both hard copy and digitized form so that students could access them through either means. In order for a screen reader to read text, the text must be scanned and saved as a graphic. The great advantage of offering texts in both hard copy and digitized form is that students who have difficulty reading accurately and fluently

Table 1
Reading course elements

<table>
<thead>
<tr>
<th>Active reading</th>
<th>Assistive technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paragraphs</td>
<td>Kurzweil 3000</td>
</tr>
<tr>
<td>• Paragraph unity</td>
<td>• Highlighting</td>
</tr>
<tr>
<td>• Topic sentences</td>
<td>• Extracting highlights</td>
</tr>
<tr>
<td>• Supporting details</td>
<td>• Adding notes</td>
</tr>
<tr>
<td>Textbooks</td>
<td>• Extracting notes</td>
</tr>
<tr>
<td>• Previewing a textbook chapter</td>
<td>• Reading the web</td>
</tr>
<tr>
<td>• Setting up a note-taking system</td>
<td>• Spelling prediction</td>
</tr>
<tr>
<td>• Reading for content</td>
<td>• Write/speak feature</td>
</tr>
<tr>
<td>Multiparagraph articles</td>
<td>Inspiration</td>
</tr>
<tr>
<td>• Extracting main ideas and supporting details</td>
<td>• Brainstorming</td>
</tr>
<tr>
<td>• Extractions (using Kurzweil 3000) to create an outline</td>
<td>• Concept mapping</td>
</tr>
<tr>
<td>• Recognizing essay patterns</td>
<td>• Sorting and organizing ideas</td>
</tr>
<tr>
<td>Longer articles</td>
<td>• Note taking</td>
</tr>
<tr>
<td>• Recognizing topic shifts within the article</td>
<td>• Exporting outlines to a word-processing program</td>
</tr>
<tr>
<td>• Chunking</td>
<td></td>
</tr>
<tr>
<td>• Creating a summary</td>
<td></td>
</tr>
</tbody>
</table>
have the opportunity to read the same text that students with more fluent reading skills have. The availability of digitized text and screen readers makes it possible for students with reading difficulties to keep up with and work together with students without those difficulties.

One example of a text used in the curriculum is the narrative essay, “The Dyslexic CEO” (Mathewson, 2001). In this short narrative, the author tells the story of how he became a writer despite his dyslexia. The author’s message is that the use of technology was crucial to his success. Before students read this essay, they learn that an author of a narrative has a purpose, a message (or central idea), and a story to support the message. While reading personal narratives in their reading class, students were composing their own personal narratives in their writing class, taking care to include their purpose, their central idea, and their story to bear out their purpose and message.

While highlighting and annotating the text of “The Dyslexic CEO” helped students to see where in the essay the author states his central idea and how he organizes his story, the use of an accompanying graphic organizer made those connections even clearer. As an aid to understanding and summarizing, students completed the graphic shown in Figure 1.

An important feature of Inspiration software is that as the user completes a graphic organizer such as that in Figure 1, he or she simultaneously creates an outline, which can be viewed by toggling to the outline side of the program. Therefore, once students completed the organizer they had also created an outline of the summary. Working in a visual mode enables many students to identify and understand the concepts and structure of their reading. Toggling between the diagram and outline views helps students learn and understand outlining, and it also prepares them for drafting a written summary. Table 4 is a sample outline of the graphic in Figure 1 that shows how ideas can be expanded and organized. By expanding and exporting this outline to a word processor, each student had a draft of a succinct paragraph summary of the narrative essay, “The

<table>
<thead>
<tr>
<th>Writing</th>
<th>Assistive technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentence structure</td>
<td>Word-processing program</td>
</tr>
<tr>
<td>• Basic parts of speech</td>
<td>• Spell checker</td>
</tr>
<tr>
<td>• Sentence expanders</td>
<td>• Reduce the need for handwriting</td>
</tr>
<tr>
<td>Paragraph structure</td>
<td>• Use of revision toolbar to assist revisions and proofreading</td>
</tr>
<tr>
<td>• Paragraph unity</td>
<td>Inspiration</td>
</tr>
<tr>
<td>• Topic sentences</td>
<td>• Brainstorming</td>
</tr>
<tr>
<td>• Supporting details</td>
<td>• Sorting and organizing ideas</td>
</tr>
<tr>
<td>Writing process</td>
<td>• Export feature to aid in drafting</td>
</tr>
<tr>
<td>• Generating ideas</td>
<td></td>
</tr>
<tr>
<td>• Sorting ideas</td>
<td></td>
</tr>
<tr>
<td>• Drafting</td>
<td></td>
</tr>
<tr>
<td>• Revising</td>
<td></td>
</tr>
<tr>
<td>• Proofreading</td>
<td></td>
</tr>
<tr>
<td>Rhetorical patterns</td>
<td></td>
</tr>
</tbody>
</table>
Dyslexic CEO. The features of the word-processing program, including spell check, grammar check, and the use of the revision toolbar to aid in editing, completed the active reading process.

### Tracking the students

Eight students enrolled in this integrated curriculum. In order to track their progress, all students

---

### Table 3

**Integrated writing and reading curriculum**

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Writing</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3</td>
<td>Syllabus terms</td>
<td>Decoding</td>
</tr>
<tr>
<td></td>
<td>• Parts of speech</td>
<td>• Establish procedures</td>
</tr>
<tr>
<td></td>
<td>• Sentence structure—isolated and short paragraphs</td>
<td>• Comprehension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Paragraph unity</td>
</tr>
<tr>
<td>4–5</td>
<td>Description and narration</td>
<td>Paragraph structure</td>
</tr>
<tr>
<td></td>
<td>• Writing descriptive paragraphs</td>
<td>• Main ideas</td>
</tr>
<tr>
<td></td>
<td>• Writing personal narratives</td>
<td>• Supporting details</td>
</tr>
<tr>
<td>6–7</td>
<td>Process</td>
<td>Reading</td>
</tr>
<tr>
<td></td>
<td>• Writing: “How to”</td>
<td>• Personal narratives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Finding the central idea of a passage</td>
</tr>
<tr>
<td>8–10</td>
<td>Definition</td>
<td>Paragraph structure</td>
</tr>
<tr>
<td></td>
<td>• Writing: “What is…?”</td>
<td>• Major and minor details</td>
</tr>
<tr>
<td></td>
<td>• Summary writing</td>
<td>• Transition words</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Process articles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Textbooks: previewing and setting up a note-taking system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inspiration software</td>
</tr>
<tr>
<td>9–11</td>
<td>Argument</td>
<td>Reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• What is terrorism?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Active reading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Margin noting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Summarizing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Study skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Test preparation</td>
</tr>
<tr>
<td>12–15</td>
<td>Shared topic: Stem cell research</td>
<td>Introduction to critical reading</td>
</tr>
<tr>
<td></td>
<td>• Final essay</td>
<td>• The elements of reason</td>
</tr>
<tr>
<td></td>
<td>• Portfolio revision</td>
<td>• Persuasive essay</td>
</tr>
</tbody>
</table>

---

**Syllabus terms**

- Parts of speech
- Sentence structure—isolated and short paragraphs
- Paragraph unity
- Kurzweil 3000 basics

**Description and narration**

- Writing descriptive paragraphs
- Writing personal narratives

**Process**

- Writing: “How to”

**Definition**

- Writing: “What is…?”
- Summary writing

**Argument**

- Final essay

**Shared topic: Stem cell research**

- Final exam
- PowerPoint presentation
- Portfolio revision
were given the following battery of reading tests at the beginning of their first semester and again at the end of their participation in the curriculum: the GORT–3, the Comprehensive Test of Phonological Processing (C-TOPP), the Wilson Assessment of Decoding and Encoding (WADE; Wilson, 1998), and the word-attack subtest of the Woodcock–Johnson Psycho-Educational Battery–Revised (WJ–R). In addition, students participated in a structured interview to track the confidence they had in their comprehension over time (Stone, 1994). While the size of the student cohort that piloted this curriculum was too small to draw definitive conclusions about the efficacy of integrated instruction, the positive outcomes for these students suggest the importance of combining reading and writing strategy instruction with assistive technology support and word-level instruction in a way that scaffolds the students’ total written language development.

The students

The eight students enrolled in this project were all new students to Landmark College. Of the eight students, four enrolled in Landmark College in the fall following their high school graduations; the other four students had attended other post-secondary institutions before coming to Landmark College. All of the students identified some area of reading as being problematic for them. All had completed the fall semester, while seven of the eight returned for the spring semester. One student left Landmark College for financial reasons. The other seven students continued in the precredit curriculum for another semester. Following that semester, one student chose not to pursue college and left. Therefore, six of the original eight students entered the credit program at Landmark College. One of the six transferred to another college after four semesters at Landmark College, while five remained at Landmark College. Three of these students have graduated from Landmark College, while two others are near graduation at this writing. What follows are accounts of two of the students’ experiences in the curriculum.

Case study 1: Mark

Mark (pseudonym) was extremely motivated, but he had a history of struggling in school. He had attended a public high school, where he had re-
received special education services that consisted of spending time each day in a resource room. He never received any extra help or tutoring in decoding or encoding. On his application for admission, Mark stated that he had difficulty with reading comprehension and that his goal was to improve his reading. Mark’s testing showed that he had difficulty with decoding and his reading rate was slow. On the GORT–3, Mark tested below the first percentile in rate and at the second percentile in accuracy. Mark’s rapid-naming score on the C-TOPP fell in the low range, but his phonological awareness and phonological memory fell within the average range. His WADE scores indicated that he had an inconsistent pattern of word attack as well as much hesitation before reading the words. Mark’s grade-level score on the word-attack subtest of the WJ–R was 4.4. On his initial comprehension confidence interview, Mark ranked his comprehension as “fair,” and he stated that his primary comprehension strategy was to read the passage multiple times.

Mark was an enthusiastic, motivated student throughout his participation in the curriculum. He embraced highlighting for main ideas, paraphrasing to make margin notes, and using visual organizers to help him see patterns in various texts, including his own writing. Once he began instruction in the Wilson Reading System, he realized that he had gaps in his decoding ability. The scaffolded approach to learning word, text, and writing patterns seemed to allow Mark to make the functional connections between these areas of language instruction. He also found that the use of a text reader was extremely helpful for longer reading assignments, because it saved him time and it gave him confidence that he was able to read every word. In his final comprehension confidence interview, Mark listed his confidence in understanding the passage he read as a 10 (highest rank). He said he always uses a pen or highlighter when he reads in order to highlight keywords or phrases, make margin notes, or break up longer words into syllables for decoding. When asked how he knew if he understood the passage, Mark said, “My brain absorbs the information. I can relate to each concept. If I can get an overall sense of the reading, I feel I understand.” Despite the well-
known difficulty of improving fluency in older students, Mark’s rate of reading improved by the end of the yearlong curriculum. His GORT–3 rate rose from <1% to 5% from September to May. His accuracy and comprehension scores improved as well: accuracy rose from 2% to 5%, while comprehension rose from 5% to 37%. Mark chose to continue his Wilson Reading instruction for an additional year while he pursued his associate’s degree. Mark achieved honors grades, and he plans to finish his BA at a four-year college.

Case study 2: Bob

Bob (pseudonym) was admitted to Landmark College directly after graduating from high school. Like Mark, Bob had experienced difficulty with academic tasks in high school, notably reading. However, Bob’s profile differed substantially from Mark’s. Bob was diagnosed with attention-deficit hyperactivity disorder, and his hyperactivity, combined with his inattention, resulted in a learning profile that was not characterized by the systematic errors typical of students with language-based learning disabilities. Bob exhibited a more random pattern of errors likely brought about by inattention and distractibility. Nonetheless, Bob’s initial testing reflected the academic difficulties he described on his application for admission. On the GORT–3, Bob’s rate was 25%, while his accuracy was 9%. His comprehension score was 2%. On the word-attack subtest of the WJ–R, Bob scored at grade level 5.5. Bob’s C-TOPP scores placed him above 50% on phonological awareness, phonological memory, and rapid naming. When asked, “How well do you think you understood this passage?” Bob replied, “Good.” When asked, “On a scale of 1 to 10, how sure are you that you understand this passage?” Bob rated his understanding at 7. Asked, “How can you tell you understood the passage that well?” Bob replied, “I have to be tested to be sure. I find I think I did well, then I can’t do the test.”

Like Mark, Bob was a highly motivated student who came to Landmark College to find ways to ensure his academic success. Like Mark, Bob attended his classes and his skills support sessions regularly. Though less enthusiastic than Mark, Bob agreed to use the study skills and writing strategies he learned in his developmental reading and writing classes. He made rapid progress in both reading and spelling using the Wilson Reading System. Bob identified himself as a visual learner, and he responded well to using concept maps as a way to make sense out of text patterns. He also identified visualization as a powerful comprehension tool. Bob’s fluency work was highly successful, but his success was the direct opposite of Mark’s. Bob began the year with a rapid reading rate but a high number of errors on the Great Leaps Reading fluency passages. As the academic year wore on, Bob’s rate remained high while his errors decreased dramatically. At the year’s end, Bob showed improvement in his ability to read and spell real and nonsense words on the WADE, his word-attack score on the WJ–R jumped to grade level 11.9, and his GORT–3 scores improved in accuracy (from 9% to 25%) and in comprehension (from 2% to 50%). His GORT–3 rate score dropped from 25% to 16%, which may reflect his efforts to slow down and be more accurate. In his final comprehension confidence interview, Bob explained that he felt confident that he could get the broad concepts in his reading without highlighting and margin noting, but to grasp the more technical details, he needed to use the active reading and note-taking strategies.

Assistive technology aids comprehension

Introducing assistive technology support into an integrated reading and writing skills curriculum was an attempt to address a broad range of difficulties that young adults face in their effort to become skillful readers and students. Mark and Bob entered the program with low reading levels that arose from their distinct learning profiles. While it is possible to individualize a curriculum in a small, structured class of eight, the purpose of the study was to explore how to build reading proficiency in
a diverse group of students while engaging them in academically challenging work that makes the structure of language more transparent. By introducing students to a variety of text structures through reading and writing, we can scaffold the learning experience so that students gain a deeper understanding of the conceptual base of written language. By supporting text structure instruction with a text reader and the software to visually represent the concepts and patterns in the text, we expand the ways in which students can understand and process text. By giving students of diverse learning profiles the opportunity to learn word structure through exposure to sounds, syllable patterns, and word analysis, we give them the tools to automatize their word recognition and to free them to focus on understanding written language.

Students’ reading skills and capabilities significantly affect what they can accomplish when faced with the complex demands of academic reading. Successful comprehension of various texts requires mastery of a complex set of interpretive mental activities as well as a solid foundation for rapid and accurate single-word recognition. To make progress toward this end, we must give our students opportunities to participate in a variety of reading and writing experiences, understand the multifaceted process of reading, and be active observers of their own reading styles so that they can develop the skills, strategies, and confidence to be successful students.

REFERENCES


