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READING AND MATH ASSESSMENT RESULTS AND RECOMMENDATIONS FOR FRESHMEN ENGINEERING STUDENTS

CALIFORNIA STATE UNIVERSITY, LOS ANGELES
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EXECUTIVE SUMMARY

A large percentage of freshmen students at California State Universities typically display high needs for skill development in both English and math in order to enrich their learning potential and achieve greater success with post-secondary classes.

In an attempt to provide a proactive approach to this issue, the Dean of Engineering at California State University, Los Angeles, initiated a process whereby the reading and math needs of freshmen students could first be determined. Once the need was established, then a pilot project designed to enhance learning skills would be the next logical step.

As a first step, the reading and math skills of freshmen students were assessed. The results of the reading tests are present first, followed by the math results and ensuing recommendations.

First, a total of 116 primarily freshmen students were screened on a questionnaire designed to identify those students who might require reading enrichment. Of those, 39 students were then individually assessed on a reading battery designed to identify their needs in basic decoding and reading comprehension.

All 39 students showed a high need for development of reading comprehension skills, including basic vocabulary. Most of the students also showed a need for to improve their basic decoding ability.

A total of 23 of the 39 students assessed in their reading also completed the math screening instrument. All 23 students showed a need for a program designed to improve their basic math skills and then prepare them for college algebra and future success.

A detailed summary follows.

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BACKGROUND

A high number of students entering the California State University system require skill development in both mathematics and English. For example, in 2006, 37.5% of the first-time freshmen entering state universities needed remedial math programs and 45.3% needed remedial English. Those numbers were for the system as a whole. For California State University, Los Angeles in particular, the percentage of students requiring remedial work was significantly higher. Of the entering freshmen, 67.3% of them required remedial work in mathematics and 75.7% required remedial work in English.
(www.asd.calstate.edu/performance/proficiency.shtml).

Providing a skills-development service at a university level for these students, in either reading or math, remains very challenging.

In an attempt to meet the needs for students in the College of Engineering, Computer Science and Technology at Cal State Los Angeles, the Dean of the College, Dr. Keith Moo-Young, requested that Paul Jones of the Corporate & University Relations Group begin a project aimed at providing the students with the kind of service they require to have them become stronger with their reading and math skills and enhance their general learning potential. The first phase of that project involved assessing a number of current freshmen at Cal State Los Angeles to determine the nature of their reading and math needs. In the first part of this report, the reading needs of the California State University Los Angeles students are reported, followed by the math results.

Paul Jones of the Corporate & University Relations Group contacted the author of this report, Dr. Steve Truch, to assess those students. A total of 39 students were assessed from February 16th to February 20th, 2008 by Dr. Truch and his assistant, Kama Truch, on a screening battery designed to pinpoint the reading needs of each student. Dr. Truch is the Director of The Reading Foundation clinic in Calgary, Alberta, Canada and Kama Truch is Assistant Director. The Reading Foundation has provided specialized interventions and has demonstrated success in improving the learning processes and learning potential for both reading and math for students of all ages, since 1990.

This part of the report is a summary of the screening assessments completed in early February on 39 freshmen students (one student was a junior).

Freshmen students were first administered a questionnaire from the Corporate & University Relations Group that was designed to identify students who might be weak readers just because strong reading is a key to any kind of academic success, The questionnaire was administered to 116 students in total and of those, 39 students, whose cut-off scores exceeded the criterion, were assessed individually. (Only 4 of the 39 students had scores less than 25 on the questionnaire.) Most of the students scored 25+ on the screening questionnaire, which is the cut-off score used to tag the student as potentially "at-risk." In fact, the average score on the questionnaire was 42.12. The range was 16-70. The maximum possible score on the questionnaire would be 100 and 0 the possible minimum.

THE READING MODEL

The testing battery used to screen the students' reading was designed to quickly pinpoint areas of potential weaknesses based on an interactive reading model. Good readers are automatic decoders and comprehend information deeply. The details of this model have been outlined elsewhere by the author (Truch, 2006). The model is also closely aligned to the "component model of reading" which has had recent research support (Aaron, Malatesha, Gooden & Bentum, 2008).

In turn, the process of decoding begins with strong phonemic awareness and letter and sound knowledge. This enables the reader to quickly learn how to "sound out" and spell words. Eventually, the process of decoding and spelling becomes easy and automatic for the reader. Good readers decode words quickly because they understand the deeper relationship between letters, letter combinations and their underlying phonemes. Poor readers are typically weak in such skills and instead to having learned to decode them, will rely on memorization or guessing to identify them.

Good readers also display strong comprehension skills including the ability to remember what they read as well as the ability to think about what they read which includes the ability to make inferences, draw conclusions and evaluate information. These are generally referred to as "higher-order" thinking skills.

The dual-coding information processing model, developed by Dr. Alan Paivio (Paivio, 1990) provides a strong theoretical framework for the process of comprehension. According to dual-coding theory, strong comprehension involves both the ability to process information verbally and the ability to simultaneously store such information non-verbally, generally in the form of mental pictures that capture the information that is being read. So if the reader is reading a simple sentence such as "The kitten jumped over the fence," then the process of automatic decoding allows the reader to quickly decode each word. The process of "dual-coding" involves understanding the vocabulary and then quickly transferring the information into a mental picture which also stores or "codes" the information. A strong body of research over many years shows that strong comprehension is a function of the ability to "dual-code." Of course, it is possible to

"just remember" and process information without mental images. Indeed, once information becomes very abstract, the ability to create mental images for it becomes more difficult. However, much information can be "dual-coded" and the process of reading becomes much stronger as a consequence.

The reading model just described has been clinically useful for many years at The Reading Foundation and has provided thousands of students with enriched learning skills and greater success at academic tasks in general.

The testing battery used by the author was designed to provide information about each of these components of the reading model.

TESTS USED

(1) Expressive Vocabulary

Students were assessed for their oral vocabulary ability using the Expressive One-Word Vocabulary subtest from the Comprehensive Receptive and Expressive Vocabulary Test, 2nd Edition (EOWVT) (Wallace and Hammill, 2002). This is an untimed, individually administered and standardized test that identifies strengths or weaknesses in oral vocabulary. The information in the Manual states the test is free of gender, linguistic, disability and ethnic bias. Raw scores are converted to standard scores with a mean of 100 and a standard deviation of 15. The test measures primarily knowledge of the meanings of words, or semantics. The Expressive score on the CREVT correlates strongly with other more extensive measures of verbal ability including overall verbal IQ scores and measures of general language processing.

(2) Phonemic awareness

Phonemic awareness entails a number of skills including the ability to segment spoken words into their underlying phonemes, blend phonemes into words and identify differences in phonemes between two similar syllable patterns. In the last 30 years, a strong and consistent body of reading research has shown that phonemic awareness is an important "building block" for learning how to decode and spell words. Students who are weak with phonemic processing in kindergarten are "at risk" for learning to read and spell even though their general intelligence is average or better. Further, phonemic awareness is not developmental in nature and must be taught directly if it is to improve. The test used on the Cal State Los Angeles students was an informal segmenting test developed by the author. Students were given a number of real words and nonsense words and asked to identify the sounds in each syllable. For example, if the word presented was "brisk," the student was expected to segment the word into its phonemes which are /b/, /r/, /i/, /s/, and /k/. The total possible score on the test is 100, so the results are expressed as a percentage correct. Students with strong phonemic processing generally score 95 or more on this test.

(3) Letter and Sound Knowledge

When reading, good readers quickly identify (at least in the earlier stages of learning to read) the underlying sound when they see a letter. For example, the letter "b" is known to represent the sound /b/ by all good readers. Further, good readers have such knowledge about the various letter combinations used in the English language, so they also know that the letters "ea" work together and can represent sounds such as /e/ in the word "bread" or /ee/ in the word "treat." Students who are weak decoders typically cannot identify this relationship quickly and accurately. If weaknesses are found, then again, they must be taught directly. Students were measured for this knowledge on another informal measure developed by the author. A total of 50 letter and letter combinations were presented to the student who then had to identify the underlying phoneme. The score is represented as a percentage. Strong readers and spellers will typically score at least 90% accurately on this test.

(4) Phonemic Decoding ability

The ability to automatically decode words involves both accuracy and speed. Good readers can automatically identify words, whether they have context clues or not. Weaker readers tend to rely more on memorization or guessing to identify words. To control for guessing and sight, the ability to read nonsense (word-like) patterns is generally seen as a control. As such, good readers will be able to read nonsense patterns quickly and accurately, despite not having seen them before. Poor readers will not perform as well on such a test.

The Test of Word Reading Efficiency or TOWRE (Torgesen, Wagner & Rashotte, 1999) contains both a real and nonsense word section. Students are given a limited time to read as many of the nonsense patterns as they can. Raw scores are converted to standard scores with a mean of 100 and a standard deviation of 15.

(5) Real Word Reading ability

The real word section of the TOWRE was used to measure this skill. Students are asked to read as many words as they can which are printed in columns (no sentences or other context clues are used) in a limited time. Raw scores are converted to standard scores with a mean of 100 and a standard deviation of 15.

(6) Spelling

Spelling was measured using the Wide Range Achievement Test – 4th Edition (Wilkinson & Robertson, 2006). Individual words were dictated to the students and sentences were used to help identify each word in terms of its meaning. In the interests of assessment time, this test was administered prior to the actual screening either individually or in small groups by Claudia Espinosa-Villegas, who is a Lecturer at the College of Engineering.

Raw scores were converted to standard scores with a mean of 100 and a standard deviation of 15.

(7) Reading Fluency

Reading fluency was measured by the Gray Oral Reading Test (GORT) (Gray, 1963). Students read graded word passages and errors were counted. Each passage was also timed. Using tables provided in the Manual, it was possible to calculate a "fluency index," based on a combination of errors and speed. It is assumed that fluent readers will read text both accurately and quickly. The maximum on the fluency index is grade 12.

(8) Comprehension

(a) Oral reading comprehension

Oral reading comprehension was measured informally. After reading each passage, the student was asked a number of basic recall questions regarding the information in each passage. Generally, four questions were asked and the student was expected to answer three of them correctly (75%). The oral reading comprehension score for this analysis was the highest grade-level score where the student attained the 75% criterion.

(b) Listening comprehension

Listening comprehension was measured by using alternate form passages from the GORT. Each passage was read to the student and four recall questions were asked. Again, the student was expected to answer three of them correctly in order to achieve a 75% criterion. The listening comprehension score was the highest grade-level score where the student attained the 75% criterion.

Both (a) and (b) primarily measure verbal recall of information. In addition, the author devised a Likert-type rating scale for each passage in order to determine the degree to which the student created mental images for the information in each passage.

The scale runs from 0 to 5 and is based on the descriptions of mental images the student is able to provide for the information she just read. A score of "0" means the student claimed not to make any mental images. A score of "1" was given to a student who described a mental image but the image was not actually relevant to the information in the paragraph. A score of "2" indicated that the student made a mental picture for at least one of the main points in the paragraph up to a maximum of "5" for each paragraph. Scores from "0-2" are considered as "weak," a score of "3" is "average" and "4-5" is "strong."

The screening battery did not include a standardized measure for comprehension and did not include a silent reading comprehension measure. More in-depth assessment in these areas will be conducted in the future if the students actually begin an enrichment program.

SCREENING RESULTS

The results for each of the variables will be presented and comments made about each. A grand total of 39 students were screened during the 3 ½ days the examiners were scheduled for this purpose. Each student was tested individually, except for spelling, as noted above.

(1) Expressive Vocabulary

The average Expressive Vocabulary score for the group of 39 students was 83.61. This score overall falls at the 14th percentile (using 84) and indicates a general oral vocabulary weakness for the group. A standard score of 90 is the minimum score that falls in the average range and even that score is just at the 25th percentile. Freshmen students at Cal State LA are about 6 points from the 25th percentile and more than a full standard deviation from the 50th percentile. The range of standard scores for the group was from a low of 61 (below the 1st percentile) to a high of 112 (79th percentile). However, just 10 of the 39 students scored 90 or above on this test with just 2 of those scoring 100 or more.

Freshmen students in general struggled with expressing the meaning of many common words that should have been in their repertoire. Part of this may be due to the fact that English is not the first language in the home but the other part is a general weakness in oral language skills that extends to many aspects of their verbal reasoning and general comprehension and is also reflected in their weak SAT I Verbal scores.

Improving and enhancing oral vocabulary is a long-term project that typically requires many years just because overcoming language delays in a general population requires more than just a few weeks of focus on building their vocabulary. The enrichment project that is planned for this group may bring some gains but these are likely to be small at this point compared to gains that are possible on other variables. However, the gains they are expected to make will also set the stage for future oral vocabulary growth.

(2) Phonemic Awareness

Phonemic awareness was measured by the informal segmenting test that had a ceiling score of 100. The average for the group of freshmen students was just 31.02. This score is very weak since 95 is a strong score. The range of scores on this test was from 0 to a high of 89, so all students in the group could use at least some skill-building in this area.

(3) Letter and Sound Knowledge

The scores on this variable were also very weak for the group as a whole. The average was 49.84%. The range was from 12% to 90% but just one student attained the 90% that is considered acceptable for this test. Almost everyone in this group of freshmen would benefit from some direct instruction in letter and sound connections.

(4) Phonemic Decoding Ability

This component was measured by the TOWRE, which has a mean of 100 and a standard deviation of 15. The mean score on this test for the 39 students was 87.71. This score falls at the 21st percentile, just below the lower end of the average range (standard score of 90). Some of the students (16 of 39) were able to achieve a score of 90 and 5 of those 16 students scored 100 or more (>50th percentile).

Overall, many of the students require assistance in learning how to "sound out" words.

(5) Real Word Reading Ability

This component was measured by one of the subtests from the TOWRE. Raw scores were converted to standard scores. The test has a mean of 100 and a standard deviation of 15 points.

The average score on this test for the 39 students was 85.12 (percentile 16). A total of 11 of the 39 students achieved a standard score of 90 or more and just 3 of the 11 scored 100 or more (>50th percentile) on this test. Scores on this test are subject to memorization (instead of automatic decoding).

(6) Spelling

The ability to spell is an important skill for a literate person. The spelling ability of the freshmen students was measured using the WRAT - 4. This test has a mean of 100 and a standard deviation of 15.

The average spelling score for the freshmen was 104.4 (percentile 61). Students with weak phonemic processing and letter and sound knowledge generally do not spell well. However, the average score for this group was surprisingly strong despite their weaknesses in phonemic processing and letter and sound knowledge. This appears to be a tribute to their ability to memorize words. Indeed, when confronted with spelling words that were quite unfamiliar, the students were at a loss as to how to represent the syllables in those words with letters.

This implies that at least some attention needs to be given to learning how to spell words, at least multisyllable words, for this group of students.

(7) Reading Fluency

The Gray Oral Reading Test (GORT) was used to measure fluency by use of tables provided in the manual. Students who are fluent will generally read quickly and with few or no errors. However, such fluency may not be the product of automatic decoding but be the result of the memorization of words by sight and the use of contextual guessing. Both of the latter strategies for word identification, while common in poor readers, are not used by good readers.

The students in this group obtained an average fluency index of grade 10.73. Most of the students were able to achieve a high level of fluency when reading contextual material. However,

as stated, this is a tribute more to their ability to memorize words and guess at them in context than it is to automatic decoding. The range of scores on this test was from grade 6.8 to grade 12 with the majority of students (25 of 39) achieving a fluency index of grade 12.

(8) Comprehension

(a) Oral Reading Comprehension

The Gray Oral Reading Test (GORT) contains comprehension questions (largely involving verbal recall of information) which the student answers based on her memory of what was just read. There were generally four questions for each passage and a score of 3 correct (75%) is acceptable.

Since these are not standard scores, the results are presented by grade level and the number of students achieving their highest comprehension score (at least 75%) at that grade level.

Grade	Number of Students
3	3
4	3
5	25
6	5
8	1
10	0
12	0
College	2

The average imagery rating (on a scale of 0 to 5) for oral reading comprehension was just 1.6 for the group with a range of 0 to 2.8.

In short, students have weak verbal recall and weak mental pictures resulting in very weak comprehension scores.

(b) Listening Comprehension

The GORT test was used for purposes of assessing the student's ability to retain information that was just read to them. Passages at different grade levels were read to the student until they achieved a minimum of 75% correct in terms of answering 3 of the 4 questions accurately. Their mental pictures were also discussed and rated using the Likert scale devised for this purpose.

Again, the results are presented by grade level and the number of students at each grade level as with the oral reading comprehension scores.

Grade	Number of Students
2	1
3	4
4	5
5	21
6	2
8	4
10	1
12	0
College	0

The average for imagery ratings for the students was 2.04 with a range of 0 to 3.5.

SUMMARY AND RECOMMENDATIONS FOR READING ENRICHMENT

The two major processes of reading involve fluent decoding together with strong comprehension. The 39 students at Cal State Los Angeles who were assessed demonstrated weaknesses in both of these core processes.

Enriching these basic processes is the specialty of The Reading Foundation which has an 18-year track record of successful interventions. This clinic has developed proprietary reading (and math) programs (Discover Reading; Discover Meaning and Discover Math) that are research-based in nature. For example, the principles followed in the Discover Reading Program are consistent with those advocated by The National Reading Panel (2000) and, for adult learners, by National Center for the Study of Adult Learning and Literacy. The enrichment programs developed by The Reading Foundation help strengthen weak decoding and comprehension skills in students of all ages. In the math area, the program reconstructs the students' understanding of basic math concepts and operations.

The programs are typically delivered in a one-to-one fashion with students at the clinic, but can be adapted to a small group setting which they would be for this project.

The Reading Foundation trains educators in the programs and issues certificates at different levels to those who complete the training. Eventually, it is possible for educators who have been trained as instructors in Discover Reading, Discover Meaning or Discover Math to become trainers themselves. That also is the intention of this project. Not only will the skills of students be enriched, but so will those of the teachers who teach them.

The outcomes of the reading assessments on students indicate a high need for enrichment work in both Discover Reading and Discover Meaning.

The initial proposal is to have two trainers from The Reading Foundation train six educators from Cal State Los Angeles as Instructors in both Discover Reading and Discover Meaning. Once such training is completed (over a two week period) then a six week "intensive immersion" program with a total 48 students would take place. Each of the six newly-trained instructors from

CSULA would work under the guidance of the two highly-skilled Trainers from The Reading Foundation for the duration of the project. This would provide the newly-trained instructors with an invaluable opportunity to implement and receive feedback regarding using the skills they were trained in with students.

The students themselves would attend for six hours each day in that time period, thereby receiving 180 hours of small-group intervention spread between both Discover Reading and Discover Meaning as appropriate.

Post-test data would be collected and follow-up support recommended. After the six week intervention it is anticipated that post-testing will show these students advancing at least 3 grade levels in reading comprehension

The intent of this program would be to provide a model of dissemination to other post-secondary institutions and provide a start on having Discover Reading and Discover Meaning become an integral part of coursework at the university.

The work in the reading enrichment project this summer would be followed by enrichment work in the math area.

RESULTS OF MATH SCREENING OF FRESHMEN STUDENTS – CALIFORNIA STATE UNIVERSITY, LOS ANGELES.

March, 2008

A total of 23 freshmen students from the College of Engineering Computer Science and Technology at California State University – Los Angeles completed a math screening test developed by The Reading Foundation, in Calgary, Alberta Canada.

Freshmen students from CSULA were previously assessed in March of 2008 for their reading skills. The need for enrichment work in reading, particularly reading comprehension, was noted in the first section of this report.

Because strong comprehension often enhances the understanding of math concepts, the math status of the freshman engineering students was also assessed. Indeed, the students who completed this test in many cases were already receiving some additional assistance in math from the university.

The screening test that was used is designed to pinpoint the math strengths and weaknesses of students. The 100 question test is consistent with the objectives of the California Math Curriculum from grades 3 to 7 inclusive. Students take the test in a paper and pencil fashion and are not permitted the use of a calculator. The test may be administered in small or large groups or one-to-one. The freshmen students from CSULA completed this test in small groups.

An analysis of the results revealed the following:
The overall average score on this test was 66/100 or 66%. However, this result was skewed because of higher scores on the easier items. This becomes apparent when the average score per grade is calculated. Those scores were:

Grade 3 items – 13.39/15 correct or 89%

Grade 4 items – 13.17/17 correct or 77%

Grade 5 items – 14.86/20 correct or 74%

Grade 6 items – 12.04/22 correct or 55%

Grade 7 items – 13.78/26 correct or 53%

The range of scores was from a low of 36% to a high of 80%.

The trend of scores is obvious. The more difficult the items, the lower the scores, grade by grade. This trend is understandable given the very sequential nature of mathematics. However, entering freshmen students in engineering do not appear to have the basic skills required for success at higher level mathematics.

The purpose of this screening was to determine whether or not students required work in overcoming those basic math weaknesses. These results indicate they do.

The Discover Math Program, developed at The Reading Foundation, is recommended for this purpose as it constructs a new way of understanding math concepts for students who are showing skill-level difficulties. Previous clinical work with the program has shown it to be highly successful, with students, enabling them to make strong gains over a relatively short time of instruction.

Based on the results from the math screening, a program of at least 60 hours instruction in the Discover Math Program is recommended. The math intervention would be started right after the reading intervention. The first phase would again involve having six instructors from CSULA trained in the Discover Math Program. The two trainers from The Reading Foundation would then remain with those instructors and assist in daily lesson plan and delivery of the Discover Math Program to a total of 48 students.

After that and for the next two weeks, the students would undertake a math “bootcamp” designed to have them prepared for college algebra.

Once the summer enrichment program is completed (a total of 220 hours of direct instruction in enrichment of both reading and math) the progress of the students who have completed the enrichment program will be compared to the progress of students who enter the fall quarter already eligible to take college algebra. The data obtained from the pre-testing, the post-testing

and the comparison testing will allow us to establish the longer-term effectiveness of the summer enrichment program.

Besides providing the students with a unique intervention and skill-building opportunity, this summer program will also provide six CSULA instructors with a unique skill set that will enable the enrichment program and delivery model to proliferate through the CSU system.

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