REPORT from Renaissance Learning™

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Relation of STAR Reading® to Other Standardized Tests of Reading and Higher-Order Thinking Skills

This study examines the correlation between reading ability and higher-order thinking skills by analyzing the results gathered from the STAR Reading computer-adaptive reading test and the Cognitive Abilities Test (CogAT®). Test results from 308 students, grades three through eight, were gathered in April and May 1998, and revealed strong and highly significant relationships between the two instruments.

Introduction

A significant number of reports have established the link between reading comprehension and higher-order thinking skills. The report, *Critical Thinking and Literature-Based Reading*, from Renaissance Learning (1997), summarizes much of this literature. It outlines the research on higher-order thinking skills as related to their definition and development. One conclusion is that higher-order (critical-thinking) skills are natural abilities that must be exercised and strengthened through stimulating activities such as literature-based reading practice and reading comprehension exercises.

This study provides empirical evidence for the relationship between reading ability (as measured by STAR Reading) and higher-order thinking skills (as measured by the CogAT). A review of the literature examining this relationship shows changes in the conclusions of research in this area. Most of the early studies reported significant correlations[1] between higher-order thinking skills (measured then by IQ and intelligence tests) and reading ability. However, these studies worked under the assumption that intelligence and cognitive abilities were predictors of reading success. Other studies, however, provide evidence to the contrary and show that increased reading skills lead to increased critical-thinking abilities. The *Critical Thinking and Literature-Based Reading* report outlines the research leading to this conclusion, and the following studies provide additional evidence in support of this theory.

Other Evidence Linking Reading Ability to Higher-Order Thinking Skills

Stanovich, Cunningham, and Feeman (1984) reviewed dozens of studies examining correlations between reading and intelligence in preparing their report, "Intelligence, Cognitive Skills, and Early Reading Progress". They found that these correlations ranged from .3 to .7 and were generally higher for upper grades than for lower grades. Their own study of the reading-intelligence link among first-, third-, and fifth-graders produced similar correlations; however, Stanovich, Cunningham, and Feeman questioned the "higher intelligence causes people to become better readers" theory. The authors state:

> There are probably many different reasons why the correlation between reading comprehension and general intelligence increases with age, and none of the explanations are mutually exclusive. First, any intelligence-achievement correlation is probably characterized by reciprocal causation. Although

[1] A correlation is a statistical measure, ranging from –1 to +1, showing the strength of the relationship between two variables or constructs. A correlation of –1 indicates that the two variables have a perfectly inverse (negative) relationship, while a correlation of +1 indicates that the variables have a perfectly direct (positive) relationship.

> intelligence is commonly seen as a cause of achievement, alternative explanations of the relationship are possible . . . and some investigators have explicitly emphasized the 'boot strapping' effect that achievement (particularly in a skill like reading) may have on intelligence. . . Perhaps part of the relation is due to effects that early reading acquisition has on intellectual development (297).

This view questioning that a more innate construct (talent, intelligence, critical-thinking ability) is required before a specific skill (such as reading, music, sports) can be developed was examined by Howe, Davidson, and Sloboda (1998) in their study, "Innate Talents: Reality or Myth?" Howe, Davidson, and Sloboda provide evidence that higher levels of academic achievement, as well as musical and athletic abilities, are fostered much more through parental encouragement and practice than through "innate talent" or inborn intellect. This argument was further supported by Robert Eisenberger (1998) in an open peer review of Howe, Davidson, and Sloboda's article:

> The emphasis on innate talent as the basis for outstanding achievement underestimates the importance of hard work. Learned industriousness helps supply the sustained effort required for superior achievement. The goal of having a productive, well-educated citizenry can be furthered by rewarding students for high effort and attending carefully to their individual educational needs (412).

Reasons for this Study

The views expressed in the previous section support Renaissance Learning's premise that "increased reading practice will develop better readers and lead to increased performance on standardized tests in all areas" (Paul 1996, and Paul et. al., 1997). To that end, the Reading Renaissance® program was developed by Renaissance Learning to help teachers develop students' reading skills by increasing the quantity, quality, and challenge level of their reading. A key part of this program involves the teacher being able to identify her students' current reading levels so that students can choose appropriate books to maximize reading growth. Therefore, the STAR Reading computer-adaptive, norm-referenced assessment tool was created to help classroom teachers pinpoint their students' reading levels.

Based upon the supporting theories for developing critical-thinking skills through stimulating activities such as increased amounts of reading, STAR Reading was also touted as a tool to measure higher-order thinking skills. To help establish the validity[2] of this statement (and of STAR Reading's usefulness as a standardized assessment instrument), student performance data were gathered from 18 other standardized tests of reading and higher-order thinking skills during the April 1996 norming phase of STAR Reading. The results from these tests (ITBS, CAT, CogAT Form 4A, MAT, Stanford 9, CTBS, TAAS, etc.) were correlated with STAR Reading's test results. The correlations between STAR Reading and these 18 standardized tests were quite high, ranging from the low 0.70s to the mid-0.90s. While these correlations are high, they are likely to be conservative in their correlation between STAR Reading and the other standardized tests.[3] One reason is that in many cases, the results for the other standardized tests were outdated. Many of these coefficients are based on tests that students took in the fall of 1995; some are even older. In order to provide evidence for a more accurate measure of the correlation between STAR Reading and a standardized test that assesses higher-order thinking skills, Renaissance Learning conducted a new study to examine this relationship.

Methods

The Cognitive Abilities Test (CogAT Form 5, Levels A–F) by Thorndike and Hagen was chosen as the standardized test of higher-order thinking skills. The CogAT is a widely recognized instrument for assessing general abstract reasoning (inductive and deductive), problem solving, and the application of these abilities to verbal, quantitative, and nonverbal cognitive tasks (Thorndike &

[2] Validity of a test is the degree to which a test actually assesses what it claims to measure.

[3] For more information about the development of STAR Reading, the publication *STAR Reading: Understanding Reliability and Validity* (1998) is available from Renaissance Learning. Call (800) 338-4204 and request literature number L0315.

Hagen, 1997; Impara & Plake, 1998). The CogAT contains batteries measuring all three sets of tasks, and produces a composite score to measure overall cognitive ability. Testing time for the CogAT is 30 minutes per section, while the testing time for STAR Reading is just 10 minutes.

The CogAT was administered to 345 students in grades three through eight on April 16, 1998. Within one month of this date, 308 of these students took the STAR Reading test. The distribution of students among the six grades in our sample is shown in the following table:

Distribution of Students Taking the CogAT and STAR Reading Tests

Grade	Number with CogAT score	Number with STAR Reading score
3	55	54
4	109	109
5	45	42
6	40	38
7	55	49
8	41	16
Total	**345**	**308**

Both the CogAT and STAR Reading tests provide several sets of scores for each student. The CogAT provides both age-based and grade-based percentile rankings for each battery and composite score. STAR Reading provides grade-based scores. The CogAT grade-based percentile rankings were converted to normal curve equivalent (NCE) scores in order to be correlated with the grade-based NCE scores given by STAR Reading 2.[4] Correlations were computed between STAR Reading and all batteries of the CogAT, along with the CogAT composite score for all 308 students tested with both instruments.

Results

The correlations of STAR Reading with each student's set of CogAT scores are reported in the following table.

Correlation of STAR Reading with CogAT

	Grades						
Grades	**3**	**4**	**5**	**6**	**7**	**8**	**All**
CogAT Sections							
Verbal	0.620	0.659	0.782	0.776	0.722	0.704	0.687
Quantitative	0.578	0.486	0.391*	0.609	0.522	0.720	0.519
Nonverbal	0.558	0.503	0.339*	0.390*	0.475	0.552*	0.466
Composite	0.656	0.621	0.582	0.665	0.659	0.758	0.631

* Indicates that correlation is statistically significant at the .05 level. All other correlations are significant at the .01 level.

As shown in the table, all of the correlations between STAR Reading and CogAT scores are statistically significant. Furthermore, based on the magnitude of these correlations, the strength of the relationship between STAR Reading 1 and the CogAT scores could be termed as moderate to high. The strongest correlation (about 0.69 over all six grades) is between STAR Reading and the Verbal battery of the CogAT, which seems quite logical since STAR Reading is intended to measure reading levels. However, the correlation between STAR Reading 1 and the CogAT Composite score (about 0.63) is extremely noteworthy. This correlation signifies the strength of the relationship between STAR Reading and the overall measure of higher-order thinking skills provided by the CogAT. While this correlation may not indicate a perfect relationship between the constructs of reading ability and higher-order thinking skills, it does provide evidence for a moderate to strong relationship.

[4] NCE scores are used for statistical computations since these scores present results on an equal-interval scale.

Also of interest, is the overall increase in correlation as grade increases, though it is not a smooth progression. This phenomenon was also documented by Stanovich, Cunningham, and Feeman (1984). Their explanation for this result was that increasing reading and literacy skills through the grades often leads to the development of intellect. The results from our analysis would appear to support this conclusion.

Conclusion

The link between reading ability and the development of higher-order thinking skills has recently been recognized as a "better readers develop into better thinkers" type of relationship. Showing this relationship empirically has, until now, presented a gap in reading research. However, the gap can be legitimately bridged by this study of STAR Reading and its relationship to the constructs measured by the CogAT test. The correlations between the CogAT composite and STAR Reading scores are not only statistically significant, but indicate a moderate to high measure of strength in the reading skills-cognitive abilities relationship.

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For more information, or for additional copies of this report, contact:

Renaissance Learning
PO Box 8036
Wisconsin Rapids, WI 54495-8036
(800) 338-4204
www.renlearn.com

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