# Knowledge and Use of Metacognitive Strategies

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## Introduction

The importance of metacognition in reading has increasingly been recognized and undoubtedly contributes to the expertise of learning in different domains. The focus of this study is to investigate the Singaporean students' knowledge and use of metacognition during the reading of the different text types. The present paper aims first to examine the metacognitive knowledge and use of metacognitive strategies by good and poor readers of English language in Singapore. A brief description about the investigation on the role of metacognition in the domain of Science will also be covered. While findings of the students' knowledge and use of metacognition have been analysed and are to be discussed, that for their use of metacognitive strategies following the reading of the Science text is currently being analysed. The students involved in the study were from Secondary One and Three and included those from the Express and Normal (Academic) Courses.

Metacognition has been described as one's knowledge concerning one's own cognitive processes and products or anything related to them, e.g., the learning-relevant properties of information or data (Flavell, 1976). Metacognitive processes are internal "executive processes" that control and supervise cognitive processes. They enable one to plan, monitor and evaluate performance throughout the execution of a task (Sternberg, 1986).

In relating metacognition to the task of reading to comprehend, one would be concerned with such activities as clarifying the purpose of reading and understanding the task demands; identifying the important aspects of a message; allocating attention to major content areas; monitoring the level of comprehension, checking whether the goals are being achieved; taking corrective action when comprehension failures are detected; and recovering from disruptions and distractions (Brown, 1980). Basically, metacognitively oriented students would not only be aware of their own characteristics, as learners, but also the demands of the task. This means that they would select, employ, monitor and evaluate their use of strategies, and would be able to recognize and correct comprehension failures.

In principle, conscious control and awareness during reading is influenced by several factors (Collins, 1994). The first factor to be described is the textual features of the respective text read. This refers to the syntax, vocabulary, clarity of the author's intentions, arrangement of ideas in the texts, and even the reader's interest and familiarity with the text all influence comprehension. Secondly, pre-requisite knowledge of text structure could enable the reader to more effectively observe and have greater control of strategies. These include how the author arranges ideas and determines which kinds of structures are used to interrelate ideas. For example, text structures identified as frequently used in informational or expository materials include hierarchical summaries, conceptual maps, and thematic organizers. These are designed to raise students' awareness of text structures (Harris, 1990; DiGisi, 1992). Thirdly, the characteristics of the reader is also influential. Younger and less matured readers have apparently been found to concentrate less on textual features because they are not aware of the impact that text structures have on learning (Armbruster, 1983).

The repertoire of metacognitive skills has been shown to be among the factors explaining the differences between good and poor readers (Kinnunen & Vauras, 1995). Researchers have consistently demonstrated that proficient readers typically execute one or more metacognitive behaviours as they read (Swanson & De La Paz, 1998). Poor readers are not as adept as good readers in engaging in planful activities either to make cognitive progress or to monitor it (Garner, 1987). Poor readers, unlike good readers, have little awareness that they must attempt to make sense of text (Baker & Brown, 1984). Poorer readers are also unlikely to demonstrate that they notice major blocks to text understanding (Garner & Reis, 1981). In addition, Oakhill and Patel (1991) have shown that poor readers do not make inferences from text and do not integrate ideas from different parts of texts in order to create accurate representations. Bos and

Vaughan (1994) demonstrated that even when poor readers were able to decode words correctly, they typically do not attend to the meaning of the passage, relate what is being read to their previous knowledge, or monitor their own comprehension.

The present study first aimed to examine the metacognitive knowledge and use of metacognitive strategies by good and poor readers of the English language in Singapore. The students involved in the study were from Secondary One and Three and included those from the Express and Normal (Academic) Courses. The awareness and knowledge of metacognition were measured with the Index of Reading Awareness (IRA; Jacobs & Paris, 1987), while the Reading Strategy Use (RSU) scale (Pereira-Laird & Deane,1997) measured the readers' use of metacognition. In view of the previous findings on the good and poor readers, it was predicted that the good readers in the present study would be more knowledgeable about metacognition and also be more active in their use of metacognitive strategies than the poor readers. Students with higher aggregates from the Primary School Leaving Examination (PSLE) were streamed into the Express Course, while those with the lower aggregate scores were streamed into the Normal (Academic) course. It was thus predicted that the students in the Express Course would be better readers, as well as demonstrate greater knowledge of metacognition and the use of it. Finally, it was predicted that the Secondary One and Three students would demonstrate differences in their knowledge and use of metacognition. Both the IRA and the RSU scale are sensitive to the age-related differences in awareness and use of metacognition during reading.

Assuming that good readers are more knowledgeable about metacognition, use metacognitive strategies more actively than poor readers, with the reading of the Science text, these readers would be expected to comprehend just as thoroughly. They would be expected to critically detect and address the differences in, for example, the organizational patterns or structures of the texts, arrangement of ideas, and the use of syntax and vocabulary.

## Method

### Participants

Thirty students, consisting 14 good and 16 poor readers, participated in the study. The participants were from Secondary One and Three, and were selected from the Express and Normal (Academic) courses, respectively. The following table presents the distribution of participants according to their comprehension abilities, educational level and academic course.

**Table 1: Distribution of participants**

| | **Good Readers** | **Poor Readers** |
|---|---|---|
| **Number of Participants** | 14 | 16 |
| | **Express Course** | **Normal (Academic) Course** |
| **Number of Participants** | 14 | 16 |
| | **Secondary One** | **Secondary Three** |
| **Number of Participants** | 9 | 21 |

Participant recruitment first involved the administration of the Stanford Diagnostic Reading Test (SDRT) for identifying the students who are good or poor in reading comprehension. The good readers scored 80 % and above for the SDRT comprehension test, while the poor readers scored 40 – 60 %.

## Design

The independent variables were (1) type of readers; (2) educational level of readers; and (3) academic course of readers. The dependent variables were (1) scores from the SDRT (comprehension) (2) scores from the IRA; (3) scores from the RSU scale.

In examining the students' possible differentiated knowledge and use of metacognition during the reading of the Science text, another independent variable was text type. Another dependent variable to be included was the scores from an adaptation of the RSU scale.

## Instrumentation

*Reading Proficiency Test*

The students completed the Stanford Diagnostic Reading Test (SDRT; Karlsen & Gardner, 1995). This included the comprehension, vocabulary and scanning tests that reflected the developmental characteristics of the reading process in depth and breadth. In the present study, only the comprehension results were the focus of the study. Two (Brown and Blue levels) of the six levels of diagnostic evaluation were utilized in the present study, the Brown level was administered to the Secondary One students, and the Blue level was administered to the Secondary Three students. The comprehension task was an individual task done silently. There were 54 questions in total.

*Metacognitive Inventories*

Two metacognitive inventories were initially administered to determine the students' knowledge and use of metacognition. Both inventories included brief cover instructions informing the participants the purpose of the respective instruments. The researcher worked through an example each with the students then allowed them to read and answer the inventories silently. Following administration, feedback was collected about the clarity of instructions, difficulty of the items, any confusing aspects of the inventories and the administration.

The Index of Reading Awareness (IRA; Jacobs & Paris, 1987) served the purpose of providing data about the students' reading awareness and knowledge of metacognitive strategies. The IRA is a multiple-choice questionnaire that measures evaluation, planning, regulation and conditional knowledge. The entire IRA includes 20 questions, each with three alternatives representing an inappropriate response (0 points), a partially adequate answer (1 point), and a strategic response (2 points). Five questions were developed to measure each aspect of metacognition.

The IRA was selected to measure the Singaporean students' knowledge of reading strategies for the following reasons. It is easy to use, easy to respond to, and has good potential for interpretation on an individual level. It is also readily interpretable with generally good reliability, good face validity and evidence for criterion-related validity. As the present study concerns measuring students' knowledge of reading strategies, this inventory has been administered to determine whether it can serve as a measure of student knowledge of reading strategies for Singaporean students.

The other inventory administered was the Reading Strategy Use (RSU) scale (Pereira-Laird & Deane, 1997) for determining the students' use of metacognitive strategies. The RSU scale is composed of a total of twenty-five items.

Thirteen items measure reading metacognitive strategy use while twelve items measure cognitive strategy use. The cognitive strategies include rehearsal, organization, and elaboration strategies (Weinstein & Mayer, 1986), while the metacognitive strategies include planning, monitoring, and regulation strategies. The cognitive and metacognitive items are randomly ordered, with twelve items worded negatively to control for response set. The responses to each item are made on a 7-point Liker-type scale. The scale ranges from 1 to 7 with the following verbal descriptors: 1 – "never", 2 – "almost never", 3 – "seldom", 4 – "sometimes", 5 – "often", 6 – "almost always", 7 – "always".

The RSU scale was selected to gather information about the students' level of strategic engagement and provide details about the kinds of cognitive and metacognitive strategies students employ in reading texts. The RSU scale's validity and reliability and its ease of use are some reasons for why it is selected as a measure of reading strategy use in adolescents. To determine the students' use of metacognition following the reading of the Science text, an adapted version of the RSU scale was administered.

**Procedure**

Students first completed the Stanford Diagnostic Reading Test (SDRT) for the selection of good and poor readers. The selected students' reading scores were then verified by the English language teachers to determine the accuracy of the placement of pupils in the categories of good and poor readers. The subsequent two sittings concerned the completion of the Index of Reading Awareness (IRA) and the Reading Strategy Use (RSU) scale, respectively.

To investigate the students' use of metacognitive strategies during the reading of the Science text, the pupils were requested to read a passage extracted from a Science textbook, and then to respond to questions that checked on their understanding of the text. Following that, the students were asked to respond to an adapted version of the RSU scale to determine their use of metacognitive strategies when reading a text in this different domain.

**Results**

The data were computed using t-tests. Tables 2-4 present the overall means and standard deviations of the scores for the SDRT comprehension test, IRA and the RSU scale.

**Table 2**

**Overall Means and Standard Deviations of Good and Poor Readers on Comprehension Test**

| | **Type** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **SDRT Comprehension** | **Good** | 14 | 47.57 | 2.50 |
| | **Poor** | 16 | 29.25 | 6.23 |

A t-test computed on the SDRT comprehension test results showed that the good readers scored significantly higher than the poor readers ($t = 10.28$, $p < .01$).

**Table 3**

**Overall Means and Standard Deviations of Good and Poor Readers on the IRA**

| | **Type** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **Scores on IRA** | **Good** | 14 | 31.29 | 3.81 |
| | **Poor** | 16 | 26.81 | 4.89 |

The t-test computed on the IRA scores demonstrated that the good readers attained significantly higher scores than the poor readers ($t = 2.765$, $p = .01$). This suggests that the good readers selected more strategic responses than the poor readers did, in responding to the questions on the IRA. The results thus indicate that the good readers displayed better awareness and knowledge of metacognition.

**Table 4**

**Overall Means and Standard Deviations of Good and Poor Readers on the RSU scale**

| | **Type** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **Scores on RSU scale** | **Good** | 14 | 87.71 | 11.40 |
| | **Poor** | 14 | 93.93 | 8.82 |

The means of the poor readers was marginally higher than the scores of the good readers. The attrition rate of two was observed for poor readers. The computed t-test on the scores for the RSU scale did not present any significant differences between the good and poor readers' responses ($t = - 1.613$, $p > .05$).

Tables 5 – 7 display the means and standard deviations of the Express Course and Normal (Academic) Course students in the SDRT comprehension, IRA and RSU scales.

**Table 5**

**Overall Means and Standard Deviations of Express and Normal (Academic) Course students on the SDRT Comprehension Test**

| | **Course** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **SDRT Comprehension** | **Express** | 14 | 46.64 | 4.85 |
| | **Normal(Academic)** | 16 | 30.06 | 7.36 |

The t-test computed on the SDRT comprehension scores showed that the Express Course students attained significantly higher scores than the Normal (Academic) Course students ($t = 7.169$, $p < .01$).

**Table 6**

**Overall Means and Standard Deviations of Express and Normal (Academic) Course students on the IRA scores**

| | **Course** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **Scores on IRA** | **Express** | 14 | 31.57 | 3.16 |
| | **Normal(Academic)** | 16 | 26.56 | 5.03 |

The t-test computed on the IRA scores demonstrated that the Express Course students selected more strategic responses than the Normal(Academic) Course students ($t = 3.209$, $p < .01$).

**Table 7**

**Overall Means and Standard Deviations of Express and Normal (Academic) Course students on the scores for the RSU scale**

| | **Course** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **Scores on the RSU scale** | **Express** | 14 | 87.71 | 11.40 |
| | **Normal(Academic)** | 16 | 93.93 | 8.82 |

Computation of the t-test on the scores of the RSU scale showed that the Express and Normal(Academic) Course students, however, did not differ significantly in their use of metacognitive strategies ($t = -.551$, $p > .05$).

Tables 8-10 display the means and standard deviations of the Secondary One and Three students for the scores on the SDRT Comprehension Test, the IRA and the RSU scale.

**Table 8**

**Overall Means and Standard Deviations of Secondary One and Three students on the SDRT Comprehension Test**

| | **Educational Level** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **SDRT Comprehension** | **Secondary One** | 9 | 41.67 | 9.58 |
| | **Secondary Three** | 21 | 36.14 | 10.59 |

Due to constraints in sample selection at school, there was an unbalanced proportion of Secondary One and Three students involved in the study. No significant differences were found between the Secondary One and Three students' comprehension scores ($t = 1.344$, $p > .05$).

**Table 9**

**Overall Means and Standard Deviations of Secondary One and Three students on the IRA scores**

| | **Course** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **IRA scores** | **Secondary One** | 9 | 26.78 | 4.09 |
| | **Secondary Three** | 21 | 29.81 | 5.03 |

No significant differences were found between the Secondary One and Three students in their IRA scores ($t = -1.593$, $p > .05$).

**Table 10**

**Overall Means and Standard Deviations of Secondary One and Three students on the scores of the RSU scale**

| | **Course** | **Number** | ***M*** | ***SD*** |
|---|---|---|---|---|
| **Scores for the RSU scale** | **Secondary One** | 8 | 84.25 | 9.74 |
| | **Secondary Three** | 20 | 93.45 | 9.80 |

The attrition rate of one was observed for the Secondary One and Three students, respectively. On the other hand, the Secondary Three students displayed significantly higher scores in the RSU scale than the Secondary One students ($t = -2.249$, $p < .05$).

**Discussion and Conclusion**

The first part of our research was to investigate the knowledge and use of metacognition by good and poor readers during reading to comprehend. For this sample of Singaporean students who were from the Secondary Level and two different Academic Courses, three main predictions were proposed. It was hypothesized that the Singaporean readers would replicate the findings of previous research that the good readers would demonstrate greater knowledge and use of the metacognitive strategies during reading. In accordance with the criteria for streaming, the students in the Express Course were expected to be more active in their knowledge and use of metacognition. Finally, age-related differences were expected between the Secondary One and Three students.

The results from the comprehension component of the SDRT clearly demonstrate that the good readers performed better in reading comprehension than the poor readers. The Express Course students also scored significantly higher than the Normal (Academic) students in reading comprehension. No differences were however found between the Secondary One and Three students with respect to their reading performance in the SDRT comprehension test. This can be explained by the fact that the students' reading comprehension scores were administered by graded reading tests, i.e., the brown and blue levels of the SDRT. The results seem to indicate that with no differences found between the Secondary One and Three students' reading performance, no differences in their knowledge and use of metacognitive strategies would be found. Indeed, the results did not demonstrate differences between the Secondary One and Three students with respect to their scores on the IRA. However, the Secondary Three students scored higher than the Secondary One students on the RSU scale. Thus, the result for the IRA did not support the prediction, while that for the RSU scale was in line with what was hypothesized.

Jacobs and Paris (1987) intended that the IRA be sensitive to individual and age-related differences in awareness about reading. The IRA was designed for children in the third and fifth grades with grade-equivalent reading abilities from the second to the seventh grade. The seventh grade is approximately Secondary One level in the local context. With no differences found between the reading awareness of the Secondary One and Three readers, the result suggests that the IRA may not have been sensitive to age-related differences beyond the seventh grade, or Secondary One level, in the present context.

In line with the prediction, the RSU scale discriminated between the Secondary One and Three students' use of metacognition. According to Pereira-Laird and Deane (1997), although a reasonably large number of items were generated to measure strategy use of young adolescents, certain types of strategies may be more relevant for students in the upper grades as compared to those in the lower grades. Certain strategies may have been found to be more

useful as the reading material may have warranted the use of such strategies. Whereas, certain other strategies may not have been found useful as the reading material may not have warranted the use of such strategies. Alternatively, the students may not have developed the skill or employed it.

The results from the IRA showed that the good readers made more strategic choices than the poor readers. Likewise, the Express Course students also scored higher on the IRA and therefore demonstrated their greater awareness of metacognition and knowledge of it. This showed strong support for the previous findings (Garner & Reis, 1981; Garner, 1987; Baker & Brown, 1984; Swanson & De La Paz, 1998; Zhang, 1999; 2000; etc.) that good readers differ from their poorer counterparts not only in language proficiency but also from having greater awareness and knowledge of metacognition. This suggests that the good and poor readers differ in the degree of their awareness of the demands of the reading tasks and the strategies that would prove useful for comprehending what is read. The argument thus seems to follow that metacognition is important and essential for reading comprehension. If one has a better command of metacognitive knowledge, it seems then that comprehending what is read would be more efficient (Zhang, 2000).

The results for the RSU scale took a turn and did not generally support all the predictions. While no significant differences were found between the good and poor readers, nor between the Express Course and Normal (Academic) Course students, the Secondary Three students actually attained higher scores than the Secondary One students. The non-significant difference between the good and poor readers' use of metacognition suggests that both types of readers used the strategies as often as each other. It is interesting to note that the poor readers and the Normal (Academic) students actually displayed higher mean scores than the good readers and the Express Course students, respectively, on the RSU scale. This raises the question of whether readers with difficulties comprehending the textual material may have found that a greater use of the metacognitive strategies facilitated their understanding of the textual material. In other words, the poorer readers' use of metacognitive strategies may have compensated for their deficiencies in reading subskills. That is, their limitations in the use of semantic, syntactic, visual and phonological information, during reading.

Considering that the data were collected via self-reports, one should exercise caution in interpreting the results. These instruments tap on students' perceptions of what they are doing rather than the accuracy of these perceptions (Pokay & Blumenfeld, 1990). For example, the RSU scale, does not account for the efficiency or appropriateness of strategy use. In addition, it may be necessary to consider a multitrait, multimethod study using a non-self-report strategy (e.g., parent and teacher ratings or observations) to validate the findings. Furthermore, as there is an established relationship between reading performance and motivation (Guthrie, McGough, Bennett & Rice, 1996; Pereira-Laird & Deane, 1997), and that both theory and research predict that negative self-perceptions and expectations may hinder the deployment of strategies, one needs to pay attention to student motivation when assessing both strategy use and knowledge of metacognition. Nonetheless, the results of this investigation provide preliminary findings on knowledge and use of metacognition for the case of the Singaporean students from the Express and Normal (Academic) Courses at Secondary level.

In summary, then, the present study has found evidence to support previous research findings that demonstrated that good readers show greater awareness and knowledge of metacognition than poor readers. With respect to the use of metacognitive strategies, no differences were found between the good and poor readers. This suggests that even though the good and poor readers differed in terms of their awareness and knowledge of metacognition, they did not use metacognitive strategies differently. Perhaps, one would have to consider whether the students also have knowledge about the metacognitive strategies that can be employed to facilitate reading comprehension. In addition, how and when to employ the strategies may also be an issue to be considered with respect to the students' use of metacognition.

With respect to the findings on the students' use of metacognitive strategies during the reading of the Science text, the analyses are currently being analysed.

**References**

Baker, L., & Brown, A.L. (1984). Cognitive monitoring in reading. In J. Flood (Ed.), *Understanding reading comprehension*. Newark, DE : International Reading Association.

Bos, C.S., & Vaughn, S. (1994). *Strategies for teaching students with learning and behaviour problems.* Boston : Allyn

& Bacon.

Carrell, P.L. (1987). Introduction. In J. Devine, P.L. Carrell., & D.E. Eskey (Eds.). *Research in reading in English as a second language.* Washington, D.C.: TESOL.

Carrell, P.L., Gajdusek, L., & Wise, T. (1998). Metacognition and EFL/ESL reading. *Instructional Science*, 26, 97-112.

DiGisi, L.L., & Yore, L.D. (1992) Reading Comprehension and Metacognition in Science: Status, Potential and Future Direction. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Boston). [ED 356132]

Flavell, J.H. (1978). Metacognitive development. In J.M. Scandura & C.J. Brainerd, (Eds.). *Structural Process theories of Complex Human Behaviour.* The Netherlands : Sijthoff and Noordhoff.

Garner, R. (1987). *Metacognition and reading comprehension*. Norwood, NJ : Ablex.

Garner, R., & Reis, R. (1981). Monitoring and resolving comprehension obstacles: An investigation of spontaneous text lookbacks among upper-grade good and poor comprehenders. *Reading Research Quarterly*, 16, 569-582.

Guthrie, J.T., McGough, K., Bennett, L., & Rice, M.E. (1996). Concept-oriented reading instruction: An integrated curriculum to develop motivations and strategies for reading. In L. Baker, P. Afflerbach, & D. Reinking (Eds.), *Developing engaged readers in school and home communities.* NJ : Lawrence Erlbaum.

Harris, J. (1990). Text Annotation and Underlining as Metacognitive Strategies to Improve Comprehension and Retention of Expository Text. Paper presented at the Annual Meeting of the National Reading Conference (Miami). [ED 335 669]

Jacobs, J.E., & Paris, S.G. (1987). Children's metacognition about reading: Issues in definition, measurement and instruction. *Educational Psychologist*, 22, 255-278.

Karlsen, B., & Gardner, E.F. (1995). *Stanford Diagnostic Reading Test* (4th Edition). San Antonio : Harcourt Brace.

Kinnunen, R., & Vauras, M. (1995). Comprehension monitoring and the level of comprehension in high- and low-achieving primary school children's reading. *Learning and Instruction*, 5, 143-165.

Oakhill, J., & Patel, S. (1991). Can imagery training help children who have comprehension problems ? *Journal of Research in Reading*, 14, 106-115.

O'Malley, J.M., Chamot, A.U., Skewner-Mazanares, G., Russo, R., & Kupper, L. (1985). Learning strategies applications with students of English as a second language. *TESOL Quarterly*, 19, 285-296.

Paris, S., Lipson, M., & Wixson, K. (1983). Becoming a strategic reader. *Contemporary Educational Psychology*, 8, 293-316.

Paris, S.G., Cross, D.R., & Lipson, M.Y. (1984). Informed strategies for learning: A program to improve children's reading awareness and comprehension. *Journal of Educational Psychology*, 76, 1239-1252.

Pereira-Laird, J.A., & Deane, F.P. (1997). Development and validation of a self-report measure of reading strategy use. *Reading Psychology*, 18 (3), 185-235.

Pokay, P., & Blumenfeld, P.C. (1990). Predicting achievement early and late in the semester : The role of motivation and use of learning strategies. *Journal of Educational Psychology*, 82, 41-50.

Swanson, P.N., & De La Paz, S. (1998). Teaching effective comprehension strategies to students with learning and reading disabilities. *Intervention in School and Clinic*, 33, 4, 209-218.

Zhang, L.J. (1999). *Metacognition, cognition and L2 reading*. Unpublished PhD thesis, ELAL, Nanyang Technological University.

Zhang, L.J. (2000). Research on metacognition and reading in a second language. *React*, 1, 21-27. Oxford Graphic Printers: Singapore.