Paradigms in Readability Research

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Abstract: There was a great deal of development in research in the area of readability from 1920 to the middle of the 1990s. The developments in this research area appeared to stop at that point, however, and very little research has been reported recently. In attempting to explain the disappearance of research in the readability area, I would like to start this paper by outlining a brief definition of readability. According to Gilliland, (1975) matching the reader and the text has come to be called readability.In the past research on readability has focused on the development of practical methods to match reading materials to the abilities of student and adult readers. These efforts centred on the development of easily applied readability formula for teachers and librarians to use. More recent readability research has involved a period of consolidation in which researchers sought to learn more about how the formulas worked and how to improve them. These observations on the development of the study of readability have defined the present paper. The purposes of this paper are therefore:

- To describe the major research paradigms used by scholars in readability research;
- To show the failure of the research paradigms previously used in this research;
- To suggest other paradigms that can be used in readability research;

Keywords: Reading, Readability, Comprehension, Comprehensibility

Introduction

Readability is mainly concerned with a basic problem related to people who would like to select reading material for their use or that of others. This is a problem of matching. During the process of selecting reading material the reader will be influenced not only by his or her given interest and reading skills but also by the range of reading material differing in content, style and complexity. The study of matching the reader and the text has come to be called 'readability'.

It is not surprising then that educators in general show an interest in readability. Research in readability began in the nineteen twenties. According to Chall (1974, 153) in those years there was a surge to emphasise quantification in developing a scientifically based curriculum. To avoid subjectivity, the methods and materials of education were put to empirical test. Hence, the study of readability was concerned with the search for factors in reading material which could be easily counted into measures which are objective. Klare, 1963 (cited in Gilliland) reports cases of individual educationists in the nineteenth century who related counts of vocabulary and familiar words to reading difficulty. The results of these investigations represent the first attempt to

appraise the difficulty of reading material objectively. This approach to the study of readability is based in a positivist paradigm.

The positivist paradigm is the obvious way of looking at readability because it believes that reality is 'out there' and can be measured. Through the beginning years of the study of readability researchers believed that reading difficulty was related to reading material. Readability research focused on devising procedures and instruments that would reliably and validly distinguish easier from more difficult reading material. In this paradigm reading difficulty was influenced by four factors mainly related to reading material such as content, stylistic elements, format, and organization. Stylistic elements were the most amenable to reliable quantitative measurement and verification (Chall, 1974, p. 156). In the stylistic elements, factors such as vocabulary load, sentence structure, idea density and human interest were found to be significantly related to reading difficulty. As such this shows that readability was conceptualised from a positivist paradigm since the reality was found outside the reader when reading difficulty or comprehension were predicted by looking through reading material instead of looking through the reader.

Researchers in readability believed that vocabulary diversity was the most significant criterion in reading difficulty. They believed that reader comprehension of the reading material related to factors outside of the reader such as vocabulary diversity. Vocabulary diversity refers to the number of different words in the reading material. According to Chall, (1974, p. 157) most studies showed that the smaller the number of different words, the easier the material. Another factor which most significantly related to reading difficulty was vocabulary difficulty. Vocabulary difficulty had to do with the reader's understanding of the individual words in a text. Chall, 1974 reported that most studies had found some measure of vocabulary difficulty to be significantly related to comprehension. The ways to measure vocabulary difficulty were either by reference to a set list of words or by word length. It was found that the larger the proportion of unfamiliar or long words in a text, the harder it was for the readers to grasp meaning. Vocabulary difficulty factors have been used in all readability formula.

Another way that researchers in readability predicted reader comprehension of the reading material was by looking at the sentence structure. Sentence structure was found to be significantly related to comprehension difficulty. The best way to measure sentence structure was thought to be by sentence length. Generally, the longer the sentences were, the harder the text. Apart from looking through sentence structure researchers were also interested in estimating sentence difficulty by the number of complex sentences, the number of simple sentences, and sentence length estimated by a count of syllables. They also found that sentence measures were interrelated and significantly related to reading difficulty (Chall, 1974). Readability is very famous for its formulae for predicting reading material difficulty. Vocabulary load and sentence structure were the most used as variables in readability formulae.

There are, however, problems in looking at readability through a positivist paradigm. As a result studies of this kind have been more or less abandoned for almost 15-20 years. In the next section of this paper I will discuss the failure of the positivist paradigm in readability studies.

Failure of the previous readability research paradigm

This approach to research in readability based on the positivist paradigm has been more or less abandoned for almost 15-20 years now and current research no longer operates in this way. Many reasons have contributed to the change in this research field. One of these factors is that the characteristics of written matter that have been found in readability studies to be correlated with comprehension difficulty can be questioned. The essential question was what characteristic of printed material have been found to account for comprehension difficulty and how influential are these characteristics in the comprehension process (Simons, 1971). Simon continues by suggesting that factors such as idea density and human interest are such vague concepts in readability studies that they have not been measured very successfully. Further he mentioned that in readability studies vocabulary is measured most accurately by the number of words in a passage not on a given list of frequent words, and sentence structure is most accurately measured by some index of sentence length. But these factors appear to be approximate measures of some underlying variables that are intrinsic to the comprehension process. He continues to argue,

> *In order for these factors to help in understanding reading comprehension the processes underlying them must be explained. An understanding of the reading comprehension process will then answer questions such as: What is it about sentence structure and vocabulary load that influences comprehension difficulty? What are idea density and human interest and how can they be described more precisely? (Simon, 1971, p. 351).*

Another reason why readability studies are now considered unrelated to the comprehension process stems from research in cognitive science in the 1980s that identified problems with texts that had been manipulated or written to satisfy readability constraints. Horns, 1930s (cited in Chall, 1979, p. 12) cautioned against the mechanical use of words lists and readability formulae for selecting and rewriting books in the social studies. He mentioned that word lists and readability formulae do not pay sufficient regard to the possibility that it is the conceptual difficulty of text that may cause poor understanding, although the words may be common. He added that words of high frequency are also likely to cause greater difficulty if a reader gives words the wrong meaning. He gave an example from the study of his students that negligible effects on comprehension may result merely from simplification of vocabulary. Many years later in 1982, Davison and Kantor in their study found out that specific changes made to make the text easier may actually make the text harder to understand. The changes that were made were splitting complex sentences into component clauses, changing vocabulary items, etc. As a conclusion of their study Davison and Kantor argued strongly against the implicit use of readability formulae as guides to writing graded texts and urged experimental research to define the real factors constituting readability (Davison, 1982, p. 187). As a result two primary professional associations in USA, International Reading Association and National Council of Teachers of English, called for the cautious use of readability formulae Michelson, 1985 (cited in Hiebert, 2006, p.398). This call was echoed in Becoming a Nation of Readers in which a moratorium on the use of readability formulae was advocated Anderson, 1985 (cited in Hiebert, 2006, p.398).

Research within the cognitive science perspective, has not only identified the problem in texts being manipulated or written to satisfy readability constraints, but they have also conceptualised the process of reading differently (Alexander, 2006). Cognitive research has marked a paradigm change in the readability studies. This is because the way of understanding the concept of reading has changed and therefore the conceptualization of the comprehension process has changed. The comprehension process is no longer considered as an input and output process. It is no longer a simple matter of getting the meaning from the page. The critics in understanding this comprehension process in general and readability in particular, stated that the readers have being considered as passive recipients of the information in the text (Dole, 1991). In other words, meaning was seen as residing in the text itself, and the goal of the reader was to reproduce that meaning. This is in contrast with the cognitive science perspective. Cognitive based views on reading comprehension emphasize the interactive nature of reading and the constructive nature of comprehension (Dole, 1991).

Hence, in this new view of comprehension both beginners and skilled readers use their existing knowledge, a range of cues from the text, and the situational context in which the reading occurs to build, or construct a model of meaning from the text. Further supporters of this view believe that even beginner readers can act similarly to skilled readers if they deal with texts and tasks on which they possess appropriate knowledge (Dole, 1991). On the other hand, even skilled readers can 'fall' to beginners when they have to deal with difficult or ambiguous texts (Dole, 1991). In this case, if a beginner reader was given a text which he/she had prior knowledge of it, he/she would be able to behave similarly to a skilled reader. Beginner readers would then be able to use their prior knowledge to interpret and construct the meaning of a given text.

Conversely, if skilled readers had to face difficult to understand or ambiguous texts they would act like beginners who are not able to determine importance, to draw inferences, and to elaborate the given text (Dole, 1991). Therefore, two important characteristics of the readers within this view were found. The characters are the knowledge that the readers bring to the task and the strategies that they use to foster and maintain understanding. Consequently, in the range of the age and the ability of the readers to interpret and construct the meaning in a given text, they will also use their own existing knowledge as a filter. The debate in reading has recently viewed it as an active process in which a model of meaning represented by the text is constructed, and the readers can select from a range of cues that derive from the text and the situational context (Dole, 1991).

According to the above arguments, there has been a vast change in the definitions and the ways of looking at reading. Hence, the changes in reading definitions have directly affected the nature of the comprehension process. Recently the comprehension process is defined as the action capability of understanding (Dole, 1991). Comprehension now refers to a higher cognitive process of the brain that searches for relations between a given object or aspect with other objects or aspects, and their relations in the long-term memory, and establishes a representational model for the object or aspect by connecting it to appropriate clusters of memory (Wang, 2003).

Therefore, reading and comprehension research has lately been closer in finding answers to what really happens in the readers' minds during reading.

The changes in views of reading and comprehension processes, definitions, and understanding, have had a huge effect on the understanding of readability. Since reading and comprehension are interactive processes, readability has also become an interactive process between the readers and the text. Furthermore, it is now obvious that comprehension process has been related to the cognitive process in the searching of meaning. Therefore, meaning does not longer come from the text, but comes from the readers' mind in an interaction with the text. At this point, it is clear that the positivist paradigm is no longer appropriate to justify readability research. Readability is no longer 'out there'.

A new paradigm in reading can provide a different way of looking at the reading and comprehension process. It is considered as a new paradigm because the reading and comprehension process are no longer measuring what is the outcome of the process, but instead, they are focusing on what is happening during this process. In the next section there will be a discussion on how this new paradigm in reading can shape new research into readability.

The new paradigm in readability research and its critics

Research in reading has been gone through tremendous changes during the last 50 years. The history of reading research has shown a transformation of physiological, psychological, and sociological dimensions. In the past era of a physiological dimension the focus was based on biological, chemical, and neurological aspects of human performance, and it was clearly presented in the behaviourist orientation where reading was a 'conditioned response' (Alexander, 2006, p. 57).

Current research in reading places emphasis on the psychological and sociological dimensions of the reading process. Within these dimensions the stress is on mental processes and socio-cultural aspects. In the psychological orientation, mental processes of the mind were the most apparent (Alexander, 2006). Here, the research in reading focuses directly on the process and the function of the mind. Reading research has become very different now and it is no more a process of focusing on the input and the output, but it is a more interesting process which describes what happens in the mind during the reading process (Alexander, 2006). There has been a lot of research showing how to describe what is there in peoples' mind during the reading process, as for example studies in the area of error and miscue analysis, and in thinking aloud (Alexander, 2006).

Within the sociological dimension, the importance of socio-cultural perspectives has been taken into account during observations in the reading process. The different ways to observe and measure the reading process have marked the need for a new paradigm. The paradigm now is an interpretive paradigm where the reality is believed no longer to be 'out there' but in the mind of the people (Sarantakos, 1997).

Taking into account this new paradigm, reading research also tends to focus on what is happening in the readers' minds during reading, as for example in the 'error and miscue analysis' study. Error analysis studies refer to the analysis of oral reading errors (Leu, 1982). This area of research has attracted the attention of researchers, as it is a useful way to study children's processing mechanisms of written information. In reading error studies, school-aged participants typically are presented with complete stories from instructional materials and have to perform a task (oral reading), that takes place within their educational setting. The researcher evaluates the observed responses (O.R.) that deviate from the expected responses (E.R.) in order to make inferences about the reading process (Leu, 1982). In earlier studies on error analysis, researchers tended to use error categories that gave very small insight into the cognitive or linguistic aspects central to the reading, and therefore, oral reading error behaviour was described in terms of the frequency of substitutions, omissions, insertions, repetitions, gross and partial mispronunciations, and inversions (Leu, 1982).

Later on, this research area demonstrated the active contribution that all readers make to the comprehension process. Reflecting this recent reorientation, oral reading errors are often referred to as "miscues," suggesting that they are mistakenly cued by the cognitive and linguistic systems of the readers as they interact with the written text (Leu, 1982, p.423).

The term miscue, originated by Kenneth Goodman in 1960s, describes any loss that the reader may have from the actual words of the text. Goodman defines miscue as:

> *A miscue, which we define as an actual observed response in oral reading which does not match the expected response, is like window on the reading process. Nothing the reader does in reading is accidental. Both his expected responses and his miscues are produced as he attempts to process the print and get to meaning. If we can understand how his miscues relate to the expected response we can also begin to understand how he is using the reading process (Goodman, 1973, p.5).*

Goodman (1973) also suggested that the analysis of oral reading errors could be used to increase our understanding of the reading process. He suggested that psycho-linguistically based measures of oral reading can be related to comprehension. He mentioned that a percentage of all the miscues together is what comes to be called the comprehending score. It is a measure of the reader's ability to keep focused successfully on the meaning. He further explained that it is not important how many miscues a reader makes but what their effect on meaning is. According to Goodman's arguments, a conclusion that can be made here is that the ways to look at the reading process have changed. The reading process is now closer to focusing on how the readers process the meaning in their mind through the language used. Apart from the error and the miscue analysis studies, there is also other research that has focused on the human mind during reading, and has been called the 'Think Aloud Protocol'. This will be discussed next.

The 'Think Aloud Protocol' studies argue the information is consciously available in the working memory of the reader, and that he/she is 'able' to code the language after reading a given sentence (Ericsson & Simon, 1993, as cited in Magliano, 2003). In such studies readers are asked to think aloud, they are taught to produce whatever opinion gets into their mind at once, after reading sentences inside a text. Therefore, the readers are not asked to introspect concerning the process of reading or to guess upon the meaning of their thoughts.

Hence, the researchers analyze the content of the protocol in order to make inferences regarding the strategies, information, and mental processes that occur during reading (Magliano, 2003). Magliano & Trabasso (2003) carried out a series of research studies assessing understanding as developed through thinking aloud. They employed a protocol analysis system that discriminated different comprehension tactics that can be related to the information that is activated during reading. They found that readers can be able to make use of information, to give details why something has happened or mentioned, to forecast what will occur next, or elaborate or embellish upon the details of the story world. They also indicated that explanations which predominated the thoughts produced while thinking aloud, were consistent with the notion that deep comprehension is guided by explanatory reasoning (Magliano, 2003).

Studies within the Think Aloud Protocol have remarkably shown the change in the nature of reading and comprehension process. The studies have shown how the process in the human mind can be predicted by asking the participants what they were thinking about during the reading process, and they were expected to give an opinion that immediately came into their mind after reading sentences inside a text. This activity of think aloud is one of the ways to detect what happens in the human mind when reading, and this has been justified by Hackos & Redish:

> *"By recording the verbal protocol, you will be able to… detect cognitive activities that may not be visible at all" (Hackos & Redish, 1998, cited in Nielsen, 2002, p. 102).*

Apparently, there has been a move and a change to this new way of conducting reading research, within the area of neuroscience research. Neuroscience is the study of the brain and the nervous system, including molecular neuroscience, cellular neuroscience, cognitive neuroscience, psychophysics, computational modeling, and diseases of the nervous system (found at: http://www.medterms.com/script/main/art.asp?articlekey=25656). Neuroimaging is a technique widely used to investigate the field of reading. Neuroimaging is the use of X-ray studies and magnetic resonance imaging (MRIs) to detect abnormalities or trace pathways of the nerves' activities in the central nervous system. One contribution of neuroimaging is that it provides a tool for localizing brain regions that are active during word reading (Fiez, 1998). Fiez (1998) has conducted a quantitative review of nine neuroimaging investigations of word reading. The aim of her study was to reveal a set of areas that were active during word reading, including left-lateralized regions in occipital and occipitotemporal cortex, the left frontal operculum, bilateral regions within the cerebellum, primary motor cortex, and the superior and middle temporal cortex, and medial regions in the supplementary motor area and anterior cingulate. She argues that beyond localization, the challenge is to use neuroimaging as a tool for understanding how reading is accomplished (Fiez, 1998).

Nowadays neuroimanging has been extensively used in the field of specific reading disability or dyslexia. Goswami (2004), claimed that neuroimaging could also be used to measure the impact of training programmes devised in response to particular theories of dyslexia. Furthermore, she suggested that if 'an exercise-based package actually improves reading in children with dyslexia, there should be measurable effects in the neural systems for reading as well'(p. 179).

Apart from the neuroscience research, there is another field of reading research that has emerged. This research field takes a *social-cultural perspective* toward reading. The social-cultural approach was developed by the New Literacy Studies (NLS). A NLS perspective has placed language and literacy in their full array of cognitive, social, cultural, institutional and historical context. Within a NLS perspective, there is actually no such an issue called 'literacy'. Instead, people adopt different "ways with printed material" within different social-cultural practice for different purposes and functions. Furthermore, "ways with printed words" within such social-cultural practices are ways integrally and inextricably integrated with ways of talking, thinking, believing, knowing, acting, interacting, valuing, and feeling. In these practices, humans are always 'meaning producers', not just 'meaning consumers' (Gee, 2001, p. 30).

This rather 'strong' statement within the social-cultural perspective toward the nature of reading, has shown that meaning comes from the human mind and this phenomenon justify how the reality is no more 'out there' as the positivist paradigm has suggested. In addition, the way in which error and miscue analysis study, and the think aloud protocol studies validate how the human mind plays an important role during process of reading and comprehension, now it is clear that the reading and comprehension process come from the reader. This phenomenon of extracting the reading and comprehension process from the human mind becomes the evidence where reality is an internal experience. Readability research should be closely related to reading research so that readability research can become more supportive in the development of the reading research, and at the same time enrich the general research field. According to these arguments, it can be suggested that a readability study should be based in the interpretive paradigm as the reading study is.

Within the qualitative interpretive paradigm inferences about what happens in the human mind when reading can be made. Evidence from what people are doing during reading can be obtained. However, it may not be as simple as that to get evidence about what happens in peoples' minds. There may still be unanswerable questions to that phenomenon as we cannot truly know what a person is really thinking about when he/she does something. Research in read aloud or think aloud for example, may stop the readers and ask them at a certain point what they think about when they are reading. This question can provide empirical evidence about what the readers are thinking about during the whole process. But it is still not guaranteed that they are thinking about those things and actually hat is known is simply what they say they are thinking about. There are many other problems that can occur during the effort to justify what the readers are thinking about during the reading process. Xu, Cui, & Chen (2007) have indicated that:

> *Another problem of think-aloud protocol is caused by the presence of experimenter /mentor which might also affect the behavior of the subjects. Orne (1969) stated that subjects can never be neutral to an experiment; the Hawthorne effect occurs when the subjects know that they are being studied. Think-aloud protocol forces subjects to speak and interferes with the thinking process. Think-aloud protocol with observation and the communication between mentor and subjects might particularly affect the outcome. Some subjects may experience difficulties talking when they perform their tasks, or be affected by the presence of the mentor. Some people may find it difficult to verbalize their every thought (Xu, Cui, & Chen, 2007, p. 1228).*

Xu, Cui & Chen (2007) have also shown evidence through their studies that suggests that actually people do not have access to their brain. Human beings cannot really see what is happening in their head and they only talk about the things that they think about during the reading process.

Additionally, the 'think aloud protocol' may also have limitations. Miscue analysis has brought up theoretical and psychometric questions about the relationship between oral reading behaviour and overall reading efficiency. There are theoretical problems associated with how psycho-linguistically based measures of oral reading can be related to comprehension (O'Brien, 1988). The puzzling relationship among oral reading comprehending and comprehension product measures may be the product of incompatibility between the operational definition of meaning construction within schema-based notions of comprehension, and of the ways meaning construction is operationally defined in miscue analysis (O'Brien, 1988). Mc Kenna (2006) strongly opposed to miscue analysis study, he argues that 'the popularity of the Goodman model prompted numerous researchers to investigate its validity. Working independently and employing a variety of methodologies, their findings converged in a single conclusion: The model is wrong' (Mc Kenna, 2006, p. 379). There are so many other questions that arise from the study of miscue analysis and its relationship with reading process in general and reading comprehension in particular. This argument has given an indication that miscue analysis studies have their own weakness to justify what really happens in the human mind during the reading process. Drawing from the limitations in the methods detailed above, it seems that there are still weaknesses in this paradigm when applying it to readability research.

Conclusion

To sum up, research in reading has been through a major change in the last 50 years. The change in reading research has had an effect on readability research as well. In an earlier section in this paper, it was shown that readability research has been investigated in a certain way which was called the positivist paradigm. It was also shown that the way to study readability within the positivist paradigm was rather inadequate and this is maybe because the way to understand the reading process has become different. Hence, in order for readability research to be related to reading research, a new paradigm for readability research has been indicated, named 'interpretive

paradigm'. Within this paradigm the researcher will try to find out what is in the readers' mind when they are reading, by interpreting what these readers say. It is hope with this new paradigm in readability research will open a new door to the development of readability research.

References

Alexander, P. A., & Fox, E. (2006). "A historical perspective on reading research and Practice". In: R. B. Ruddell, & N. J. Unrau, (Eds.) *Theoretical Models and Processes of Reading, Fifth Edition*. Newark: International Reading Association.

Chall, J. (1974). *Readability: An Appraisal of Research and Application*. Essex: Bowker Publishing Company.

Chall, J. S. (1988). "The beginning years". In: B. L. Zakaluk, & S. J. Samuels, (Eds.) *Readability, Its Past, Present & Future* (pp. 2-13). Newark: DE: International Reading Association.

Davison, A., & Kantor, R. N. (1982). "On the Failure of Readability Formulas to Define Readable Texts: A Case Study from Adaptations'. *Reading Research Quarterly* Available at: http://links.jstor.org/sici?sici=0034-0553%281982%2917 %3A2%3C187%3AOTFORF%3E2.0.CO%3B2-5. Accessed on February 25th 2008.

Dole, J. A., Duffy, G. G., & Pearson, P. D. (1991). "Moving from the old to new: research on reading comprehension instruction". *Review of Educational Research,* (Online Journal). Available at: http://www.jstor.org/stable/1170536. Accessed on May 24th, 2008.

Fiez, J. A., & Petersen, S. E. (1998). *Neoroimaging studies of word reading, in Proceeding National Academic of Science of The United State of America*, (Online Proceeding). Available at: http://www.pnas.org/cgi/content/abstract. Accessed on May 28th 2008

Geogre, R. K. (1969). *The measurement of readability*. Iowa: Iowa State University Press.

Gee, J. P. (2001). "A socio-cultural perspective on early literacy development". In: S. B. Neuman, & D. K. Dickinson (Eds.) *Handbook of Early Literacy Research*. (pp. 30-42). New York: The Guilford Press.

Gilliland, J. (1975). *Readability*. London: Unibooks Hodder and Stoughton.

Goodman, K. S. (1973). Miscue analysis: Application to reading instruction. Illinois: ERIC Clearinghouse on Reading and Communication Skills

Goodman, Y.M. & Marek, A. M. (1996). "Retrospective Miscue Analysis". In: Goodman, Y.M. & Marek, A. M. (Eds) *Retrospective miscue analysis: Revaluing readers and reading* (pp. 39-48). New York: Ricahrd C. Owen Publishers. Inc.

Goswami, U. (2004). "Neuroscience, education and special education". *British Journal of Education,* (Online Journal). Available at: http://www.blackwell-synergy.com/doi/pdf/10.1111/j.0952-3383.2004.00352.x Accessed on June 15th 2008.

Hiebert, E., & Mesmer, H. (2006). "Perspectives on difficulty of beginning reading Texts". In: D. K., Dickinson, & S. B., Newman (Eds.) *Handbook of Early Literacy Research*, vol. 2. London: Guilford, pp 395-409.

Leu, D. J. (1982). "Oral reading error analysis: a critical review of research and application". *Reading Research Quarterly*, (Online Journal). Available at: http://www.jstor.org/stable/747528. Accessed on June 8th, 2008.

McKenna, C.M and Picard, M.C. (2006) "Revisiting the role of miscue analysis in effective teaching. *The Reading Teacher*, 60, pp. 378-380

Magliano, J. P., & Millis, K. K. (2003). "Assessing reading skill with a think-aloud procedure and latent semantic analysis". *Cognition and Instruction*, (Online Journal). Available at: http://dx.doi.org/10.1207/S1532690XCI2103_02. Accessed on 29th May 2008.

Nielsen, J., Clemmensen, T., & Yssing, C. (2002). "Getting access to what goes on in the people's heads?: Reflections on the think-aloud technique". In: *ACM International Conference Proceeding Series, vol. 31: Proceeding of the second Nordic conference on Human-computer interaction*, p. 101-110. (Online Conference Paper). Available at: http://portal.acm.org/citation.cfm?id=572033. Accessed on 26th May 2008.

O'Brien, D.G. (1988) "The relation between oral reading miscue patterns and comprehension a test of the relative explanatory". *Journal of Psycholinguistic Research*, 17, pp. 379-401

Simons, H. (1971). "Reading comprehension: the need for new perspective". *Reading Research Quarterly*, 6, 3. pp. 338-363.

Wang, Y. (2003). "The cognitive process of comprehension", in *Second IEE International Conference on Cognitive Informatics (ICCI03') Proceeding*. Available at: http://doi.ieeecomputersociety.org/10.1109/COGINF. 2003.12259 63 Accessed on 28th May 2008.

Xu, S., Cui, Z., & Chen, X. (2007). "Empirical evaluation of the dialog-based protocol and think-aloud protocol", in the *Canadian Conference on Electrical and Computer Engineering,* 2007, pp. 1227-1230. (Online Conference Paper). Available at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4232972. Accessed on 29th May 2008.