

## Searching Using ‘Microsoft® Encarta™, *A Study of Cognitive Style Effects on Secondary Students’ Strategies*

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**Abstract:** This paper reports on a study of the effects that cognitive style may exercise on information retrieval strategies. The background to the research project, the nature of cognitive style and the ways in which it may influence the learning process are discussed. Analysis of research data revealed that students' lack of information retrieval skills disallowed wide differences to emerge in terms of searching strategies. Some interesting tendencies and consistent preferences were identified with respect to the Wholist-Analytic style. The paper concludes by considering the possible existence of a searching style and discussing its interpretation.

### 1. BACKGROUND

A fundamental issue for education is the influence that learners' individual differences may exercise on the efficiency and effectiveness of the learning process. A student's prior knowledge base, gender, intelligence, preferences and cognitive style form the student's learning agenda and determine what will be selected as information from the environment, how this information will be encoded and how it will be retrieved or recalled.

It has frequently been suggested that the educational system should provide for the needs of individuals, by achieving an appropriate match between the functional characteristics of learners and the teaching methods

and materials used (Messick 1985, 1995, Moran 1991). This implies changes in teaching and learning practices and places emphasis on the utilisation of flexible self-instructional materials suited to a range of learners.

Interactive multimedia applications with an encyclopaedic format, apart from having the significant advantage of presenting information in a range of different ways, empowers users "to interact with the material and influence the course of presentation" (Tannenbaum 1998). Information in these systems are not connected and presented in a linear manner but through linking words or ideas, and access to these information sources can be achieved through a range of different and sophisticated information retrieval techniques. Indeed, the searching system of a multimedia encyclopaedia permits users to interrogate entries not only by using the traditional Index, but also through the utilisation of a multitude of searching strategies. Keyword searching, which entails the use of logical operators and Boolean logic, as well as searching by topic, place, time, media, etc. are generally available.

Essentially, the existence of a variety of access routes provides a flexible method of information retrieval, which can be strongly associated with individualised learning. It also follows from this that if these kinds of applications can truly "suit a variety of learning styles" (Perzylo 1993), then different types of learner will follow different routes while using these systems. Indeed, several researchers and theorists have suggested that learning styles may influence the ways in which multimedia applications are used (Heller 1990, Riding and Chambers 1992).

The implications of the above for research into interactive multimedia applications are that individual attributes that a learner brings to the learning situation, implications of the characteristics of the use demonstrated, and the design of the multimedia application, must be considered. This approach was adopted in this particular research, which sought to examine the effects that cognitive style may exercise on students' actual use of and attitudes towards the searching system of an interactive multimedia encyclopaedia.

## **2. COGNITIVE STYLES**

Cognitive styles have been perceived and defined as consistent individual differences in the ways of constructing and processing information and experience (Messick 1976). They can be seen as "stable, traitlike consistencies in one's approach to attending, thinking and perceiving" (Schmeck 1988) which are independent of general ability and "reflect the fundamental make up of a person and have a physical basis" (Riding 1996). Numerous attempts have been made to identify cognitive style and describe

its nature and implications for learning, and as long ago as 1986, Child (1986) suggested there was a growing need for rationalisation.

Riding and Cheema (1991) after conducting a survey of cognitive style labels suggested that these could be assigned into two principal, and independent from each other, cognitive style dimensions.

- The Wholist-Analytic style, is an individual's inclination to process information as a whole or in parts, and
- The Verbal-Imagery style, is concerned with an individual's tendency to represent information in memory verbally or as mental images.

Recognising the fact that the usefulness and validity of the cognitive style dimensions proposed are highly dependent on how clearly defined, assessed and distinguished they are from other important constructs a computerised test, the Cognitive Styles Analysis (CSA) that assessed an individual's position on each cognitive style dimensions was developed (Riding 1991). Through the administration of this test, Riding and his associates, offered empirical evidence which supported the independence of cognitive style from gender, ability, and other personality attributes (Riding and Caine 1993, Riding and Pearson 1994, Riding 1997, Riding and Rayner 1998). Nevertheless, cognitive style's independence from other significant constructs was not enough in educational settings and it was recognised that it should have implications for teaching and learning and in this respect it should also be related to observed behaviours.

Considering the Wholist-Analytic dimension. Analytics perceive situations as collections of different parts. They approach learning in an analytical fashion and consequently they may appear quite successful in tasks requiring comparison, differentiation and analysis. A negative aspect of the Analytic style is that it may not enable comprehension of a "balanced view of the whole" (Riding 1996). By contrast Wholists are global in their information processing approaches. They can perform quite well on tasks needing an overall perspective, while they may have a foggy picture of the parts that make up a problem or a situation (Riding and Sadler-Smith 1992, Riding 1997, Riding and Rayner 1998).

The Verbal-Imagery style, may influence an individual's preferred mode of presentation, in the sense that Verbalisers are inclined to memorise information through 'word-like' propositions or codes, whereas Imagers tend to use analogical or 'pictorial' representations. As such, Verbalisers may often learn better by processing verbal information while Imagers prefer processing images or diagrammatic information (Riding and Cheema 1991, Riding and Rayner 1998)

A significant number of early studies that investigated the effects of cognitive style on learning appear to support these theoretical assumptions. In summary, research evidence suggests that cognitive style differences exist

among learners, and these affect students' learning preferences and academic performance. In the case of Wholist-Analytic style these differences may be associated with the structure of the information presented (Riding and Sadler-Smith 1992, Douglas and Riding 1993, Riding and Rayner 1998). While the Verbal-Imagery style, could be related to the mode or form within which information is presented (Riding and Douglas 1993, Riding and Sadler-Smith 1992).

However, most of these studies concentrated on differences in students' recall rather than the process through which students managed to achieve a particular outcome. As a result, the differences identified could not be directly associated with behaviours that would explain the product achieved. Moreover, prior research relating to the effects of cognitive style on students' information seeking strategies is non-existent. Thus, nothing could be assumed concerning cognitive style effects in this study, which examines the individual preferences of, and the procedures through which, students retrieve information from a CD-ROM encyclopaedia.

### **3. METHODS-PROCEDURE**

Considering the methodological shortcomings of past cognitive style research and bearing in mind that the current project might result in 'spying out lands' never actually met before, a decision was made to follow a flexible, exploratory, and semi-experimental research design that would reflect the problem under investigation. In particular, it was hypothesised that if the use of encyclopaedic CD-ROMs truly suits a variety of individual preferences related to cognitive style, then these preferences would be mirrored in students' chosen and applied information seeking strategies.

Setting up an experimental situation, in which students could be asked about their searching preferences and be systematically observed using an electronic encyclopaedia on a standard set of tasks, would enable cognitive style groups to be compared. A set of seven discrete and differentiated, in terms of searching demands, activities were therefore devised to act as stimuli for engaging the students in information seeking procedures. Furthermore, a structured schedule/instrument was devised for systematically observing the students. This instrument provided a record of the students' actions when using 'Microsoft® Encarta™', which due to its popularity and regular utilisation in educational settings became the target application of this study (NCET 1994, Sparrowhawk 1995). Further, a list of discussion topics and questions to be asked in the course of interviewing the students was constructed.

Each student was observed individually for about an hour interacting with 'Encarta' in a quite classroom of the school in which s/he was being educated. At the start of these sessions each participant was given the set of the questions and asked to answer them using the information provided by the encyclopaedia. At the end of the observational session, each student was asked whether s/he would like to talk about the encyclopaedia. If a positive answer was obtained then interviewing would take place immediately or shortly after. After the observations and the interviews had been conducted, the identification of students' cognitive style was accomplished through the administration of the CSA test (Riding 1991).

### **3.1      The sample**

The population participating in the observational phase of the research consisted of 88 secondary school students, 36 were also interviewed. All of the students were of above average ability and of similar age (Year 9: 13-14 year olds), and all had prior experience of using 'Encarta'. However, in order to make sure that the students' level and quality of experience in using the encyclopaedia would not differ widely, a training session was given in the use and the features of 'Encarta'. These training sessions took place approximately 2 weeks before testing started.

The results of the CSA test were initially in the form of ratios. However, for the purposes of statistical analysis all 88 students were grouped into equal divisions on the basis of their ratios on each cognitive style dimension.

## **4.       THE RESULTS**

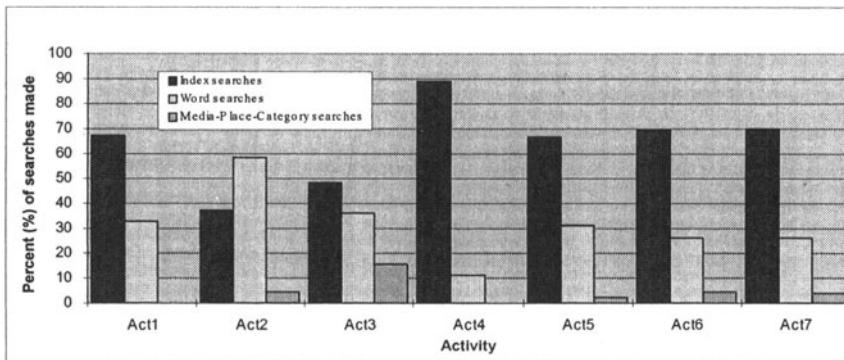
This section concentrates on analysing and discussing the across-activities findings with respect to the cognitive style effects on students' information retrieval strategies by considering students' searching preferences and the quantity of searching performed. Nevertheless, in order that this description is meaningful to the reader, the first part of this section will consider briefly the general findings about information seeking regardless of cognitive style.

### **4.1      General findings regarding information seeking**

The rate of success in answering the set questions was very high. With rare exceptions almost all the students managed to retrieve the specified

information in each of the given tasks. It would appear from this finding that in general the students found it easy to retrieve information.

Indeed, when interviewed, approximately half the students (53%) pointed out that they found it easy to find information. However, the other half expressed their reservations regarding the ease of information retrieval. In some of the interviews concerns were expressed regarding the multiplicity of searching methods available, and to the task specific aspect of the ease of searching.



*Figure 1.* Frequencies of types of searches used

Inspection of the types of searches that students chose to utilise across activities offered a reasonable interpretation of these findings. As Figure 1 illustrates, students' most preferred and most used searching strategy was the Index>Title search. Yet, the decision to use the Index>Title search was not always the most appropriate. The predominance of the Index search over any other kind of search suggests that in general this is the strategy that students habitually utilise for retrieving information in school or at home. This was endorsed by the interview data collected, with 45% reporting that they only used Index>Title search, while 19% stated that they mainly used the Index and sometimes they might utilise keyword searching. In search for an explanation, it was found that students' persistence in the use of the Index was related to their past experiences. Of the students interviewed, 80.6% pointed out that their participation in this research project was a learning experience in the sense that they found out a lot about 'Encarta's' searches in the training session.

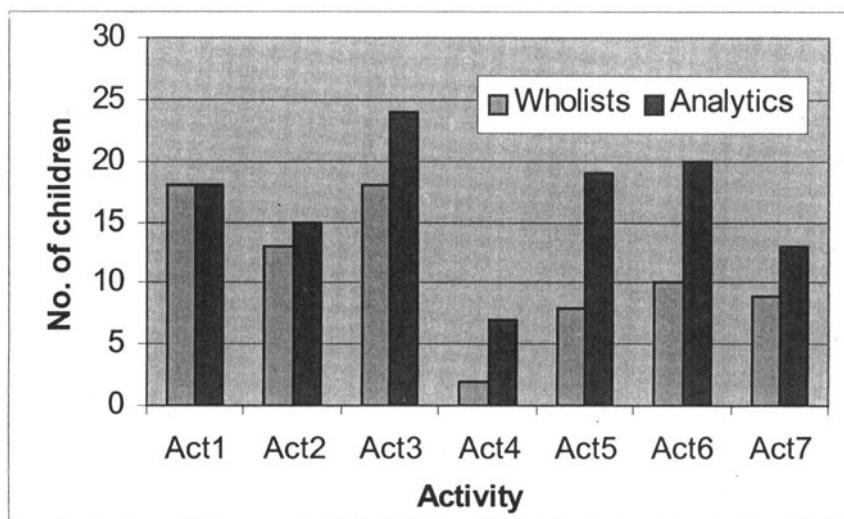
#### **4.2 Information seeking and cognitive style effects**

The findings presented above illustrate students' inefficient searching strategies and have implications not only for teaching and learning, but also

for emanating cognitive style effects. Students' lack of information skills was expected to disallow extensive variations to be exhibited in students' information seeking tactics. Obviously, a preference in searching strategy cannot emerge when almost all individuals are aware of only one strategy. Thus, it was anticipated that cognitive style effects observed would be minimal.

To some extent this proved true. Statistical analysis of the total time students spent on searching, the total number of searches performed and the searching choices students made, showed that no statistically significant differences existed among students of differing cognitive style. However, some consistent, meaningful tendencies were identified indicative of how cognitive style may effect searching preferences.

As regards the Wholist-Analytic style dimension, diverse inclinations were identified between the searching preferences of Wholists and Analytics. The majority of students insisted on using an Index search for finding the information required. There was however a number of students who actually preferred the use of keyword searching (Word search). Across all 7 activities, the students that used Word search tended to have a common position in the Wholist-Analytic continuum of style (Figures 2 & 3, Table 1).



*Figure 2. Cognitive style and children using word search*

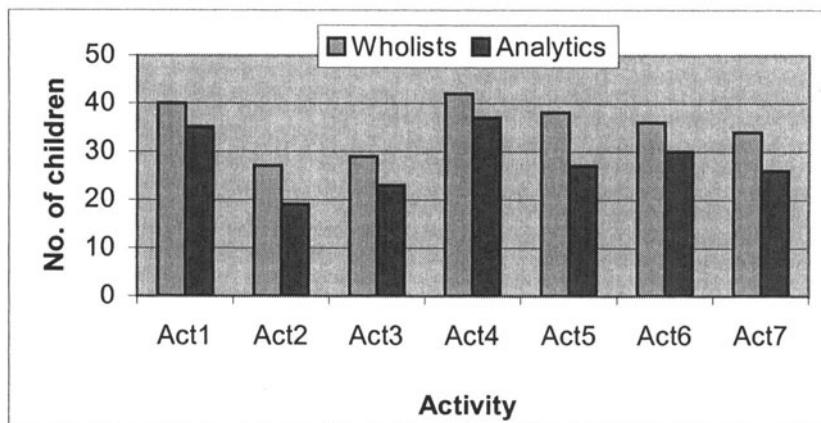


Figure 3. Cognitive style of children using index search

Table 1. Statistical significance of the group differences shown in Figures 2 &amp; 3

	Act.1	Act.2	Act.3	Act.4	Act.5	Act.6	Act.7
Test	Anova	$\chi^2$	$\chi^2$	$\chi^2$	$\chi^2$	$\chi^2$	$\chi^2$
Significance	P<0.05	NS	NS	NS	p<0.01	p<0.05	p<0.05

Inspection of the above figures and table, indicates that across all the tasks, a consistently higher number of Wholists used the Index search to retrieve the information needed, while many more Analytics used the Word search. This was also evident in the average total number of Index and Word searches (Table 2).

Table 2. Cognitive style and mean total number of searches

	Wholists	Analytics
Index Searches	9	7.1
Word Searches	3.8	5.8

On average, Wholists made two more Index searches than Analytics, whereas the latter made two more Word searches. Furthermore, Wholists' preference towards Index search and Analytics' tendency to utilise keyword searching was also manifest in the interview data collected. When questioned regarding the type of search habitually utilised when looking for information in 'Encarta', a significantly higher number of Wholists referred to the use of Index search. Adversely, most Analytics claimed they use Word search or that they combine different searches (see Table 3).

*Table 3.* Cognitive style and types of searches reported as commonly used (Chi-square=7.734, df=2, p<0.05)

	<b>Wholists</b>	<b>Analytics</b>	<b>Total</b>
<b>Index Search</b>	11	5	16
<b>Word Search</b>	1	7	8
<b>Combination of searches</b>	4	8	12
<b>Total</b>	16	20	36

These findings appear to point to the possible existence of a searching style or a preference related to the Wholist-Analytic style. Even though not always significant in statistical terms, Wholists and Analytics tended to differ in the information seeking strategies they followed. The activities set differed substantially in their optimal searching requirements. For some tasks the Word search was most appropriate, in others the Index, and elsewhere both were needed. Many Wholists and Analytics remained fairly consistent in their searching preferences regardless of suitability for the task in hand. Undoubtedly this finding gives credence to the viewpoint that cognitive style is actually independent of general ability and its effect on performance may be positive or negative depending on the task (Riding 1996, Riding 1997, Riding and Pearson 1994). Consequently, Wholists' and Analytics' diverse searching tendencies may actually represent a practical application of cognitive style in information handling situations. Since no literature exists concerned with the effects of the Wholist-Analytic style on information seeking strategies, comparisons with earlier research is impossible. In all likelihood, the searching styles illustrated are related to the disparate ways in which Wholists and Analytics process information and necessarily they may be interpreted through cognitive style theory.

Probably, Wholists' tendency to appreciate the overall context of a situation is associated with the holistic point of view that a summarising title may entail. By using Index>Title search, Wholists demonstrated that what they comprehended from a particular question is that they have to search for specific information regarding a broad topic or a theme. Resultantly, they looked for a source that would have an entry titled as this theme. By contrast, Analytics may have perceived the same question as an accumulation of different concepts. Consequently, they felt the need to search for sources that would contain or refer simultaneously to these concepts and for this purpose the use of keyword searching might better represent their understanding of the question.

The effects of the Verbal-Imagery style were not so explicitly evidenced by the analysis of the data collected. In most of the activities, no consistent influences were illustrated on the part of this style dimension. Verbalisers and Imagers selected and followed similar information seeking strategies to find the sources needed, and the quantity of searching they performed was

relatively similar. This lack of statistically significant effects was also demonstrated in the total number of searches students performed, the total time taken on searching and the overall number of Index, Word and other (Media/Category) types of searches used.

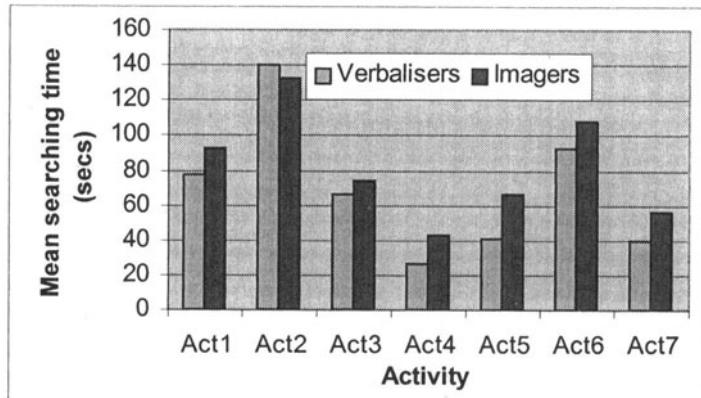


Figure 4. Cognitive style and searching time spent across activities

Yet, some consistent, but not statistically significant, differences were identified on the searching times across the 7 tasks. The statistical tests performed did not support the idea that the differences in time between these two groups of learners were wide enough so as not to be an outcome of pure chance. However, this finding may gain in significance through its repeated occurrence across the tasks posed (see Figure 4 and Table 4).

Table 4. Cognitive style and mean number of searches across activities

	Verbalisers	Imagers
Activity 1	2.5	2.6
Activity 2	2.4	2.6
Activity 3	1.5	1.7
Activity 4	1.0	1.0
Activity 5	1.2	1.6
Activity 6	2.8	2.8
Activity 7	1.1	1.3
Total	13.0	13.9

Even though Imagers and Verbalisers made about the same number of searches for retrieving the information required, Imagers in almost all of the activities appear to have spent more time looking for this information. It follows from this, that Imagers may have found it more difficult than Verbalisers to construct and phrase their searches.

The non-existence of studies concerned with the searching behaviour of these cognitive style groups does not enable comparison of this finding with

earlier research. Necessarily, the only, if not the most possible, interpretation to it can be derived by theory regarding the ways in which Imagers and Verbalisers process information. In general terms, Verbalisers are superior when working with verbal versions of information and Imagers when learning from pictorial modes of presentation (Riding and Ashmore 1980, Riding and Douglas 1993). Resultantly, it may well follow that Imagers took longer than Verbalisers to comprehend the questions asked and transform the information contained in them into searching descriptors recognisable by the database. In conclusion, however, it is worth noting that the time differences between Imagers and Verbalisers were not significantly different and necessarily further research is needed to support these findings and comment on possible explanations.

## 5. CONCLUSIONS

As with much research, the present study generated more questions than those that it attempted to answer. One of the most significant and unexpected findings was students' extensive lack of information retrieval skills and the subsequent and unavoidable effects that this had on cognitive style influences, which were the main interest of this study. Students' ignorance of 'Encarta's' search engines did not allow the emergence of extreme variations in searching strategies. Minor and insignificant differences were found between the times that Imagers and Verbalisers spent on searching for information, and the tendencies identified on the part of the Wholist-Analytic style were not always statistically significant.

Nevertheless, it is still notable that even under those unpropitious circumstances some sort of searching style occurred which was consistent in its appearance. Wholists used, and stated that they often used, the alphabetical Index for finding information, while Analytics showed an inclination towards keyword searching. Yet, any attempt to interpret this finding appears to be a difficult task, especially if one considers that no literature exists with direct relevance to it. It is possible that Wholists' propensity to process information in wholes (Riding 1996, Riding 1997, Riding and Rayner 1998) may be related to their preference for a summarising title, whereas Analytics' inclination to 'break' information into their constituent parts, encourages them to search for the occurrence of multiple keywords.

Yet, regardless of the potential explanations, it seems appropriate to suggest that only further research can identify the reliability of these inclinations. Meanwhile, one could suggest that the present study has supported cognitive styles' independence from ability and pointed at

interesting and practical applications of the Wholist-Analytic style in the educational context, which can be either eliminated or exacerbated as students' experience in using interactive multimedia applications increases.

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