A Study on the User Cognitive Styles in the Web-based OPAC System Evaluation*

웹 기반 OPAC시스템 평가에서의 이용자 인지형태에 관한 연구

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ABSTRACT

The aim of this study was to discover the correlation between users cognitive style and their attitude towards evaluating the system. Postgraduate students cognitive styles were defined as Verbaliser/Imager and Wholist/Analytic, and the functionality and ease of learning features of a Web-based OPAC(Online Public Access Catalogue) system were evaluated using a combined evaluation methods: interviews for the preliminary survey, a questionnaire for the central data collection, and a psychometric approach for the judgement of students cognitive style using Ridings CSA(Cognitive Style Assessment) tool. Forty-four postgraduate student volunteers responded and data was analysed using SPSS(Statistical Package for Social Science) for Windows. The statistical analysis of each feature of the evaluation, the correlation between the variables, and the features were explored using Pearsons correlation coefficients(r). In exploring the effects of the cognitive styles of individuals, this study has failed to reveal a significant ($P < 0.05$) correlations in the interactive Web-based OPACs evaluation. It could be said that the contribution of cognitive styles to evaluating Web-based OPACs is likely to be weaker than that of non-cognitive (or demographic) variables.

초 록

본 연구의 목적은 이용자의 인지유형과 그에 따른 웹기반 OPAC시스템 평가에 대한 상관관계를 알아보기 위한 것이다. 이용자들의 인지유형은 (1)Verbaliser/Imager와 (2)Wholist/Analytic으로 나누었고, 웹기반 OPAC시스템의 (1)기능적인 측면과 (2)학습용이성 측면에 초점을 맞추어 평가를 하였다. 연구방법으로는 (1)사전조사를 위한 인터뷰, (2)주된 데이터 수집을 위한 질문지, 그리고 (3) 이용자의 인지형태 결정을 위해서 심리측정학(psychometric)방법을 사용하였다. 사전조사결과와 문헌의 리뷰에 근거하여 온라인 조사방법으로 (1)웹기반 온라인 질문지와 (2)Riding의 CSA(Cognitive Style Assessment)을 Sheffield 대학 캠퍼스 네트워크에 연결된 모든 PC에서 접속할 수 있게 온라인 테스트 환경을 구성하였다. 이 환경을 통하여 44명의 석,박사 학생들이 자발적으로 본 실험에 참가를 했으며, 이들로부터 수집된 데이터는 SPSS(Statistical Package for Social Science)를 이용하여 분석하였다. 통계분석에서 각 평가항목 변수들 간의 상관관계분석을 위해서 피어슨(Pearson)의 상관계수 (Coefficient, r)를 사용하였다. 연구결과 개인의 인지형태와 웹기반 OPAC시스템 평가간에는 비교적 낮은 통계학적인 상관관계를 보였다.

Keyword: Cognitive Style, User Studies, Web-based OPAC Evaluation,
Verbaliser/Imager, Wholist/Analytic

인지유형, 이용자연구, 웹기반 OPAC 시스템 평가

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1 Introduction

User centred design of Web-based OPACs (Online Public Access Catalogues) is complicated by the newness of the library systems in the digital library age. It is because of their ability to integrate a range of functions that were previously designed separately, the heterogeneity of their user population, and the physically distributed nature of usage. If we have made the assumption that every user of OPACs has similar capabilities and limitations, then we therefore can make generalisations. To an extent this is true: the psychological principles and properties that we have discussed apply to the majority of users. Notwithstanding this, we should remember that, although we share processes in common, humans, and therefore users, are not all the same. There are some assumptions about individuals: "individuals differ in their general skills, aptitudes, and preference for processing information, constructing meaning from it, and applying it to new situations." Surely, this assumption will be getting important in the era of the Internet since the users are getting more diverseness.

Therefore, it is important that we should be aware of users individual differences in their evaluation of Web-based OPAC as one of moot point to improvement of the next generation of OPACs.

1.1 Research Questions and Aim

Although there are a lot of studies and efforts to improve OPAC systems, however, there is little information on the characteristics, skills, and searching patterns of specific user groups identified from the viewpoint of users' evaluation of OPAC systems. Information about the strong and weak points of Web-based OPAC system and the identification of users different behaviour in using the system will not only allow librarians to better help these users, but also system designer to better design the systems.

Therefore, two rather broad research questions arise with regard to the use of Web-based OPACs:

- (1) How do users cognitive styles affect the system evaluation?
- (2) Which users cognitive style strongly correlate with the system evaluation, if any?

Various studies have investigated research questions similar to those raised in this study; however, there has been little concerted effort toward probing the psychological aspects. Furthermore, most studies have focused on librarians rather than end users, and on online retrieval systems rather than on OPACs (Bates, 1979a, 1979b; Fenichel, 1981; Vigil, 1983; Fidel, 1984; Bellardo, 1985).

The aim of the present study is:

- To explore whether cognitive style

variables defined as Verbaliser/Imagery and Wholist/Analytic, vary in their use of Web-based OPAC systems, and to discover the correlation between cognitive style variables and users' attitudes towards the usability of Web-based OPAC systems.

2 Literature Review

2.1 Cognitive Styles and Individual Differences

It is difficult to pinpoint the exact beginning of any field of study, and cognitive psychologists would likely offer a wide variety of dates if asked when cognitive psychology began. William Jamess Principles of Psychology, published in 1890, included chapters on attention, memory, imagery, and reasoning. F.C. Bartletts book Remembering: A Study in Experimental and Social Psychology, published in 1932, contained a theory of memory for stories that is very consistent with current views (Reed, 1988).

Metaphorically, cognitive structure may be viewed as a series of inter linked categories, which individuals utilise to "sort" incoming messages. Individual differences in message perception and message utilisation are attributable to different cognitive structures. Broadly put, individual differences in cognitive structure will result in individual differences in information selection. Given the existence of different cognitive styles, one would predict the existence of variability in information processing (Davidson, 1977).

There is evidence that individuals differ in the strategies they employ when processing information. A tendency for an individual consistently to adopt a particular type of strategy is known as a cognitive style. The individual is viewed as possessing a cognitive structure.

Cognitive style is a hypothetical construct that has been developed to explain the process of mediation between stimuli and responses. The term cognitive style refers to the characteristic ways in which individuals conceptually organises the environment. Messick (1976) also defined cognitive style in terms of consistent patterns of "organising and processing information." Zajonc (1968) similarly maintained that cognitive structures mediate between environmental input and the organisms output. He added the idea that cognitive structures organise behaviour as well as input. Goldstein and Blackman (1978) defined the term cognitive style refers "to the ways in which thought is structured." Behavioural consistency is viewed as the product of this structure. Tennant (1988) defined succinctly cognitive style "An individuals characteristic and consistent approach to organising and processing

information."

In the present context, a cognitive style is considered to be a fairly fixed characteristic of an individual, which may be distinguished from cognitive strategies, which are the ways that may be used to cope with situations and tasks. Strategies may vary from time to time and may be learned and developed. Styles, by contrast, are static and are relatively in-built features of the individual (Riding, Burton, Rees and Sharratt, 1995).

Borgman (1986c) in a pilot study looking at the effect of individual differences in on-line catalogue use, finds that of a number of factors evaluated, college major appears to be the one related to variables associated with aptitude for information retrieval and programming. In a study by Logan (1990) of a small sample of novice searchers, initial results appeared to confirm finding from the MEDLINE study and suggest that the relationships between learning style and search behaviour exist regardless of searcher experience.

Ellis, Ford and Wood (1993) found out the significant relationship between cognitive styles and students use of different hypertext navigational tools. Ford, Wood & Walsh (1994) found significant correlation between cognitive styles and on-line searching. Searchers characterised by different learning styles tend to adopt different search strategies and strategies associated with comprehension and operation learning style results in qualitatively different searching performance in the test of 275 searchers of a LISA CD-ROM.

Similarly, Wood et al. (1996), tested undergraduate students how they searched databases (e.g., CD-ROMs, BIDS: Bath Information and Data Service, and information services on the Internet), the effectiveness of their searches and their satisfaction with them. There were significant differences in the searching behaviour and the effectiveness of the searches carried out by students with different learning and cognitive styles - verbaliser/imager difference.

2.1.1 Wholist/Analytic or Field-dependence/-independence[1]

A number of different labels have been given to cognitive styles and it has been argued that many of these are but different conceptions of the same dimensions (Brumby, 1982; Coan, 1974; Fowler, 1980; Miller, 1987; Riding and Buckle, 1990). Riding and Cheema (1991) surveyed the various labels and, after reviewing the descriptions, correlations, methods of assessment and effect on behaviour, concluded that they may be grouped into two principal cognitive styles: the "Wholist/Analytic" and the "Verbal /Imager" dimensions.

1) Riding and Sadler-Smith(1992) refer to as a Wholist/Analytic dimension that is equivalent to field-dependence/field-independence.

The literature on cognitive style is fairly large and a variety of cognitive styles have been proposed and investigated, indeed Messick et al. (1976) provides a glossary of 19 different terms. Perhaps the best-known and most widely used cognitive style dimension has resulted from the work of Witkin and his colleagues (Witkin, 1976; Witkin et al., 1977). Witkin's research began with an interest in perceptual factors but developed into an attempt to conceptualise and measure an aspect of cognitive style known as Field-dependence/Field-independence.

Wholist/Analytic or Field-dependence/Field-independence is the most extensively researched cognitive control. Research on Field-dependence/Field-independence began over 40 years ago, and it remains among the most prescriptive of learning and instructional out-come (Jonassen and Grabowski, 1993). Field-dependence/Field-independence describes the degree to which a learner's perception or comprehension of information is affected by the surrounding perceptual or contextual field, that is, "the extent to which the organisation of the prevailing field dominates perception of any of its parts" (Witkin et al., 1971). When Field-dependents interact with stimuli, they find it difficult to locate the information they are seeking because other information tends to mask what they are looking for. Field-independents, on the other hand, find it easier to disambiguate information, that is, to recognise and select the important information from its surrounding field.

Some other researches were conducted applicable to information technology design. For example, Ambardar (1988) tested Field-independent and Field-dependent subjects on three different information retrieval interfaces and discovered that Field-dependent subjects preferred a highly structured approach that featured sequential browsing, while Field-independent subjects preferred a more flexible approach using keyword searching. Interestingly, this research also suggested that Field-independent subjects were unable to adapt to the structured approach: their preference was so fixed that it constituted a disability. Yoo (1990) tested library school students and found that Field-independent searchers had a higher success rate than Field-dependent searchers.

2.1.2 Verbaliser/Imager or Verbaliser/Visualiser[2]

Neuropsychological evidence shows that people process visual information differently from verbal information (Paivio, 1989).

It is clear that words can evoke visual images, and visual stimuli suggest words, but nonetheless, the abundant evidence for

2) Riding (1994) refers to as a Verbaliser/Imager dimension that is equivalent to Verbaliser/Visualiser.

separate visual and verbal coding indicates that visual and verbal memory can usefully be conceptualised as distinct but related domains (Paivio, 1971: Woodhead and Baddely, 1981).

This dimension of whether an individual is inclined to represent information during thinking verbally or in mental pictures. Kirby, Moore and Schofield (1988) describe that the visualiser/verbaliser cognitive style is individual preferences for attending to and processing visual versus verbal information. Some individuals prefer to process information by seeing, through the use of graphics, diagrams, or illustrations. Others prefer to process information in words, through reading or listening.

It will be another research task to classify the criteria of users characteristics because there has no such a criterion on it. Different researchers applied different criteria. In this study, nonetheless, after long considerations based on the above earlier studies we adopted Ridings (Riding, 1994) classifications as cognitive style, that is, (1)Verbaliser/Imager and (2)Wholist/Analytic.

2.2 Evaluation of Interactive OPAC System

"Interaction" or "interactive" has strong 'human' connotations, as used in, for example, social psychology: it is the mutual or reciprocal communication and negotiation, e.g., verbal and non-verbal, taking place between two or more participants.

As an interactive system, the Web-based OPAC can dynamically communicate with its user: it can be responsive and informative at a given time to a given need. The OPAC is public and very revealing of its use (Hildreth, 1987). Many of the mysteries of what actually takes place when a user is searching the catalogue can now be solved. What users of the catalogue actually do in the search process, if not why they do it, can be objectively ascertained.

In this study, we fundamentally adopted Sugar's (Sugar, 1995) 'process' variables to apply into STAR Web-based OPAC evaluation focused on Hildreth's (Hildreth, 1987) 'distinguish' variables that are:

- (1) Functionality - e.g., search keys: narrowing search: and Boolean operations, and
- (2) Ease of use and ease of learning - e.g., preferences of interaction style: character and image: browsing and navigating style: screen layout: and ease to learn.

3 Research Design

In order to explore users' cognitive style

differences in Web-based OPACs, a framework model of system evaluation based on the concept of individual differences, and a sample drawn from postgraduate students (M.A. and Ph.D.) at Sheffield University was used for this case study. It was assumed that postgraduate students' purpose in using OPAC was almost always research, and their attitudes as participants more sincere and that they would provide more quality data. Also, because Sheffield University has a newly launched Web-based generation of STAR OPAC system, it was assumed that many students would be willing to express their opinions on the new library system.

After consideration of the advantages and disadvantages, a combined survey research method was used for data collection - using interviews and a questionnaire. The main data, i.e., quantitative data relating to postgraduate students evaluating patterns was gathered using a Web-based online questionnaire which was designed based on qualitative data analysis after a number of semi-structured interviews.

The Web-based questionnaire was adopted as a data collection tool rather than traditional paper-based questionnaire methods, since it presents a number of distinct advantages over current methods:

(1) Shorter Field Time - Data can be collected in a matter of days;

(2) Higher Quality Response - Less intrusive because respondents can self schedule;

(3) Lower Respondent Error - Questionnaire can self correct and edit on the fly;

(4) Broader Stimuli Potential - Exposure can include colour graphics, video, 3D;

(5) Less Expensive - In most situations, more cost efficient than phone or paper.

Riding's CSA was used for the measurement of psychometric data to assess users' cognitive styles - Verbaliser/Imager and Wholis/Analytic in this study.

Using the SPSS statistical package for Windows Version 6, the data analysis sought to establish statistical evidence of the relationships between the different user variables and their attitude toward Web-based OPAC system evaluation.

Sheffield University library's OPAC - STAR[3] - was selected as an appropriate site to achieve the aims of this study since it exemplifies one instance of Web-based

3) Star is Sheffield Universitys Library catalogue and contains records of items held by the Library, including books, periodicals, conferences, thesos, CD-ROMs, videos and microforms. Star can be used for several purposes: (1) to discover if the Library has an item in stock, (2) to find items by a specific author, (3) to find items on a particular subject, (4) to find out if an item is on loan to another borrower, and (5) to check which items you have on loan with an option to renew.

OPAC. Postgraduate students can access the system anywhere within the campus through the networked PC for their study and research.

The important concern in this research was to attempt the use of a real system with real people to carry out real work activities in a real setting in order to collect real data. The experimental work in Stage 1-6 below was undertaken as follows:

Stage 1

- Interaction styles of 264 university library Web-based OPAC sites were searched through the Internet, and categorised into eight interaction styles of HCI based on Newman and Lamming's (1995) classification. The main purpose of this stage was to know how many different interaction styles were running on Web sites and to categorise the interaction styles of university libraries' Web-based OPACs into the 8 interaction styles of HCI as part of the preliminary survey.

Stage 2

- Pilot testing of Cognitive Style Assessment (CSA, Riding's test). This test was conducted in an offline stand-alone environment for the purpose of testing the stability of the CSA psychometrics instrument.

Stage 3

- Interviews. Five doctoral student volunteers from different faculties and different years of research at Sheffield took part. The semi-structured interview and the cognitive style test were carried out during this session. The main purpose of the interview was to gather students understanding of OPAC system and to test the pilot questionnaire. The CSA was aimed to test the reliability of the tool as well as to identify whether there were any particular significant differences between students' opinion and the CSA scores even with small number of participants in the preliminary survey.

Stage 4

- A Web-based online questionnaire, based on the results of interview and the review of literature, was developed using HTML (HyperText Markup Language) and CGI (Common Gateway Interface) script. The pilot Web-based online questionnaire and the online CSA instrument were tested in the real users' environments.
- The online survey (Web-based online questionnaire and online CSA test) was made available through Sheffield University PC network. Postgraduate student volunteers were sought, and instructions given by email. According to the defined CGI function, the results

of CSA test and answers to the question were automatically emailed to the researcher. This online survey was designed to produce easy access via volunteers' PC as well as the real environment of research rather than the laboratory situation. This survey was unsupervised rather than an artificial environment to provide a realistic environment.

Stage 5

- The scores of the CSA test and the responses to the online questionnaire were crosschecked against each student's 'name' and 'age' response value to ensure correct identification.
- In this research cognitive styles were customised as a dichotomous classification in the sense that the sample was grouped on the basis of their ratios on each cognitive style dimension. The divisions were - in the Wholist/Analytic (WA) dimension, Wholists 0.65 to 1.19, Analytics 1.20 to 1.86; and in the Verbal-Imagery dimension (VI), Verbalisers 0.78 to 1.05, and Imagers 1.06 to 1.49.

Stage 6

- Collected data was converted into SPSS for Windows Version 6 and analysed using *Pearson's correlation coefficients (r)*. The differences in the students' opinions on the STAR OPAC system were evaluated and their preferences for interaction style and their evaluation of OPAC systems were analysed to explore the concept of user difference.
- The results are presented in graphic and table mode focusing on individual differences, i.e., cognitive styles' variables: Verbaliser/Imagery and Wholist/Analytic dimension.

4 Data Analysis

This chapter presents the results of the data analysis. Subjects are analysed focusing on (1) Wholist/Analytic and (2) Verbal /Imager as the cognitive style variables.

Overall twenty-five fundamentals of functionality factors and ease of use factors for interactive Web-based OPACs are analysed and presented with various figures. The correlations between the two variables and the twenty-five factors are explored using Pearson's correlation coefficients (r)[4] and presented with tables.

4) A measure of linear association between two variables. Values of the correlation coefficient range from -1 to 1. The absolute value of the correlation coefficient indicates the strength of the linear relationship between the variables, with larger absolute values indicating stronger relationships. The sign of the coefficient indicates the direction of the relationship.

Each variable and each factor are analysed concentrating on those where a significant correlation was found. For a more in-depth analysis of cognitive style, *mean*[5] and *standard deviation (SD)*[6] ratings on each cognitive style comprising each of the factors was calculated and presented in tables. This analysis method was adopted from Riding et al's (Riding, Burton, Rees and Sharratt, 1995) method.

The collected data were treated at interval level and analysed using SPSS for Windows version 6. This decision was made during research design and reached after careful consideration of the measurement issues presented in standard research methods and statistical texts (Norusis, 1993; Babbie and Halley, 1994; Kinnear and Gray, 1994; Schweigert, 1994).

4.1 Analysis of Cognitive Style Variables

Information about interpreting the CSA data was as follows:

Heesop Kim *(1)* 35*(2)* 1.03*(3)* 1.17*(4)* 10.27*(5)* 9.62*(6)* 97*(7)* 99*(8)*

(1)-Testee name; (2)-Age; (3)-Wholist /Analytic ratio (WA); (4)-Verbaliser/Imager ratio (VI); (5)-WA speed; (6)-VI speed; (7)-WA correct (number of correct responses to WA items); and (8)-VI correct (number of correct responses to VI items).

Among the items (1)-Testees name and (2)-Age were used as crosschecking identification code against the responses of the Web-based questionnaire. Only (3)-Wholist /Analytic ratio and (4)-Verbaliser/Imager ratio scores were analysed for determining the cognitive styles in this study.

According to Riding (1994), the cognitive styles are determined by the CSA scores. He classifies people as: Wholist (WA score of 1.02 or less), Analytic (WA score of 1.36 or above), and Intermediate (WA score of between 1.03 and 1.35); and Verbaliser (VI score of 0.98 or below), Imager (VI score of 1.10 or above), and Intermediate (VI score of between 0.99 and 1.09). In this study, the Verbal/Imagery style ratios ranged from 0.78 to 1.49 (Mean = 1.05, Median = 1.04, SD = 0.13)[7] (See Figure 1). The Wholist /Analytic style ratios ranged from 0.65 to 1.86 (Mean = 1.17, Median = 1.10, SD = 0.28) (See Figure 2).

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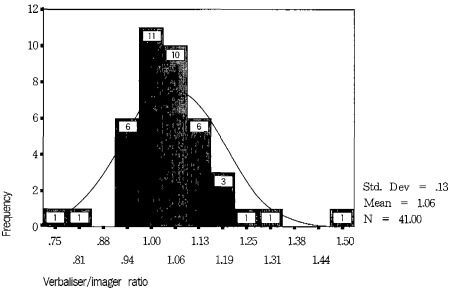
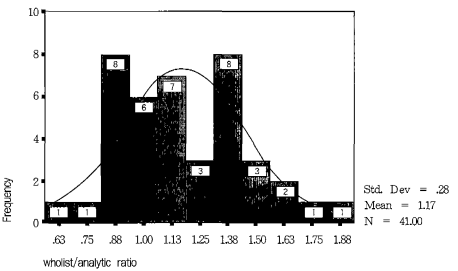
5) Mean: The arithmetic average: the sum divided by the number of cases.

6) SD (Standard deviation): A measure of dispersion around the mean, equal to the square root of the variance. The standard deviation is measured in the same units as the variable itself.

7) Median: A value that is greater than half of the actual data and less than the other half.



〈Figure 1〉 Cognitive styles of the subjects: Verbaliser/Imagery ratios



〈Figure 2〉 Cognitive styles of the subjects: Wholist/Analytic ratios

4.1.1 Variable 1: Verbaliser/Imager

Twenty-two students (50.0%, Valid percent: 53.7%) were identified as Verbalisers and nineteen students (43.2%, Valid percent: 46.3%) were spotted as Imagers, and three (6.8%) missing cases were occurred.

4.1.2 Variable 2: Wholist/Analytic

Twenty-three students (52.3%. Valid percent: 56.1%) were identified as Wholists and eighteen students (40.9%. Valid percent: 43.9%) were spotted as Analytics. and three (6.8%) missing cases were occurred.

4.2 Analysis of Factors

Selected twenty-four factors, which related to the interactive Web-based OPAC evaluation were summarised in Table 1. The table contains each factor's evaluation feature, their overall Mean value along with their maximum value. and correlations. The correlations between the two variables - Verbal/Imager (VI). Wholist/Analytic (WA) - and each of the twenty-four factors is analysed using Pearsons Correlation Coefficient (r). along with N (cases) and P (2-tailed significance).

In the designers' point of view. the result of mean value can be interpreted to apply in the stage of the designing a Web-based OPAC system. For example. there found that users prefer 'search by title' and/or 'search by keyword' (both Mean value showed 3.9 out of 5.0) to 'search by 'author + title combination' (Mean value resulted 3.3) in OPAC searching. In the analysis of ease of factors (i.e., Factor 21 to Factor 24) the designer need more pay attention to 'ease of learning' factor other than 'character and image on screen' or 'screen layout', since the 'ease of learning' showed higher Mean value than any other factors. .

In the result of correlation. there found only one significant correlations between Wholist/Analytic dimension and the pattern of narrowing searching by Opus number when $P < 0.05$ was adopted. The Wholist/Analytic cognitive style was positively related with searching by Opus number that is searching for music work. This result indicates that the Analytic students tend to use the more frequently searching by Opus than Wholist students do.

It may true that some students are equally comfortable using either visual or verbal information for learning. In fact. the differences between the visualiser and verbalizer are often not as vast as researchers have found with other cognitive styles.

In order to compare the cognitive style differences. the mean ratings on each cognitive style that derived four types: 'Wholist. 'Analytic', 'Verbaliser', and 'Imager' comprising each of the factors were calculated regardless either significant correlations were found or not in the table. This analysis aimed to supply the example data to psychologist who interested in cognitive science. The analysis method adopted from Riding et als idea (Riding. Burton. Rees and Sharratt. 1995).

Table 2 summarise the result of the descriptive statistics of Mean and standard

〈Table 1〉 Summarise of the Twenty-four Factors' feature, Mean, and correlation

	Features of the Web-based OPAC Evaluation	Mean (Max)	Correlation	
			VI	WA
Factor 1	Frequency of use: Text-based (1.0) vs. Web-based (2.0)	1.9 (2.0)	r = 0.0474 (N = 41) P = 0.769	r = -0.1209 (N = 41) P = 0.452
Factor 2	Usability of Text-based STAR	3.3 (5.0)	r = -0.0916 (N = 41) P = 0.569	r = 0.1021 (N = 41) P = 0.525
Factor 3	Usability of Web-based STAR	4.0 (5.0)	r = 0.0220 (N = 41) P = 0.891	r = 0.1314 (N = 41) P = 0.413
Factor 4	Search by Author	3.6 (5.0)	r = 0.1617 (N = 41) P = 0.313	r = -0.0464 (N = 41) P = 0.773
Factor 5	Search by Title	3.9 (5.0)	r = -0.0041 (N = 41) P = 0.980	r = 0.0489 (N = 41) P = 0.761
Factor 6	Search by Keywords	3.9 (5.0)	r = 0.2158 (N = 41) P = 0.175	r = 0.1231 (N = 41) P = 0.443
Factor 7	Search by Author + Title combination	3.3 (5.0)	r = 0.0263 (N = 41) P = 0.870	r = 0.0440 (N = 41) P = 0.785
Factor 8	Search by Author + Keyword combination	2.6 (5.0)	r = -0.0394 (N = 41) P = 0.807	r = 0.2108 (N = 41) P = 0.186
Factor 9	Search by Class-mark	1.6 (5.0)	r = -0.0136 (N = 41) P = 0.933	r = 0.0939 (N = 41) P = 0.559
Factor 10	Search by Number	1.3 (5.0)	r = -0.1655 (N = 41) P = 0.301	r = 0.0621 (N = 41) P = 0.700
Factor 11	Number of the Initial	2.0 (5.0)	r = -0.1234 (N = 41) P = 0.442	r = 0.0078 (N = 41) P = 0.961
Factor 12	Boolean operation AND	3.5 (5.0)	r = -0.1648 (N = 41) P = 0.303	r = -0.0725 (N = 41) P = 0.652
Factor 13	Boolean operation OR	2.2 (5.0)	r = 0.0172 (N = 41) P = 0.915	r = -0.0892 (N = 41) P = 0.579
Factor 14	Boolean operation NOT	1.7 (5.0)	r = -0.0767 (N = 41) P = 0.633	r = 0.1216 (N = 41) P = 0.449
Factor 15	Boolean operation XOR	1.3 (5.0)	r = -0.2073 (N = 41) P = 0.193	r = 0.0202 (N = 41) P = 0.900

〈Table 1〉 Summarise of the Twenty-four Factors' feature, Mean, and correlation(To be continued)

	Features of the Web-based OPAC Evaluation	Mean (Max)	Correlation	
			VI	WA
Factor 16	Narrowing search by Date	2.7 (5.0)	r = -0.1500 (N = 41) P = 0.349	r = 0.0647 (N = 41) P = 0.688
Factor 17	Narrowing search by Language	2.5 (5.0)	r = -0.0086 (N = 41) P = 0.958	r = -0.0892 (N = 41) P = 0.579
Factor 18	Narrowing search by Format of Publication	1.15 (5.0)	r = -0.0426 (N = 41) P = 0.791	r = 0.2141 (N = 41) P = 0.179
Factor 19	Narrowing search by Opus number	1.1 (5.0)	r = -0.0733 (N = 41) P = 0.649	**r = -0.3176 (N = 41) P = 0.043**
Factor 20	Browsing Index List	1.1 (5.0)	r = -0.0474 (N = 41) P = 0.769	r = 0.1209 (N = 41) P = 0.452
Factor 21	Character and Image on Screen	1.1 (5.0)	r = 0.1399 (N = 40) P = 0.389	r = -0.1124 (N = 40) P = 0.490
Factor 22	Browsing and Navigating Style	3.4 (5.0)	r = 0.0974 (N = 41) P = 0.545	r = -0.0801 (N = 41) P = 0.619
Factor 23	Screen Layout	4.0 (5.0)	r = -0.0603 (N = 41) P = 0.708	r = -0.1060 (N = 41) P = 0.510
Factor 24	Ease of Learning	4.3 (5.0)	r = -0.0035 (N = 41) P = 0.938	r = 0.1720 (N = 41) P = 0.282

deviation (SD) for each cognitive style. In the table, however, each of the cognitive styles rating (R) may not have any significant meaning, but it tells the variation of the cognitive style differences depend on the different factors. With the rating list, we can interpret their preferences. For example, Factor 10 (i.e., Students were asked "How would you rate search by Number according to your frequency use in the Web-based OPAC system?"), and among the four different styles, Verbalisers mostly tend to use (or prefer) of 'search by Number' followed by Analytics, Imagers and Wholist, respectably. The same interpretation principle may be applied to all the factors throughout the table.

5 Conclusions

In exploring the effects of the cognitive

〈Table 2〉 Summarise of the Cognitive Style differences in Descriptive statistics: Mean ratings

	Wholist			Analytics			Verbalisers			Imagers		
	Mean	SD	R	Mean	SD	R	Mean	SD	R	Mean	SD	R
Factor 1	1.913	0.288	1	1.857	0.359	4	1.880	0.332	3	1.909	0.294	2
Factor 2	3.217	0.850	3	3.286	0.845	1	3.280	0.936	2	3.136	0.710	4
Factor 3	3.826	0.834	4	4.095	0.889	1	3.960	0.935	3	4.000	0.756	2
Factor 4	3.652	1.027	2	3.476	1.209	3	3.400	1.258	4	3.682	1.041	1
Factor 5	3.913	0.848	1	3.905	1.044	2	3.880	1.054	3	3.864	0.889	4
Factor 6	3.783	1.166	3	4.048	0.973	2	3.720	1.100	4	4.136	0.941	1
Factor 7	3.304	0.822	1	3.190	1.209	2	3.160	1.028	4	3.182	1.097	3
Factor 8	2.391	1.406	4	2.762	1.179	1	2.560	1.294	2	2.455	1.299	3
Factor 9	1.478	0.665	4	1.667	0.796	1	1.600	0.764	2	1.591	0.734	3
Factor 10	1.217	0.422	4	1.333	0.577	2	1.360	0.569	1	1.227	0.429	3
Factor 11	2.043	0.825	3	2.048	0.669	2	2.120	0.781	1	1.955	0.653	4
Factor 12	3.522	1.275	2	3.429	1.326	3	3.680	1.069	1	3.318	1.460	4
Factor 13	2.261	0.810	1	2.048	0.865	4	2.120	0.781	3	2.136	0.889	2
Factor 14	1.609	0.891	3	1.762	0.944	1	1.720	0.843	2	1.591	0.959	4
Factor 15	1.304	0.765	2	1.286	0.644	3	1.400	0.707	1	1.136	0.640	4
Factor 16	2.609	1.469	3	2.762	1.136	2	2.840	1.214	1	2.500	1.406	4
Factor 17	2.609	1.672	1	2.381	1.465	4	2.520	1.584	2	2.500	1.596	3
Factor 18	1.783	0.902	4	2.190	1.365	1	2.000	1.258	2	1.909	1.019	3
Factor 19	1.000	0.000	4	1.286	0.717	1	1.160	0.554	2	1.091	0.426	3
Factor 20	1.087	0.288	4	1.190	0.402	1	1.160	0.374	2	1.136	0.351	3
Factor 21	3.480	0.963	2	3.286	0.845	4	3.292	0.806	3	3.500	1.012	1
Factor 22	4.077	0.845	2	3.952	0.973	4	3.960	0.889	3	4.091	0.921	1
Factor 23	3.731	1.002	1	3.524	0.981	4	3.600	1.041	3	3.682	0.945	2
Factor 24	4.154	0.784	4	4.333	0.730	1	4.240	0.779	2	4.227	0.752	3

styles of individuals. this study has failed to reveal a significant ($P < 0.05$) correlations in the interactive Web-based OPACs evaluation. It could be said that the contribution of cognitive styles to evaluating Web-based OPACs is likely to be weaker than that of non-cognitive (or demographic) variables.

In spite of that another possible argument could be raised that the traditional cognitive

approach has neglected the importance of how people work in the real world when using computer systems. Sometimes this is problematic because the environment is too artificial for the type of question that is investigated. Results of research may be applicable only as they support or challenge existing theory.

Another possibility is that we may find the cognitive style level may have an influence on the set of processes in searching or execution, whereas non-cognitive (or demographic) aspects may influence another set, for example, on the selection of search strategies.

They are also much more objective about the information they are learning. Some students are equally comfortable using either visual or verbal information for learning. In fact, the differences between the visualiser and verbalizer are often not as vast as researchers have found with other cognitive styles.

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