

Robert Sternberg's mental self-government theory and its contribution to our understanding of first-year distance learners' multiple thinking style preferences

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Abstract

Empirical investigations have revealed that the diversity and flexibility of students' opinions on common thinking style issues and the apparent elusive nature of learning styles account for the often-unpredictable array of personal thinking style preferences. Sternberg contributes to our understanding of mental ability and cognitive performance by equating mental self-governance to the way we manage businesses and institutions. This intelligence (the perception we have of information systems and the way we manage them) will influence the way we think and learn. This also applies to students and specifically to distance learners whose academic performance often depends on their ability to organise and manage information and information systems effectively. To assess this assumption, the Sternberg-Wagner Self-Assessment Inventory was applied to a sample of 503 first-year university and college students at five institutions in South Africa. The measuring instrument and items generated a Cronbach's alpha reliability coefficient of 0.8676, while the first-order and second-order factor analyses reaffirmed the presence of multiple self-management preferences among the distance learners included in the sample. The clustering of an external or field dependent style among respondents was prominent. Another preference supported by the empirical investigation and factor analysis was the association between an executive and a conservative thinking style, the existence of learners who prefer to be critical and analytical when reviewing learning material, and learners who apply a variety and wide range of techniques and strategies when problems have to be solved. The implications of these findings for a better distance education praxis are also explained in the article.

INTRODUCTION

The main reasons for an investigation into distance student learning and distance instructional strategies stem from numerous problems presently encountered with distance education in South Africa. These problems include the relatively high dropout and failure rates among distance education students as compared to face-to-face or contact students at residential institutions. The worldwide changes in distance education policy (concerning the task, structure, function and operation of

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distance education institutions), as well as contemporary trends in course design (with specific reference to the internal substantive and syntactical structure of courses) that are aimed at accommodating diverse and heterogeneous student learning styles and knowledge accessing modes furthermore justified the current research into distance learning (Fraser 1993).

AIM OF THE INVESTIGATION

The main aim of this investigation was to assess the opinions of a representative sample of distance learners enrolled at different distance education institutions or institutions involved with distance education in South Africa on their knowledge accessing modes (also known or defined as learning styles and learning), with specific reference to Sternberg's thinking style preferences. The Sternberg-Wagner Thinking Styles Inventory was applied to the respondents after adapting (localising) the inventory slightly to accommodate the target population. The purpose with the items was to probe distance learners' understanding of their mental self-governance capacities and to interpret the responses in terms of the impact that diverse thinking style preferences could have on distance learners' instructional preferences.

THINKING STYLES AS MECHANISM TOWARDS LEARNING AND UNDERSTANDING

After more than a decade of continuing research, Dunn and Dunn (1979:238) are convinced that the diversity of theories on how students achieve academically is explained by the fact that each theory contributes only partial insight into the learning process. None of them provides a totally accurate explication of how individuals gain and retain knowledge. Marzano, Pickering and Brandt (1990:17) argue that this is because student thinking does not occur in neat, easily identifiable categories. It is also highly unlikely that any single learning tactic will ensure the creation of well-constructed knowledge, and multiple tactics are usually required (Derry 1989:10).

The main purpose of learning style research is normally to identify factors that could be used by educators to strengthen future academic achievement among learners. Lippitt (1991:2) writes that the results of learning style assessments are indicators of how a student currently translates the information presented within an educational experience. This implies that certain learning styles may be more suitable for the particular demands of distance teaching than others. For distance education, independent learning is at stake and one could speculate that a close link or match between learning style and independent learning should enhance student achievement. Students' learning styles may also account for differences in perception (Gibson & Graff 1992:42). Dunn (1984:12) defines learning style as the way in which each person absorbs and retains information and/or skills, while

Sternberg (1994:36) refers to a style as a preferred way of using one's abilities. To Singh (1988:357 –358), learning styles are the methods by which one comes to know and understand the world, as well as the accustomed patterns used in the acquisition of information, concepts and skills. According to Leino, Leino and Lindstedt (1989:56), learning styles refer to individuals' typical performances and preferences. They see learning styles as involving cognitive styles as well as study and environmental preferences.

Säljö (1979), as quoted by Kirkwood (1989), identified five qualitatively different conceptions of learning held by students in a wide variety of educational situations. They are: a quantitative increase in knowledge; the memorisation of new information; the acquisition of facts, methods and procedures that can be retained and utilised when necessary; the abstraction and construction of meaning, and an interpretative process aimed at the understanding of concepts, ideas or aspects of reality.

Academics agree that no specific learning style can be regarded as correct or incorrect, and Keefe (in NASSP 1982:44) argues that one learning style cannot be valued more than others. Different learning styles also call for different instructional styles (Beutell & Kressel 1984:89). When students are taught through methods that complement their learning characteristics, they become better motivated and also achieve better academically (Dunn & Dunn 1979:239; Dunn 1984:12). The link between learning styles and teaching styles is also documented by Conti (1985:227), Davidson (1990:36), Fischer and Fischer (1979:251) and Kember (1989:206). However, Doyle and Rutherford (1984:23) warn that learning style clearly cannot be the sole basis for designing instruction, while Dunn and Dunn (1979:244) suspect that learning style and teaching style characteristics do not always cluster into neat packages. Leino *et al* (1989:59) conclude the learning versus instructional style debate by writing that there still remains the unsolved problem of whether optimal instruction should be based on the idea of match or mismatch between learning styles and instruction.

Cilliers and Sternberg (2001:23) argue that our learning environments have to accommodate all identified styles of thinking and learning, and that flexibility and variety in teaching practices can be essential to ensure that the needs of all learners are taken into consideration. Researchers appear to have reached consensus over the last few years that learners tend to adopt different approaches and strategies when they have to perform tasks and solve problems. Sternberg (1997:83 – 84) supports this notion and argues that learners have profiles (also called patterns) of styles and not just a single style. He concludes that "... (t)here is no unidimensional scale of styles, any more than there is of abilities. People vary in all sorts of ways". One can therefore agree with Horak, Steyn and De Boer (2001:208) that we will have to reassess our traditional approaches to instructional design and delivery when dealing with a composite group of learners in a specific programme. It is documented by Herrmann (1996) that learning environments represent a complete spectrum (and diversity) of learning style preferences. Sternberg (1997:85)

furthermore maintains that “stylistic flexible learners” are better equipped to adjust to a variety of situations.

ROBERT STERNBERG'S CONSTRUCTS OF MENTAL SELF-GOVERNMENT

Robert Sternberg's (1997) theory of mental self-government is a theory linked to the management of learners' own thinking styles. A thinking style is a preferred way of thinking or a mode of thought. It is not regarded as “an ability” in general, but as a way in which learners use their abilities (Sternberg 1990:366; 1994:36). Sternberg (1997) uses government as metaphor to explain his theory of self-governance because he maintains that government is an external reflection of what goes on in people's minds (see also Sternberg 1994:37 and 1990:367). Government consists of various facets such as function, form, level, scope and leaning. The primary functions of government are legislative, judicial and executive. In terms of this definition, major forms of government are monarchic, hierarchic, oligarchic and anarchic. Levels of government are global and local. The scope or domains of government are internal (domestic affairs) and external (foreign affairs), while the main leanings of government are conservative and liberal.

Sternberg (1997) subsequently classifies thinking in terms of function (legislative, executive and judicial), form (monarchic, hierarchic, anarchic and oligarchic), level (global and local), scope (internal as well as external issues) and leaning (conservative and liberal). Confined space does not allow for defining and explaining the functioning of the thirteen different thinking style categories and readers are advised to consult Sternberg's (1997) “Thinking Styles” should more information be required.

THE RATIONALE BEHIND THE RESEARCH DESIGN

A quantitative research design was decided upon, mainly to involve in the research as many first-year distance learners who represent different distance education institutions as possible, and to assess and validate the responses of the respondents according to specific factorial design techniques. The decision to strengthen the investigation through the application of a quantitative factor analysis design is supported by the assumption and understanding that such a technique has the capacity to expose the hypothetical mental constructs that drive learners' internal organisational skills and capacities.

The first phase of the investigation involved the assessment of respondents' opinions in terms of Sternberg's assumption that the thirteen thinking styles distinguish themselves very clearly in the minds of learners when they face everyday learning tasks and functions. It is for this purpose that the responses were subjected to a first-order investigative factor analysis on the assumption that the

responses would cluster very clearly into the thirteen described thinking style preferences.

The second phase of the investigation involved the combination of related or associated items and subjected the responses of learners to a confirmative second-order factor analysis. The purpose of this intervention was to determine whether a logical clustering of predetermined functions would withstand the scrutiny of a factor analysis and whether a logical grouping of different yet related functions would be supported empirically.

The adaptation and construction of the questionnaire

The researchers obtained permission from Sternberg to use the original Sternberg-Wagner Thinking Styles Inventory as contained in Sternberg (1997) for assessing learners' thinking styles in a distance education environment. The questionnaire contained two sections, one focusing basically on biographical information and the other focusing on Sternberg's thirteen thinking styles.

Section A dealt with typical biographical information such as the tertiary institutions the learners were registered with, gender, marital status, place of occupation, the sharing of study space, the availability of tutorial support, highest post-school qualification, the vocation the learners were possibly practising, as well as the main field of specialisation (Table 1) the learners were involved in. Two additional items were included in the questionnaire to probe respondents' perceptions of themselves as problem solvers (Table 2). They were also requested to classify themselves either as designers, doers, talkers or thinkers (Table 3).

Section B dealt with the thirteen thinking styles identified by Sternberg (1997:26) as explained earlier in this article: legislative, executive, judicial, monarchic, hierarchic, oligarchic, anarchic, global, local, internal, external, liberal and conservative. Altogether 104 items were included in the questionnaire (see Sternberg 1997:27 – 75), which means that approximately eight items were used for each of the thirteen categories listed. The items were scrambled randomly throughout the questionnaire. The researchers also decided to readapt Sternberg's original seven-point scale with options ranging from "Never" and "Sometimes" to a four-point scale with options ranging from "Often" and "Always", as they considered the latter to be more feasible in the context of this study.

The research sample and the application of the questionnaires

Letters explaining the rationale behind the proposed research project and inviting participation were sent to the principals of Lyceum Correspondence College, Success Correspondence College, the University of South Africa, the University of Pretoria and Vista University (VUDEC Campus). The former two institutions have in the meantime closed down, while the latter has merged with the University of South Africa.

A sampling method called "sampling probability proportionate to size" (Dooley 1984:247) was used to constitute a test group. The multistage cluster sampling design was commenced by requesting participating institutions to cluster or stratify the possible courses first-year students could enrol for at their institutions. Budgetary restrictions for phase one of the project played a major role in the final decision of whether to involve large student numbers in the investigation, as well as in the selection of a representative sample size. Administrative costs, which constituted the largest item contributing to the budget, accounted mainly for the translation and editing of the questionnaires, the final printing thereof and postal expenses that included a post-paid addressed envelope accompanying each questionnaire.

The limited budget obviously affected the selection of the sample size. Although the limitation of the sample size was accepted as a possible threat to the validity of the population (Neale & Liebert 1986:257) and subsequent ecological validity, it was decided to continue with a quantitative investigation by mailing the maximum number of questionnaires to a representative sample of students enrolled for distance education courses at the institutions listed.

Each institution then prepared a random sample of each population cluster and supplied address labels of the names and addresses of the learners in the samples for further distribution. Altogether 1 044 questionnaires were finally mailed to first-year students who studied at the institutions mentioned above. Of these, only 497 or 47.6 percent were returned for further processing. Approximately 44.6 percent ($n = 218$) of the respondents represented the University of South Africa, while 183 completed questionnaires were received from the University of Pretoria (Fraser, Van Ede & Lombard 2001:96).

The frequency analysis

All the responses were subjected to a classical frequency analysis. The raw frequencies and percentage calculations of three items that pertained directly to the learning style preferences in the factor analyses will be discussed below.

The Principal Component Factor Analysis

Student responses to the 104 items listed by Sternberg were subjected to a factor analysis to reveal and identify factors that could be defined reasonably well by the actual variables (Anastasi 1982:146). A principal component factor analysis with a varimax method of rotation, known as the PRINCOMP Procedure (SAS/STAT User's Guide 1990:1241 – 1263), was applied. The varimax method of rotation used in this factor analysis has proved very successful as an analytic approach to obtaining an orthogonal rotation of factors (Kachigan 1991:238 & Nunnally 1967:333).

Applying the following four criteria identified factors:

- The weighting and retaining of eigenvalues (less than one eigenvalue) (Kachigan 1991:246; SAS/STAT User's Guide 1990:1242);
- the interpretation of the scree test (variance of a set of scores equals the square of the standard deviation) (Cattell 1966:245 – 276);
- the consideration of the total variance accounted for or “explained” by the factors (Kachigan 1991:246 – 247), taking into consideration Nunnally's (1967:357) suggestion that only variables with loadings of 0.30 and higher should be taken seriously; and
- the degree to which each of the variables correlated with each of the factors (Anastasi 1982:364; Guilford 1956:466 – 467; Kachigan 1991:243).

Cronbach's correlation coefficient alpha formula was used to estimate the reliabilities of the responses on which the factor analyses were based (see Anastasi 1982:117; Ebel & Frisbie 1991:85, and Nunnally 1967:210). It addresses the question of whether or not a measuring instrument is consistent (Vockell 1983:22), or as Sax (1974:172) puts it, describes the extent to which measurements can be depended on to provide consistent, unambiguous information. The Cronbach alpha formula provides a good estimate of reliability in most situations for a set of two or more construct indicators (Hair, Anderson, Tatham & Black 1992:428), or composes a measure on scores with values other than 0 and 1 (Cronbach 1951, in Ebel & Frisbie 1991:84). As will be illustrated in the following paragraphs, a Cronbach alpha reliability coefficient of 0,8998 was obtained, indicating that the items and questionnaires were highly reliable in their task (see Gearheart & Willenberg 1974:18).

Analysis of variance (ANOVA) and application of Duncan's multiple range test

In order to determine the levels of significance ($p < 0,05$) between the means of the responses in terms of (a) the independent thinking styles and (b) the four grouped clusters discussed in this investigation as for (i) gender, (ii) fields of specialisation and the (iii) performance of given tasks, a simple multivariate and one-way analysis of variance (GLM procedure, SAS PROC FACTOR) was conducted on the means of the groups listed (Bartz 1976:270; McMillan & Schumacher 2001:373). This procedure was followed by a *post hoc* comparison to determine the extent of the differences between the means. Duncan's multiple range test as well as Scheffé's test were applied for this purpose (Bartz 1976:285; McMillan & Schumacher 2001:374).

Results of the frequency analyses

The majority of respondents who participated in the investigation were female (65.8 percent), while close to 78 percent of those students who completed the questionnaires were 22 years of age and younger. Most of them were unmarried (89.4 percent), lived with their parents (62.9 percent) and had nobody at home to assist them with their studies (64.9 percent). Where tutors were present to assist them with their studies, most of these tutors were in possession of a tertiary or trade qualification (65.6 percent). Most respondents (68.5 percent) were also not working full-time (Fraser, Van Ede & Lombard 2001:96 – 102).

Table 1 is self-explanatory with regard to the fields of specialisation of the students involved in the investigation.

Table 1: Main academic affiliations of respondents who participated in the investigation

Main academic affiliations of respondents	n	percent
Natural Sciences (Chemistry, etc.)	60	12.2
Humanities (Language; Education, Sociology, Psychology, etc.)	171	34.8
Legal Sciences (Law Faculties)	21	4.30
Economical and Managerial Sciences	190	38.6
Health Sciences	12	2.40
Religious Sciences	4	0.80
Other	34	6.90
TOTAL	492	100

Frequency missing = 5

When requested to illustrate the types of tasks (see Table 2 below) they prefer when solving problems, most respondents (43.3 percent) indicated that they would prefer to talk about specific problems in a group and reach mutual agreement in the course of the problem-solving process. Another section (20.4 percent) thought it well to think about a problem and to solve, for example, mathematical problems mentally, while a further 28 percent of the respondents indicated that they would prefer consulting literature during the problem-solving process. Only a few students (8.3 percent of the respondents) preferred to solve problems through discovery and experimental designs.

Table 2: Respondents' preferences for specific activities when having to solve problems

Tasks to be performed when problems have to be solved	n	percent
Preference for <i>thinking</i> about a problem and solving mathematical problems <i>mentally</i> .	101	20.4
Preference for setting up <i>experimental apparatus</i> and solving problems through <i>discovery</i> .	41	8.3
Preference for <i>talking</i> about specific problems in a group and <i>reaching mutual agreement</i> .	214	43.3
Preference for the <i>consultation</i> of <i>literature</i> to solve a problem.	138	28
TOTAL	494	100

Frequency missing = 3

The next question prompted respondents to put themselves in one of four broad categories, namely “designers”, “doers”, “talkers” and “thinkers” (see Table 3). While 36.2 percent of the sample saw themselves as doers and a further 36.2 percent as thinkers, only a very small percentage (5.5 percent) regarded themselves as designers. The fact that the remaining 22.1 percent of the respondents considered themselves to be talkers is quite interesting seeing that most respondents (43.3 percent) placed a high premium on talking about specific problems in a group and reaching mutual agreement when problems have to be solved (see Table 2).

Table 3: Respondents' perceptions of themselves according to four predetermined performance categories

Classification preference	n	percent
A designer (preference for designing things)	27	5.5
A doer (preference for doing things)	179	36.2
A talker (preference for talking about things)	109	22.1
A thinker (preference for thinking about things)	179	36.2
TOTAL	494	100

Frequency missing = 3

Results of the principal component factor analysis

Investigative and confirmative factor analyses were subsequently performed on the learners' responses to the 104 items. The results of these analyses are discussed below.

Results of the investigative factor analysis

Students' responses to the above-mentioned 104 items were subjected to an investigative factor analysis that required the clustering of items in terms of their internal consistency into possible factors. According to the correlation matrix of the rotated factor patterns of the 104 items, it appeared that the responses of the students could best fit into eight diverse clusters or categories. These eight isolated factors explained close to 56 percent of the total variance and produced eigenvalues of 12.67, 7.27, 5.59, 4.57, 2.72, 2.46, 1.99 and 1.86 respectively.

The scree test as well as the calculated eigenvalues confirmed the dominance of the following possible eight factors over the lesser and recessive traits that formed part of the cluster of traits:

FACTOR 1: An external/field-dependent thinking style

FACTOR 2: An executive style clustering with conservative attributes

FACTOR 3: A clustering of judicial, liberal and anarchic characteristics

FACTOR 4: A clustering of legislative and internal/field-independent items

FACTOR 5: An oligarchic thinking style

FACTOR 6: A global thinking style with monarchic affiliations

FACTOR 7: A hierarchic thinking style

FACTOR 8: A strong thinking style reflecting local preferences

Results of the confirmative factor analysis

Seeing that four factors accounted for most of the variance recorded during the investigative analysis, a four-factor analysis was requested to confirm the existence and extent of these four factors. The purpose of the analysis was to determine whether the logical clustering of predetermined functions as four factors would support a logical grouping of different, yet related mental functions as four possible multiple stereotypes. The sorted and rotated factor loadings that represent the four possible factors are illustrated in Table 4.

Table 4: Rotated factor loadings representing four factors (poor items excluded)

Item number	Factor 1	Factor 2	Factor 3	Factor 4
V32 (Li)	0.431	-0.019	-0.071	0.032
V35 (L)	0.399	-0.039	-0.078	0.107
V39 (J)	0.597	0.137	-0.114	-0.081

Item number	Factor 1	Factor 2	Factor 3	Factor 4
V40 (Li)	0.620	-0.093	0.083	-0.01
V41 (H)	0.234	0.005	0.077	-0.21
V45 (A)	0.444	0.154	0.11	-0.113
V47 (O)	0.363	0.171	-0.081	-0.116
V49 (A)	0.371	0.064	-0.168	0.122
V52 (Li)	0.507	-0.098	-0.027	-0.074
V58 (M)	0.331	0.110	0.077	0.103
V65 (Li)	0.708	-0.209	0.124	0.017
V66 (J)	0.532	0.106	0.101	-0.181
V70 (H)	0.411	0.153	-0.113	-0.152
V77 (L)	0.498	-0.038	-0.240	0.139
V78 (Li)	0.657	-0.099	0.063	0.007
V81 (J)	0.594	0.094	0.168	-0.086
V88 (A)	0.470	-0.015	0.020	0.073
V89 (L)	0.679	-0.128	-0.176	0.084
V90 (Li)	0.681	-0.070	0.081	-0.028
V93 (Li)	0.652	0.028	0.048	-0.039
V94 (J)	0.505	-0.001	0.172	-0.021
V101 (A)	0.468	-0.027	0.058	0.025
V102 (G)	0.505	0.060	-0.024	-0.078
V103 (L)	0.599	-0.069	-0.053	0.080
V104 (G)	0.409	0.073	0.025	0.064
V110 (J)	0.488	0.052	0.138	-0.024
V120 (Li)	0.507	-0.265	-0.149	0.131
V121 (H)	0.391	0.106	-0.069	-0.162

Item number	Factor 1	Factor 2	Factor 3	Factor 4
V122 (A)	0.308	0.093	-0.018	0.059
V23 (E)	0.161	0.398	0.053	-0.111
V25 (M)	0.051	0.277	-0.093	0.158
V26 (H)	0.123	0.339	0.086	-0.193
V30 (Lo)	0.189	0.350	-0.039	-0.125
V34 (C)	-0.006	0.575	0.071	0.066
V37 (E)	0.147	0.508	0.091	-0.150
V38 (M)	0.051	0.428	0.127	0.009
V48 (C)	-0.219	0.393	-0.086	0.106
V53 (E)	0.186	0.554	-0.010	-0.055
V63 (C)	-0.153	0.704	-0.069	0.128
V64 (E)	-0.103	0.750	-0.036	0.059
V68 (M)	0.135	0.368	0.156	-0.053
V79 (E)	0.057	0.475	0.108	-0.011
V99 (Lo)	-0.077	0.236	-0.044	0.012
V106 (C)	-0.208	0.657	0.002	0.130
V108 (Lo)	0.110	0.398	-0.017	-0.069
V119 (E)	-0.091	0.758	0.037	0.071
V25 (M)	0.141	0.172	0.201	0.141
V33 (Ex)	0.148	0.033	0.498	0.134
V61 (Ex)	0.191	0.107	0.679	0.300
V124 (Ex)	0.188	0.025	0.784	0.238
V125 (Ex)	0.247	0.058	0.796	0.205
V97 (I)	-0.095	-0.06	0.592	-0.101
V29 (G)	-0.088	-0.056	0.039	0.488

Item number	Factor 1	Factor 2	Factor 3	Factor 4
V42 (G)	0.097	-0.081	-0.018	0.384
V50 (A)	0.009	0.007	0.015	0.415
V55 (O)	-0.08	0.057	0.109	0.382
V60 (G)	0.102	0.01	0.072	0.470
V67 (Ex)	0.084	0.076	-0.219	0.260
V74 (O)	-0.085	0.033	0.13	0.451
V75 (G)	0.041	0.023	0.079	0.471
V83 (M)	0.155	0.176	0.007	0.458
V86 (G)	-0.154	-0.103	-0.089	0.480
V87 (O)	0.149	-0.164	-0.073	0.264
V96 (M)	-0.134	0.116	-0.031	0.397
V111 (O)	0.178	0.012	-0.132	0.316

The following four isolated factors explained close to 20 percent of the total variance (see Table 5) and produced eigenvalues of 9.30, 5.79, 3.55 and 3.42 respectively:

FACTOR 1: A close association between the judicial, liberal and legislative styles

FACTOR 2: An executive style linked to conservative and monarchic preferences

FACTOR 3: An external/field-dependent thinking style

FACTOR 4: A global thinking style with oligarchic links

Table 5: The variance explained, eigenvalues and Cronbach alpha reliability coefficients calculated for four hypothetical factors

Factor	Variance Explained	Eigenvalue	Cronbach's Alpha
1	8.4889	9.30166	0.906
2	5.0924	5.78667	0.842
3	2.9881	3.55243	0.745
4	2.767	3.4211	0.732

The identification of factors and construct validation of learners' responses in terms of four possible factors

- The sorted and unrotated factor loadings have been illustrated in Table 4. What became evident from the original correlation matrix was that some of the variables showed intercorrelations or associations with items linked to other factors. This occurred in the case of items identified under all four possible factors. Certain items or variables were subsequently removed from the matrix because of their high correlation or association with items that also correlated highly under other possible factors.

To resolve the issue of items correlating highly with items representing other factors, a second-order rotated factor loading was performed on the remaining variables. (The reader will recall that poor items that showed high internal consistencies across the factor loading were removed and the factor analysis was repeated on the remaining items.) These results are illustrated in Table 6 below.

Table 6: Clustering of the sorted and rotated factor loadings representing four factors

New Factors	Cronbach's Alpha	Clustering of variables
1 Critical Analysts (Liberal; Judicial; Anarchic; Global)	0.91	V65(Li), V90(Li), V78(Li), V93(Li), V40(Li), V81(J), V39(J), V103(L), V66(J), V94(J), V52(Li), V102(G), V70(H), V121(H), V88(A), V58(M), V104(G), V45(I), V47(O), V32(Li), V101(A), V35(L), V122(A), V110 (J), V40(Li), V49(A), V77(L), V89(L), V120(Li)
2 Careful Conservatives (Ex- ecutive; Local; Con- servative; Monarchic)	0.84	V119(E), V64(E), V63(C), V106(C), V53(E), V37(E), V26(H), V25(M), V23(E), V68(M), V79(E), V38(M), V99(Lo), V108 (Lo), V30(Lo), V34(C), V48(C)
3 Energetic Extroverts (External)	0.75	V25(M), V33(Ex), V61(Ex), V124(Ex), V125(Ex), V97(I)
4 Flexible All-rounders (Global; Oligarchic)	0.73	V60(G), V75(G), V74(O), V29(G), V86(G), V50(A), V83(M), V96(M), V42(G), V55(O), V111(O), V87(O)

The different variables clustering under a given factor (cluster) are explained by using the following key: legislative thinking style (L); executive thinking style (E); judicial thinking style (J); monarchic thinking style (M); hierarchic thinking style

(H); oligarchic thinking style (O); anarchic thinking style (A); global thinking style (G); local thinking style (Lo); internal thinking style (I); external thinking style (Ex); liberal thinking style (Li); conservative thinking style (C).

As is evident from Tables 7 and 8, there are substantial differences between scores for female and male students in relation to one of the factors. The means of male students differed significantly from those of female students for factor 1 (critical analysts). For two of the factors (factor 1 and factor 3), there were significant differences between the mean scores of students' preferences for performing certain tasks concerned with the solving of problems. These differences will be explained in the following paragraph.

Table 7: One-way analyses of variance carried out on first-year distance students with style clustering (new factors) as dependent variables and subject specialisation, gender and task preferences as independent variables

Source	df	SS	MSS	F*
Factor 1:				
Specialisation	4	556.22	139.05	ns
Gender	1	4245.80	4245.80	26.76
Task	3	1313.90	437.97	2.76
Factor 2:				
Specialisation	4	365.26	91.31	ns
Gender	1	4.97	4.97	ns
Task	3	190.06	63.35	ns
Factor 3:				
Specialisation	4	10.14	2.53	ns
Gender	1	2.69	2.69	ns
Task	3	1493.48	497.83	37.63
Factor 4:				
Specialisation	4	197.12	49.28	ns
Gender	1	51.19	51.19	ns
Task	3	67.69	22.56	ns

* $p \leq 0,05$; ns = differences between means are not significant

The most striking finding from the *post hoc* comparisons (see Table 8) is that significantly more male than female students viewed the application of liberal, judicial, anarchic and global thinking as a higher priority. The differences between their means confirmed this finding. For the rest of the analyses, the differences between the preferences of male and female students were not significant.

Table 8: Post Hoc comparison with least squares means between subject specialisation, gender and task preferences using style clustering (new factors) as dependent variables

Independent variable	Variable: Least squares means	Female	Male		
Gender	Factor 1				
Female	84.33				
Male	91.28	*			
Independent variable	Variable: Least squares means	Thinking about a problem	Performing an experiment	Talking about the problem	Reading to solve a problem
Task	Factor 1				
Thinking	89.394) *
Experimenting	88.944) *
Talking	86.72				
Reading	83.60				
Task	Factor 3				
Experimenting	18.78			*	
Talking	21.04				
Reading	17.38) *	*	
Thinking	17.02)		

*p ≤ 0,05

Interesting results emerged from the differences between the means of the four newly clustered categories and the types of tasks the respondents preferred to perform. A significant difference was found between the task performance preferences of students classified as critical analysts (factor 1). The mean of students who preferred to solve for example mathematical or statistical problems mentally was significantly higher than that of students who would prefer to consult literature when having to find a solution to a problem. As expected, a striking difference was found between the task performance strategies of the external thinkers (factor 3). There were also significant differences between those students preferring to solve a problem by talking about it and those finding it easier to conduct an experiment or consult literature. A communicative mode of operation apparently remains a prominent problem-solving strategy for students who are external thinkers.

DISCUSSION

The second-order four-factor analysis clearly distinguished between four prominent learning style groupings as illustrated in Table 4. The components of each cluster (factor) were carefully analysed and named in terms of the variables contained in each. For the purpose of this investigation it was decided to rename the thinking style preferences of the individuals represented by each cluster as free-thinking critics, careful conservatives, task-oriented extroverts and flexible all-rounders respectively. The rationale behind this decision will now be discussed.

Critical analysts

Four of the thinking style preferences (liberal, judicial, anarchic and global) were grouped together and given the name of free-thinking critics or critical analysts. The four style preferences are related and bear some resemblance as far as distance learner thinking style preferences are concerned. According to the literature that supports the existence of such preferences, judicial respondents like to evaluate rules and procedures, while they prefer problems that require the analysis and evaluation of existing things and ideas (Sternberg 1997:21). Anarchic individuals are driven by a variety of needs and goals that they may find difficult to sort out. They tackle problems in a random manner, and whenever they feel restricted by a system, either reject or fight against it (Sternberg 1997:23). Global learners prefer to work with relatively large and abstract issues, while they also seem to ignore details and prefer to pay attention to broader issues (Sternberg 1997:24). Individuals with a liberal thinking style like to go beyond existing rules and procedures and seek to bring about as much variation as possible in their everyday situation (Sternberg 1997:74).

However, when the number of respondents who opted for the items belonging to this first factor (“free-thinking critics”) is compared with that in the second

factor (see “careful conservatives” under the next heading), it seems that fewer respondents selected options of “always” and “often”. Approximately 65.3 percent of all the respondents indicated a preference for starting with their own ideas when having to work on a project, while 72.6 percent of the participants stated that they preferred to work on projects where they could rate and study different (existing) views and ideas. Fewer respondents (67.5 percent) admitted that they would welcome the sharing of ideas and inputs from others when working on a project, while 69.1 percent favoured projects that could be completed independently. Altogether 64.6 percent of the respondents indicated that they would prefer to change routines in order to improve the way tasks are done. Some also liked to compare and rate different ways of doing things (68.6 percent) or to compare opposing points of view when making decisions (69.5 percent).

What do these learners have in common? They are open-minded and critical individuals who find it difficult to work under rigid and conventional circumstances. They also need a great deal of freedom to solve problems and complete tasks, and will find it difficult to stick to a single application, rule or procedure in completing a task. They prefer to do things “their way” and are convinced that the way they perform a task would be the most appropriate and best solution for that task.

Learners exhibiting these characteristics generally find it easier to work in an open self-regulated learning environment. They flourish when learning is directed towards the achievement of outcomes, especially when there are no prescriptions as to how these goals should be accomplished. Such learners would obviously function very poorly in a traditional distance education environment or in any environment where the processes and products of the learning experience have been predetermined and prescheduled. They prefer to manage their own learning and learning environments and can be expected to be critical of learning activities managed and driven by teacher-centered processes and activities.

Careful conservatives

The second factor assembles or joins those thinking styles that typify the conservative and teacher-dependent learner. These learners may find it very difficult to work outside existing rules and regulations. They depend on prescribed study guides and study materials and often see the prescribed guidelines as the only solution to a given problem. Executive thinkers tend to work well when guidance is given to them and are quite happy to follow and implement the rules (Sternberg 1997:35). They feel uncomfortable when working outside the comfortable boundaries of tested and approved techniques and strategies, and usually do not have the capacity or predilection to identify and address more than one problem, goal or task at a time.

The frequency analyses of the individual items revealed a high preference among many students for tasks and functions related to the isolated cluster or

factor of “careful conservatives”. For the purpose of this analysis, the two options “always” and “often” were again combined to provide a stronger reflection of respondents’ opinions. Most respondents (90.9 percent) indicated a preference to know the order in which things had to be done when working on a project, while 85 percent wanted to be familiar with the methods or procedures for performing a task before commencing with such a task. Close to 84.4 percent of the respondents listed a strong preference for taking all aspects into consideration when having to make a decision, while 67.1 percent preferred to complete one task before commencing with the next. Many respondents (82.4 percent) preferred a clear structure and set goals when having to proceed with a task or project.

According to Cilliers and Sternberg (2001:22) executive, internal, conservative and hierarchic characteristics tend to group together. Similar findings have been observed in the above-mentioned clustering of constructs. The executive thinking style associates very closely with conservative attributes, implying that individuals who prefer to function within certain fixed parameters, can be regarded as conservative in their preferences and functions. They would, to a certain extent, flourish under the classical or traditional transmission mode of teaching, preferring to be prescribed to and to work within comfortable and tested learning environments. It is not clear whether this specific learning style preference is the product of a given teaching style, or whether individuals with certain traits and characteristics tend to give preference to a specific knowledge accessing mode.

We have to accept the possibility that many learners may reveal a critical and open-minded appreciation of reality. They could have a post-modern focus on information and their eclectic management of information is such that residential and distance education have found it difficult to cater for and accommodate their preferences in practice (Fraser & Lombard 2002). However, research conducted by Fraser and Nieman in 1995 (1995:73 – 93) emphasises the prominence of the positivist paradigm for distance education practices. They illustrate how a sample of distance learners (representing major distance education institutions) over-emphasised the memorisation of facts and principles, continued to identify important concepts in the text, memorised subject contents and reproduced such material in assignments and examinations, and preferred to work with subject information that has been set out logically and in an orderly manner. Furthermore, variables such as the successful completion of tasks and assignments, and the effect of student self-confidence and regular feedback from lecturers on these achievements play a significant role in distance learning (Fraser & Van Staden 1996:220 – 221).

Energetic extroverts

Although only a limited number of items clustered under this specific factor, it will be explicated for further reference. The four items clustering under this specific category explain a learning style or thinking style preference that has been

described and elaborated over many years. It represents a strong affiliation with an individual preference for field dependent thinking, and highlights the possibility that here we have a style that relates to individual learners who enhance their own competence and understanding through the interacting with other learners. People with an external style tend to be extroverted, people-oriented, outgoing and socially more sensitive to other people (Sternberg 1997:70).

A comparison between the response rate of learners who opted for the items listed under the third factor and that of learners who chose the first two factors, shows that more respondents regarded the preferences represented by these items as important. A few respondents (36.2 percent) stated that they would normally like to stick to one main idea when writing about ideas, while 51.3 percent of the respondents indicated that they would brainstorm ideas with friends or peers when starting a task. Close to 53,5 percent argued that they should be given tasks where they can work together with others, while 61,9 percent wanted to be involved in situations where they can interact with other learners. Close to 62 percent of the respondents argued that they would like to address competing issues of importance in assignments simultaneously.

Flexible all-rounders

The thirteen items or variables associated with global and oligarchic thinking strategies are well defined within Sternberg's thinking style preferences. Individuals with an oligarchic style tend to be motivated by various and often competing goals of perceived equal importance (Sternberg 1997:53 – 54). They link successfully with global associations, implying that they prefer to achieve a broad universal goal or aim before working with details and minute specifics.

As far as the results of the fourth factor ("flexible all-rounders") are concerned, one's attention is again drawn to the relatively low number of respondents who selected "always" or "often" in the items covered by this factor. Only 35.8 percent of all respondents cared more about the general effect than about details when performing tasks, while 45.7 percent indicated that they would do whatever occurs first to them. Close to 29 percent had difficulty in deciding the order in which to do things, while only 26.1 percent of the respondents preferred tasks where they could focus on general issues, rather than on specifics. Few (21.7 percent) had trouble setting priorities for multiple tasks, while 39.7 percent of all the respondents indicated that they would prefer working on projects that dealt with general issues and not with nitty-gritty details.

CONCLUSION — IMPLICATIONS OF THE FINDINGS FOR A DISTANCE EDUCATION PRAXIS

More than 36 years ago Ausubel (1968:9) already argued that over the previous 50 years there had been a decline in knowledge and theorising about learning,

especially at school level. The same seems to apply to psychology and educational psychology, as De Corte (2000:251) tends to agree with scholars that the field of educational psychology has not resulted in proportional innovation in school practices.

We have seen the emergence of a new approach towards learning and have acknowledged the role postmodernism has played in molding a new theory of learning for our schools and classrooms. It was Marland (1989:180) who proposed, as far back as in 1989, a new paradigm of research into learning (with specific reference to distance learning) by referring to a so-called hybrid paradigm. He called for a connection between the socio-anthropological orientation and the cognitive psychological approach. He also suggested that users of this paradigm be obliged to employ methods that give access to students' phenomenological knowledge about their own learning as well as other methods that tap their thought-processes as they learn (Marland 1989:180). What we have here is a definite move away from the classical transmission mode of learning, or more specifically those modes, strategies and techniques that used to rely heavily on the abilities of the teacher or trainer to "transfer" information to the learner.

What has to be taken into consideration with any assessment of learners' thinking style preferences, is the substantiated fact that thinking styles remain preferred modes of operation that fluctuate and change according to the needs and expectations of learners as well as according to teachers' modes of delivery (De Boer, Steyn & Du Toit 2001:185; Horak, Steyn & De Boer 2001:206). This notion is supported by Sternberg (1997:84) who states that "(s)tyles vary not only with tasks, but with situations". He also remarks that thinking style fluctuations are the result of differences in age and experience (Sternberg 1997:88). Although Gardner (1993:44 – 45) distinguishes very clearly between thinking styles and operational multiple intelligences (MI), he argues that the selected thinking style preferences are often predetermined by the content learners have to work with. He argues that learners "may well exhibit one style with one kind of information (such as being impulsive in the musical realm) while exhibiting a contrasting style with other information (such as being reflective when working on a jigsaw puzzle)". Gardner recommends the following solution to the complexity of learning style differentiation: "The most comprehensive analysis of individual differences may need to chart *both* the styles and the contents, in order to determine which styles seem yoked to specific contents and which may operate across the board, at least in the case of a particular individual" (Gardner1993:45).

One also has to take note of Gardner's (1993:48) observation that "(i)t is no accident that an individual develops strengths in one area as opposed to another ...". Although this argument applies specifically to the development of different intelligences, it also relates directly to the development of specific thinking styles and their relationships to given tasks and functions.

The results of the factor analysis confirm to a certain extent the existence of dominant or preferred thinking styles among distance learners, but a closer analysis

of the correlation matrixes reveal a significant amount of diversity in terms of thinking styles among the respondents who participated in the investigation. According to Table 2 the first factor identified by the factor analysis explains only 11 percent of the total amount of variance, while 12 of the 36 items that showed a high internal consistency as components of the first factor or cluster, also correlate highly with other items accumulated under the rest of the three factors. This observation corresponds with the work by Horak, Steyn and De Boer (2001) and De Boer, Steyn and Du Toit (2001), in which emphasis was placed on Herrmann's whole brain approach to teaching and learning in higher education. Although the emphases in these investigations were on thinking styles that were defined in terms of Herrmann's mode of thinking, both studies reflected a strong diversity in thinking style preferences, which emphasised the possibility that learners' way of thinking may be influenced by a single or multiple levels of operation.

The empirical investigation discussed in this article highlight a number of important limitations that students experience with distance learning. As illustrated earlier in Table 2, most respondents would have liked to solve specific problems by coming to a mutual agreement following a group discussion. Only a small percentage (8.3 percent of the respondents) indicated that they would rather like to solve problems through discovery and experimental designs. When respondents were requested to classify themselves either as "designers", "doers", "talkers" or "thinkers", more than 72 percent of the sample saw themselves as doers or thinkers. A very small percentage of the sample regarded themselves as designers, but the unexpected finding was that only about one fifth of the respondents regarded themselves as talkers. According to them, "talking about something" had not been a very popular category of self-classification.

The above phenomenon can be referred to as the plasticity or pliability of personal learning style preferences (Fraser & Nieman 1996:195). It would correspond with the researchers' hypothesis of "learning style switching", implying that learners have the ability to transfer from one learning style to another, depending on the nature of the task to be mastered, and the prior knowledge and experience of the learner. This notion is supported by Sternberg (1990:369) who remarks that "(i)ndividuals can use more than one style, but they differ in their ability to switch among them". The rationale behind the postulation of "learning style switching" could be rooted in Cattell's (1967:215) assumption that intelligence is a composite of human traits, one of them being "the capacity to acquire new capacity", a function which is vested in the author's theory regarding fluid and crystallised intelligence. Bloom *et al* (1979:16), as well as Clark (1988:8-9) support this notion.

How are these foundations of human ability linked to learning style? Fraser and Nieman (1996:195) refer to Merrill's understanding (see Merrill 1971:38) that a student will execute a task or function at the lowest possible level of exertion. He explains this observation as follows: "Learners have an innate tendency to reduce the cognitive load as much as possible; consequently, a learner will attempt to

perform a given response at the lowest possible level. This phenomenon has become known as the ‘push down principle’. Basically, this principle states that a behaviour acquired at one level will be pushed down to a lower level as soon as conditions have changed sufficiently so that the learner is able to respond to the stimulus situation using lower level behaviour.”

The factor analyses, supported by the construct validation of the mental capacities and skills associated with the thinking style preferences of especially distance learners involved in this investigation, exposed three valuable characteristics that one should accommodate in the development of powerful distance education learning environments.

The first is that the design of our instructional strategies should basically be influenced, guided or steered by the substance and syntax of the field of specialisation dealt with by the distance education mode of delivery (Fraser, in Moore 2000:4). This implies that instructional design should take into consideration the epistemology or “body of knowledge” of the learning task, as well as the processes and functions that underpin the outcomes to be achieved.

The second is that the mental self-government thinking style preferences of the sample of distance learners involved in the investigation do not cluster as individual and separate characteristics or preferences, but group logically into different prominent composite functions. In the current research the first two clusters or conglomerates of thinking style preferences exhibited two very prominent information management characteristics that typify contemporary trends in information organisation and management. Sternberg (1990:371) distinguishes between producers and consumers.

The combination of the liberal, judicial, anarchic and global thinking style preference reiterates the possibility that many learners might prefer to work outside the conventional and rigid learning environments so often associated with first generation distance education modes of delivery. They prefer to work outside of limiting time schedules, predetermined modes of operation and prestructured frames of mind. Their thoughts and actions are predominantly driven by a critical mindset calling for opportunities and freedom to be critically reflective towards the tasks and functions put to their disposal. Such preference would explain the creative or productive focus of learners working within this parameter of performance.

On the other hand, the executive, local, conservative and monarchic thinking style clustering focuses instructional designers’ attention on learners’ need to function, work and operate within well-organised and thoroughly structured learning environments. They seek shelter within a comfortable and protected learning system where the procedures and outcomes have been tested against measures of success and security. They break free with great difficulty from “textbook stereotypes” and become frustrated when assignments and tasks venture beyond or outside the outcomes and processes outlined in the tutorial material (see Sternberg 1990:371). These learners have become consumers and don’t utilise the

freedom to produce the knowledge that will eventually expand our boundaries of knowledge and understanding.

The third observation directs our attention to the results of the frequency analyses. A clear paradox emerges when we compare the frequencies of the responses linked to the first prominent factor, with the frequencies of the converged items of the second factor. The internal consistency of the items of the factor that defines freedom of choice, independent and critical thinking, a random approach towards problem solving and the application of own ideas within an open and approachable learning environment, was high enough to define a strong and prominent first factor. One would have expected distance learners to exploit the freedom flexible learning has to offer. The majority of respondents, however, focused their thinking preferences on structure, familiar examples, and tried and tested teaching strategies and methods.

There is also a fourth observation that impacts on the performances of distance learners in education and training. The current investigation highlighted the importance of learning task design and the impact that different tasks have on the performance of learners in distance education (DE). Distance learners not only do tasks differently, but different tasks would also call for the activation of different mental functions. This notion is supported by learners' preference towards mutual co-operation, co-operative learning and teamwork. Talking about how to solve problems is a solution favoured by many learners. Communication inevitably plays a much stronger role in the distance learner's frame of operation than in the past, while two of the present and traditional modes of operation, that of reading and the consultation of literature to solve problems, do not feature as prominently as expected with distance learners. The latter observation is of crucial importance to DE, seeing that most traditional DE programmes in South Africa are text driven.

For more than three decades classical first and second generation distance education modes of delivery (De Wolf 1999:134 – 135) have succeeded in complying with the requirements put forward by practitioners of the latter thinking style preference. The following of a modernist approach towards learning and teaching with an emphasis on routinized and pragmatic strategies, methods and approaches still forms the foundation of distance education instructional design premises and praxes (Fraser & Lombard 2002:88). For many distance learners, well-designed and well-structured learning environments have remained the most influential variable dictating the pace and scope of the learning experience. For many years our traditional first generation modes of delivery and content-bound distance education support materials have been preparing distance learners "to consume knowledge (and) not how to produce it" (see Sternberg 1990:371).

On the other hand, this investigation has also highlighted that the majority of distance learners share strong trends towards freedom of choice and a freedom to adapt the learning environment in terms of their personal styles and preferences. These learners fit within the postmodernist mode of operation, searching with eclectic minds best practices and solutions to problems. They roam the

unconventional parameters of educational dialogue and benefit best when the learning environment allows for constructivist learning and praxis (Fraser & Lombard 2002:93 – 96).

The investigation once again confirmed our suspicion that thinking styles expose themselves as a blend of characteristics within the cognitive capacities of distance learners. These styles or preferences do not follow unitary patterns but rather reflect multivariate qualities in each of the educators and learners engaged in distance education practices.

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