The Cognitive Basis of Knowledge Work

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ABSTRACT

Thinking styles refer to the way in which an individual processes information and are an important aspect of knowledge work which requires the efficient management of information. This paper presents the results of a study examining the thinking styles of 77 university students about to enter the workforce. They have shown greater preference for the executive, hierarchic, local, external and conservative thinking styles. Factor analysis demonstrated preferences for both complex and more simplistic thinking styles. The results of this study have implications for the training of students and employees as knowledge workers.

Keywords

Thinking styles, information processing, knowledge worker

1.0 INTRODUCTION

The objective of this paper is to report on a study of cognitive processes underlying the use of knowledge. Knowledge workers are characterized as being creative, innovative, flexible and able to independently obtain and process the necessary information. The ability to do so is greatly affected by the thinking styles of the individual. This paper will define the nature of thinking styles and its association with performance before presenting the findings of a study examining the profile of thinking styles present within a sample of university students who are about to graduate and enter the workforce. The successful transition from university to the workforce is to some extent determined by the new employee's information processing ability to understand and adjust to the novel demands of the workplace. Thus it is appropriate to study the thinking styles that fresh employees bring to the workplace as an indication of how they will respond to the information demands of the knowledge era.

2.0 THINKING STYLES

Thinking styles represent relatively stable ways of processing information. Style as a construct refers to relatively stable individual characteristics influencing information processing and behaviour. Style and ability indicate two different concepts. They are distinguished by their impact on performance; abilities have a proportional relationship with performance, whereas styles can either positively or negatively influence performance. In other words, performance on a task will improve as ability increases, whereas the effect of style on a task can be either positive or negative depending on the appropriateness of the style to task demands or task characteristics (Riding, 1997). Thus, thinking styles are general and fairly stable ways in which individuals perceive, process and organize information prior to its influencing behaviour.

Sternberg's conception of thinking styles is based on five dimensions. These are (1) functions of mental self-government consisting of the legislative, executive and judicial thinking styles, (2) forms of mental self-government consisting of the monarchic, hierarchic, oligarchic and anarchic thinking styles, (3) levels of mental self-government consisting of the local and global thinking styles, (4) scope of mental self-government consisting of the internal and external thinking styles and (5) leanings of mental self-government where the individual would show a preference for either a liberal or conservative thinking style.

Each thinking style reflects an inclination for particular types of tasks or ways of working (Sternberg, 1997; Sternberg & Zhang, 2001). The legislative style of thinking reflects a preference for tasks that challenge accepted views and favour creativity, the executive style is associated with an interest in implementation and the judicial style reflects the tendency to be evaluative. Forms of mental self-government refer to preferences in work structuring; the monarchic style of thinking indicates a preference to concentrate fully on one task at a time, the hierarchic style is associated with distributing attention amongst several prioritized tasks, the oligarchic style indicates a preference for working towards several objectives at the same time and may be associated with difficulty setting priorities, and the anarchic style of thinking indicates a desire for flexibility in structuring the task to be carried out. The local style indicates a preference for detailed work, whereas the global style indicates a preference for abstract ideas and broader perspectives. The internal

style individual enjoys working independently and the external style individual prefers tasks providing opportunities for interaction with others. Finally the liberal style of thinking is best matched to tasks requiring novelty and ambiguity, while the conservative style indicates a tendency to adhere to existing rules and guidelines in performing tasks. As with effective government, effective thinking involves the use of a variety of thinking styles as appropriate to the task.

Thinking styles are learnt through socialization when children observe adults or other role models and then internalize the attributes observed. Among the factors influencing the development of thinking styles are culture, gender, age, parenting style, school and occupation (Sternberg, 1997). Cultures favouring individualism are thought to encourage the development of the legislative, liberal and internal thinking styles, whereas collectivistic cultures would encourage executive, conservative and external thinking styles. Societal stereotypes suggest that males are more likely to be rewarded for legislative, internal and liberal thinking styles, while females would more likely demonstrate executive or judicial styles, external and conservative styles. Liberal parenting styles are thought to encourage the development of legislative or judicial thinking styles. Age does not have a consistent relationship with type of thinking styles because of the influence of other socializing agents such as schools and peers and eventually occupation. Sternberg suggests that initially preschool would reward legislative thinking; for the most part however schools would expect conformity and therefore are more likely to reward the executive thinking style. Similar trends are suggested for the workplace where innovative behaviour is expected but in reality the executive and conservative thinking styles are rewarded.

The effectiveness of thinking styles is determined by the match between thinking styles and the cognitive demands of the task to be accomplished. The closer the fit between thinking styles and task demands, the more successful the individual is in accomplishing that task. Stylistic flexibility is also an important attribute, since the demand for particular thinking styles varies with different tasks. The person with the most effective performance is one who can successfully acquire a repertoire of various styles and then successfully match thinking styles with cognitive demands in a variety of situations. The implications for the workplace are that effort must be made to coordinate thinking styles with job allocation either through training or selection. The most effective knowledge worker is one who has the cognitive predispositions to best manage the information processing demands presented.

2.1 Empirical Studies Using the Thinking Styles Inventory

Thus far research using the Thinking Styles Inventory (Sternberg & Wagner, 1997) has been mainly located in education. The executive, conservative and internal thinking styles have been shown to contribute to academic achievement among Hong Kong, Philippine and Spanish university students (Zhang, 2002b; Bernado, Zhang & Callueng, 2002; Cano-Garcia & Hughes, 2000). Conversely, negative relationships have been reported in these studies between the more complex legislative, liberal and global thinking styles and academic achievement. It has been suggested that biases in the education system favour the tendency to follow guidelines (conservative), link learning directly to experience (executive) and work independently (internal). There is a lesser emphasis on evaluation, conceptualization and creation of knowledge. While the acquisition of knowledge is important, education systems would be working at cross purposes with the demands of the knowledge era if they neglect to foster abilities required for the manipulation and creation of knowledge.

The relationship between thinking styles and intelligence has also been studied. Zhang (2001b) has shown that thinking styles contribute to academic achievement beyond self-rated abilities on analytic, creative and practical intelligence among Hong Kong secondary school students. This suggests that thinking styles and intelligence have separate impact on academic achievement. While intelligence may reflect the speed and ability with which the individual processes information, thinking styles indicate the ability to use this information towards meeting system objectives. This result again emphasizes the difference between style and ability. The implication for the workplace is that training in necessary to develop the appropriate thinking styles for the task to be done.

Another implication for the workplace is the need to identify different combination of thinking styles for different categories of jobs. Results of previous studies in education indicate that differences have been found between thinking styles and domains or field of studies (Zhang & Sach, 1997; Zhang, 1999) with natural science and technology students scoring significantly higher on the global and legislative thinking styles as compared to social science and humanities students. Thus it may be good practice to identify thinking styles needed for particular job roles before placing the employee in that position.

Thinking styles have their conceptual basis in the theory of cognitive development which postulates the development of increasingly complex intellectual and ethical thinking as the person matures. One such scheme has been proposed by Perry who proposes that individuals progress from simple dualistic thinking, to multiplicity and relativism before stabilizing beliefs at

the commitment stage (West, 2004). This model has been used to categorize the 13 thinking styles into three Types with each indicating greater complexity. Some empirical support for this conception has been found by Zhang (2004) who found significant correlations between dualism and the executive and conservative (Type II) thinking styles whereas students at the relativistic level of cognitive development reported significant correlations between a wider range of thinking styles from the Type I, II and III categories. Thus it was concluded that students at the early stage of cognitive development tended to employ a narrower range of thinking styles that are norm-favouring and require more simplistic information processing, whereas students at the next higher stage of cognitive development tended to employ a wider range of thinking styles.

In light of the influence of socialization on the development of thinking styles, socioeconomic factors may be expected to have some impact on thinking styles. Gender differences have been observed among students in Hong Kong, the US and mainland China with males tending to score higher on legislative, liberal and judicial thinking styles (Zhang, 2001; 2002a; 2002b). The early studies did not find any significant gender differences (Zhang & Sachs, 1997; Zhang, 1999; Zhang & Postiglione, 2001) but did however find a significant effect for age. Older students were found to be significantly more judicial, legislative, hierarchical and global while younger students were significantly more conservative in thinking style. These results support the view that thinking styles are affected by non-work factors, such as gender and age, as well as experiences at work.

Based on this rich theoretical and empirical background, the objectives of this study were to locate Malaysian students on the thinking styles platform. It was intended to discover which thinking styles were preferred by local students and whether they indicated a preference for complex or more simplistic thinking styles. The relationship between thinking styles and academic performance is also investigated as well as the influence of socioeconomic factors such as age, ethnicity, overseas exposure, work experience and size of hometown.

3.0 METHOD

This was an exploratory study to develop a reliable measure of thinking styles, to identify local students' profile of thinking styles and examine the influence of socioeconomic factors on the development of thinking styles. A cross-sectional design was employed.

3.1 Participants

The sample in this study consisted of 77 students enrolled in the faculty of arts and social sciences.

Student age ranged from 20 to 25 with a mean of 21.68. Female students (74%) outnumbered male students (26%). The majority of students were Malay (67.5%), followed by Chinese (15.6%), Indians (10.4%) and East Malaysian students (6.5%).

3.2 Measure

All participants responded to the Thinking Styles Inventory (TSI; Sternberg and Wagner, 1997). The short version of the TSI is a self-report test consisting of 65 statements with each set of five statements assessing one of the 13 thinking styles. Participants were required to rate themselves on a 7-point scale with 1 indicating that the statement does not characterize them at all and 7 indicating that the statement represents them extremely well. In the present study all five dimensions of mental self-government were measured. To adapt the inventory for local use, the TSI was translated and back translated to create a *Bahasa Malaysia* version, the language of instruction in Malaysia. Questionnaire items were presented in both *Bahasa Malaysia* and English.

4.0 RESULTS

The following section presents the results of reliability and validity testing of the TSI, the profile of thinking styles chosen by participants and factor analysis of the TSI before ending with an analysis of the impact of socioeconomic factors on thinking styles.

4.1 Scale reliability

Alpha reliability coefficients were very varied ranging from 0.19 to 0.82. The monarchic sub-scale showed the lowest alpha at 0.19, followed by the anarchic sub-scale with alpha at 0.33. The other sub-scales all yielded alphas 0.54 and higher. Examination of validity coefficients for each sub-scale showed that reliability could be further improved by the elimination of some items. Item 30 was removed from the monarchic sub-scale to improve reliability to 0.25. This is still a very low value, indicating that respondents have not been consistent in their responses. However, for the purpose of generating a complete thinking profile it was decided to use the modified sub-scale of four items in subsequent analysis. The removal of item 32 from the oligarchic sub-scale improved reliability from 0.54 to 0.58. Similarly removal of item 59 from the anarchic sub-scale improved reliability to 0.39. Impressive improvements in reliability were seen in the local and conservative sub-scale with the removal of items 63 and 13 which improved reliability from 0.56 to 0.72 and from 0.41 to 0.61 respectively. In the case of the executive sub-scale, item 28 showed low validity and was removed, however reliability remained at 0.82. A total of 6 items were removed from the original 65 item scale to improve reliability and validity. Subsequent

analyses were conducted using the modified sub-scales.

4.2 Profile of Thinking Styles

Based on mean scores, Figure 1 below indicates the profile of thinking style preferences within this sample of students.
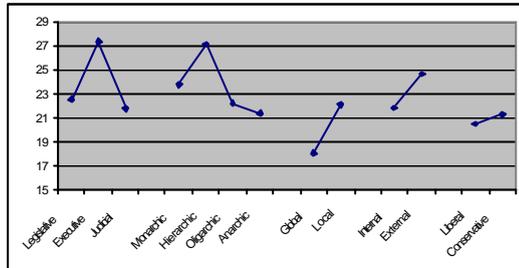

Figure 1: Profile of thinking styles

The highest scores were observed on the executive and hierarchic thinking scales while the lowest score was reported for the global thinking style. Overall the results indicate that these students have a preference for the executive, hierarchic, local, external and conservative thinking styles. The choice of thinking styles is very distinct on the first four dimensions of the TSI but less clear on the last dimension with the liberal (20.53) and conservative (21.29) means being almost similar.

4.3 Factor structure of the TSI

Sub-scales of the TSI were subjected to principal components factor analysis with varimax rotation. Factors with eigenvalues greater than 1 were retained. By this criterion, four factors were extracted that explained 72.18% of variance. The results are shown in Table 1 below. The judicial, monarchic and hierarchic thinking styles were the strongest cluster in Factor 1 with the executive and liberal thinking style showing lower loadings. Factor 2 showed high loadings for only the legislative and internal thinking styles. Factor 3 indicated a clustering of four thinking styles, namely the global, oligarchic, external and anarchic thinking styles in order of decreasing loading. Lastly, the conservative thinking style showed the highest loading on Factor 4 with lower loadings for the local and executive thinking styles. The executive sub-scale has shown high loadings on both Factors 1 and 4. Since the loadings are almost similar it was decided to retain this factor as a component of Factor 4. The presence of the executive thinking style makes intuitive sense in Factor 4, therefore though unusual, it was decided to include it as a component in both factors.

Table 1: Factor loadings of the TSI

Sub-scales	Factor 1	Factor 2	Factor 3	Factor 4
Legislative	0.43	**0.77**	0.23	0.12
Executive	**0.63**	0.19	0.12	**0.60**
Judicial	**0.76**	0.05	-0.06	0.12
Monarchic	**0.71**	0.03	-0.03	-0.09
Hierarchic	**0.70**	0.14	0.14	0.42
Oligarchic	-0.32	0.40	**0.66**	0.23
Anarchic	0.09	0.53	**0.56**	0.05
Global	0.05	-0.03	**0.84**	0.02
Local	0.53	0.28	-0.18	**0.62**
Internal	0.01	**0.89**	-0.10	0.06
External	0.56	-0.27	**0.63**	0.16
Liberal	**0.60**	0.36	0.35	-0.19
Conservative	-0.09	-0.03	0.18	**0.87**
% Variance	33.88	15.74	12.08	10.48
Cumulative variance	33.88	49.62	61.70	72.18
Eigenvalues	4.41	2.05	1.57	1.36

4.4 Socioeconomic factors and the TSI

Analyses were carried out to examine the relationship between thinking styles and age, gender, ethnicity and academic performance. To examine the impact of socialization, analyses were performed to examine the relationship between work experience, overseas travel, size of hometown and thinking styles.

No significant relationships were found between age, gender, academic performance (measured by GPA) and thinking styles. Some ethnic differences were found on the legislative ($F_{3,73}$=3.19, p<.05), oligarchic ($F_{3,73}$=4.61, p<.0), and anarchic ($F_{3,73}$=8.74, p<.001) sub-scales. On the legislative sub-scale, significant differences were observed between the Chinese and Indian participants with the latter having a mean score of 28.78 compared to 22.54 for the Chinese participants. No significant differences were observed involving Malay participants. The pattern of results was different on the oligarchic sub-scale where significant differences were observed in Tukey's post-hoc analysis between all three ethnic groups. For this thinking style Indian participants reported the highest score with a mean of 21.78, followed by a mean of 17.26 for Malay participants and finally a mean of 16.62 for Chinese participants. Similarly significant differences were observed between all three ethnic groups on the anarchic sub-scale. Indian participants scored the highest with a mean of 20.89, followed by Malay participants with a mean of 17.20 and finally the Chinese participants with a mean of 12.85.

In examining the probable impact of social factors on thinking styles, no significant difference was found in the analysis of the relationship between experience of overseas travel and thinking styles. Only 14 (18.2%) of the participants had experienced travel overseas. Of these most had traveled to neighbouring countries in

the Asean regions with only one student having experience of traveling further. Similarly no significant difference was observed between students who had work experience and those who did not have work experience. 21 students (27.3%) indicated that they had experience working in part-time jobs and 56 (72.7%) had no previous work experience. Significant differences were found in the analysis of the relationship between size of hometown and the global thinking style ($F_{2,74}$=3.78, p<.03). Post-hoc analysis indicated that participants who had grown up in cities were most global with a mean of 22.13, followed by those who had lived in medium-sized towns before entering universities who reported a mean of 17.89. Students who had grown up in small towns indicated almost similar scores with a mean of 17.00 on the global sub-scale.

Thus the results overall have indicated some interesting trends. First is the distinct preference indicated by students for the executive, hierarchic, local and external thinking styles. The preference was less divergent between the liberal and conservative thinking styles. The second finding was the four factor solution from factor analysis of the 13 sub-scales of the TSI. Factor 1 contained the judicial, monarchic, hierarchic, executive and liberal thinking styles. Factor 2 contained the legislative and internal thinking styles. Factor 3 consisted of four thinking styles, namely the global, oligarchic, external and anarchic thinking styles. Finally Factor 4 showed high loadings on the conservative and local thinking styles. Finally analyses of the relationship between socioeconomic factors and thinking styles showed significant results only for ethnicity and size of hometown.

5. DISCUSSION

The first objective of this study was to determine the profile of thinking styles preferred by Malaysian students. The results showed that this group of students has indicated a preference for the executive, hierarchic, local and external thinking styles. This choice indicates a tendency to be drawn towards knowledge with practical value, to prioritize work, give attention to detail and being comfortable working in groups. That these are the qualities demonstrated by students is not surprising as pragmatic concern about future employment is a major preoccupation of undergraduates; often to the extent of influencing their choice of major subjects. While having practical merit, this profile lacks the qualities associated with knowledge workers such as creativity and innovation.

The second objective was to determine whether the students tended to use more complex cognitive processing styles or retained the simplistic thinking styles of lower school. The results of the factor analysis of sub-scales indicated mixed results. The loadings on Factor 1 contained a mixture of both complex cognitive

processing styles (judicial, hierarchic and liberal thinking styles) and the less complex (monarchic and executive) thinking styles. This combination could be interpreted as reflecting students who are grappling with both acquiring and evaluating knowledge. The assessment demands at university level require students to both accurately understand knowledge as well as to present some attempt at evaluation and critique of the material, particularly in the field of social sciences. Thus the thinking styles in Factor 1 could be an indication that the majority of the students are in fact trying to do both.

The second factor of the four factor solution is encouraging in that it contains the legislative and internal thinking styles indicating a preference for challenging and creative tasks as well as the ability to work independently. By occurring as the second factor it suggests that there is lesser use of these thinking styles, however their presence is a heartening sign that university students do attempt some critical evaluation of knowledge. This is an appropriate start to promote the development of knowledge workers prior to these students leaving education and entering the workforce.

The combination of thinking styles observed in the third factor indicates a clear inclination for dealing with broad issues. This factor containing the global, oligarchic, external and anarchic thinking styles indicates the tendency to view information from a wider perspective, the propensity to work in less systematic ways and an inclination towards working in groups. Viewed optimistically this combination is perhaps a foundation for encouraging thinking out of the box. While it is too large a leap from here to creativity and innovation, at the very least it is encouraging that there is some tendency among students against rule following which could lead to unconventional perspectives and perhaps discovery of new knowledge.

The final factor indicates a preference for maintaining the status quo (conservative thinking style) and tendency to pay attention to details (local thinking style). It is a positive indication that this factor emerges last and does not represent a very significant trend among students. Overall the factors emerging through factor analysis of sub-scales of thinking styles present an encouraging view of universities' ability to develop knowledge workers. While there is a strong presence of the less complex information processing thinking styles, it is very encouraging that the higher order thinking styles such as the legislative, judicial, hierarchic and internal thinking styles are also present. This indicates that university students do possess the potential to become knowledge workers even as they enter the workforce as new employees. The challenge ahead for educational institutions is to increase the number of graduates able to do so.

The final set of analyses examined the influence of socioeconomic factors on thinking styles. Based on the conception that thinking styles are developed, it was expected that social environmental characteristics would have some impact on thinking styles. The results of this study provided only partial support for this contention through significant differences on ethnicity and size of hometown. All other analyses were non-significant. The finding that thinking style is more global in cities as compared to small towns is understandable in terms of exposure and access to information. The variety of information and activities in big cities would naturally develop awareness of alternative views and accordingly encourage a tendency towards using a broader perspective. The results of ethnic differences are less easily understood without further information on the social environment of participants.

The results of this study although showing some significant patterns should be interpreted with some caution because some weaknesses inherent in research design. The sample used in this study is both small and specialized in that it only represents the field of social sciences. Based on earlier findings that thinking styles vary with discipline, it is strongly recommended that future research uses more varied samples. For example it would be interesting to compare the thinking styles of both science and arts students. Is it possible that creativity and innovation would be expressed through different combination of thinking styles among students from various disciplines? Future studies should also use much larger sample sizes especially when conducting factor analysis. Would it be possible to replicate the four factor solution in other samples? There is also a need to determine the profile of thinking styles prevailing among the workforce. As yet no studies have been undertaken locally that study the thinking styles of employees. Past studies have shown that thinking styles differ with tasks, that is different task demands require different combinations of thinking styles. Therefore there is an urgent need to discover the type of thinking styles required in common entry level jobs for fresh graduates and also to match employee thinking styles with job demands before placement in a particular job.

Keeping in the mind the limitations of this study, these initial results do have implications for developing knowledge workers. Firstly there is an urgent need to review methods of instruction and assessment within universities to encourage the development of more complex thinking styles among a greater proportion of undergraduates. Students should be encouraged to critically review material taught, to carry out project work that allows them to brainstorm and develop creative and innovative solutions and be encouraged to work both independently and in groups.

The second implication is the need for education and industry to work together. Universities could collaborate with industry on experimental projects that allow opportunities for developing new solutions. The results indicate that our students have a practical disposition. Cooperation between universities and education could encourage both practical and creative tendencies by allowing students to problem solve real issues and dilemmas currently experienced within industry. This two-way interaction could result in producing new employees with both practical and creative thinking skills who are already familiar with industry issues and are ready and confident of their ability to contribute solutions.

Implementation of the second recommendation also has beneficial implications for on-the-job training. In most industries, especially the manufacturing sector, production demands often do not allow much time for training. Thus industry would prefer that graduates are equipped with basic, generic skills in addition to some specific skills that would lessen the need for training when they enter the workforce. Having prior exposure to task characteristics allows undergraduates to prepare themselves prior to entry into the workforce. Companies could then focus on specific skills training which would mean cost savings and also greater competitiveness. An added benefit of developing higher order more complex thinking styles is that individuals equipped with the legislative, judicial, hierarchic, internal and liberal thinking styles would be more effective learners. Thus they could improve themselves by both formal on-the-job training and also by independently applying inferential and deductive thinking approaches. Thus by developing the appropriate thinking styles, individuals possess the foundation to become life-long learners, which is one of the key qualities of a knowledge worker.

6. CONCLUSION

The objectives of this study were to profile thinking styles among undergraduates in order to discover if they mainly tended to use higher order or more simplistic information processing styles and to examine the impact of socioeconomic factors on thinking styles. The results indicate a prevailing tendency to use more straightforward thinking styles such as the executive, local and conservative thinking styles. Although factor analysis did indicate the presence of some higher order information processing, this appears to be limited to a small number of students. The impact of socialization received only partial support through differences observed on ethnicity and size of hometown, which is not surprising as the sample was small, specialized and relatively homogenous on social and demographic characteristics. While keeping in mind the limits on generalizability, the results do have important implications for both educators and industry, with the latter being the eventual employer and beneficiary of

knowledge workers. Foremost is the need to foster the development of more complex cognitive processing abilities through the use of more varied and challenging modes of instruction and assessment. The second implication is the need to form smart partnerships between education and industry so as to encourage the development of both practical and innovative thinking styles. Such initiatives would give a head start to improving productivity and competitiveness. Overall the results of this study show that local university students have the potential to develop as knowledge workers. The challenge facing us is in implementation, such that knowledge workers can be developed quickly and efficiently to meet the objectives of the nation to develop the K-economy.

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