A Structural Model of Personality Factors, Learning Approaches, Thinking Styles and Academic Achievement

KADIVAR, PARVIN & SHOKRI, OMID
Department of Psychology
Tarbiat Moallem University
NO 49, Mofateh Ave, Tehran
IRAN

Abstract: In This Research a short form of the Big Five personality factors Inventory, Study Process Questionnaire, and Thinking Styles Inventory were conducted on a sample of 419 subjects (214 and 205 males and females respectively). Measures of academic achievement were also obtained. Using the path analysis, the direct and indirect effects of personality traits on learning approaches (deep and surface approaches), thinking styles (thinking styles have five dimensions – Functions, Forms, Levels, Scopes, and Leanings) and academic achievement were tested. The obtained results indicated that openness and conscientiousness have a significant positive effect on deep learning approach, while openness and conscientiousness have significant negative effect and neuroticism has a significant positive effect on surface learning approach. The results also showed that openness, neuroticism, conscientiousness, and extraversion respectively have significant positive effect on judicial, global, and liberal thinking styles; on executive, local, and conservative thinking styles; on legislative and hierarchical thinking styles; and on global, liberal, hierarchical and external thinking styles (with the exception of openness that has a significant negative effect on conservative thinking styles).

Key-Words: Structural Model, Personality Factors, Learning Approach, Thinking Style, Academic Achievement.

1 Introduction

The role of thinking styles in the academic achievements have been examined in different cultures such as Hong Kong china, Philippine, Spain, and the United States. Zhang (2002) indicated that conservative thinking style and global and liberal thinking styles are negative predictor for students' academic achievement. The results of Zhang (2001, 2002) indicated that conservative and hierarchical thinking styles have a positive correlation and creativity generating styles such as judicial and legislative thinking styles have negative correlation with academic achievement. Bernardo et al. (2002) concluded that conformity based thinking styles and respect to authorities is positively related with academic achievement. There was also a positive correlation between judicial thinking style and academic achievement. Cano-Garcia and Hallgesh (2000) indicated that students with internal and executive thinking styles have a better academic achievement.

The idea of relation between the people preferred method in learning with personality factors is not new. For example Messick (1984) as cited by Duff et al. (2003) pointed out that the personality factors determine the formation of learning approach or people preferred method in processing information. Some of other researchers pointed that learning styles or approaches is a sub set of personality (such as Sternberg) or learnt components of personality (Furnham A., Jackson, C.J & Miller T 1999).

Zhang (2003) conducted a research to answer this question that whether the Big Five personality factors could predict learning approaches. The results of this research indicated that factors such as openness and conscientiousness are strong predictors and can explain student's differences in using learning approaches than other factors. On these bases, conscientiousness and neuroticism could be considered as good predictors for deep and surface approaches, respectively. Duff et al. (2003) reported that: structural equation modeling identifies the Big Five personality factor scores account for between 22.7% and 43.6% of the variance across scores on the three approaches to learning dimensions. A linear regression analysis with academic achievement as the dependent variable and prior educational attainment and conscientiousness as independent variables, accounted for 24.1% of the variance in academic achievement.
In order to predict the probability of available relationships between the research variables and academic achievement in this study first a model was selected on the basis of literature review, research background, and research findings; second, after assessing the relationships between the research variables in framework of a casual model, the significance of each variable were assessed and the coefficients were estimated, and finally our proposed model was fitted to the data. The baseline model that we were trying to fit it to our data is provided at the following figure.

![Fig.1: The baseline model to be fitted](image)

The present research was guided by the following hypotheses: Personality factors including openness, conscientiousness, and extraversion; deep learning approach; and thinking styles including judicial, legislative, global, hierarchical, and liberal have a direct as well as positive effect on academic achievement. And personality factors including neuroticism; surface learning approach; and thinking styles including executive, local, and conservative have a direct and negative effect on academic achievement.

Personality factors including openness, conscientiousness, and extraversion through deep learning approach and thinking styles including judicial, legislative, global, hierarchical, and liberal have indirect as well as positive effect on academic achievement. And personality factors including neuroticism through surface learning approach and thinking styles including executive, local, and conservative have a direct as well as negative effect on academic achievement.

2 Methodology
2.1 Participants
Subjects consisted of 419 students (214 and 205 male and female respectively) at the Tarbiat- Moallem University in Tehran that were selected based on multi-stage cluster sampling.

2.2 Instruments

The Big Five Inventory (BFI): To measure the Big Five personality dimensions, we used the BFI or the big five personality factors inventory: A short form of the Big Five personality factors questionnaire is a paper- pen scale that has 44 items and has been designed by Sanjay Srivastava and Oliver P. John in 1991. BFI items are rated on a 5-point scale ranging from 1= disagree strongly to 5= agree strongly. The 44 BFI items consist of short and easy-to-understand phrases to assess the prototypical traits defining each of the Big Five dimensions. In the present research the coefficient alpha reliabilities of the five scales were computed and reported as follows: 0.83 for Conscientiousness; 0.55 for Agreeableness; 0.79 for Neuroticism; 0.79 for Openness; and 0.64 for Extraversion.

A. The Biggs’ Study Process Questionnaire (SPQ) was developed by Biggs (1987) as a 42-item self-report inventory designed to evaluate students’ approaches to learning (SAL) in the higher education context. The SPQ conceptualizes SAL in terms an equal composite of a motivation and strategy sub-scale in three broad learning approach scales (deep, surface and achieving approach). The original SPQ consists of 42 items grouped into 6 subscales, these being: surface motivation (SM), surface strategy (SS), deep motivation (DM), deep strategy (DS), achieving motivation (AM) and achieving strategy (AS). Students are asked to respond to each item by indicating how true the statement is of them using a 5-point Likert scale, from 1= “this item is never or only rarely true for me” to 5= “this item is always or almost always true for me”. Biggs et al. (2001) recognised the need for a two-factor version of the SPQ and developed a revised and shortened version of the instrument: a two-factor model of a deep approach and a surface approach. This version was evaluated with 495 undergraduate students through the use of confirmatory factor analysis using AMOS. The internal consistency of the sub-scales as measured by the use of Cronbach alpha are quite acceptable (values of α = 0.79 for deep approach and α = 0.77 for surface approach). The two models having the best fit to the data are represented by the original six sub-scale model which loads onto two higher order factors, a deep approach and a surface approach to learning, or a seven sub-scale version which loads on the same two higher order factors.

B. Thinking Styles Inventory: Thinking Styles Inventory (TSI) is a self-report inventory. The whole inventory is designed for measuring 13 types of thinking styles, consisting of 65 items (statements). Each item belongs to one thinking style and 5 items assess one style. The participants rate themselves on a 7-point Likert scale. In the present study, the Cronbach’s alpha coefficients were used to estimate the reliabilities of the 15 styles. The alpha coefficients were respectively for the legislative style= 0.74, executive style= 0.68, judicial style= 0.71, global style= 0.71, local style= 0.58, liberal style= 0.85, conservative style= 0.82, hierarchical style= 0.75, monarchic style= 0.80, oligarchic style= 0.81,
anarchic style = 0.53, internal style = 0.71, and external thinking style = 0.82.

An inventory was used to gather data on students’ academic achievement such as grade point average. When the participants were filling the above inventories they were asked to write down their ID number and academic division code which are usually displayed on the student ID card in the above section of each inventory. Data on academic achievement were gathered based on the ID number and academic division code from the registrar’s office of their respective faculties.

3 Procedure

After conducting the designed scales, and gathering the required data, the raw data were entered into a computer file. Then the baseline model which had already been depicted and other models were fitted to the data.

The research design we used in our study leads us to call it as a co relational study which is an example of descriptive research. Here to investigate the role of personality factors, learning approaches, and thinking styles in the academic achievement we used the path analysis method. There were a lot of questions to answer in the questionnaires, so data had to be collected carefully. If values were missing, we couldn't get adequate information of the variables.

4 Results

The results of statistical analysis are provided at the below table. The information of this table indicates that from among the personality factors (exogenous variable) factors such as openness, neuroticism, conscientiousness, and extraversion; and from among thinking styles (independent endogenous variable) dimensions such as legislative, liberal, conservative, hierarchical, and external thinking styles; and deep and surface learning approaches (independent endogenous variable) are positively and significantly correlated with academic achievement (dependent endogenous variable).

Further more, from among thinking styles variables (independent endogenous variable) legislative, judicial, global, liberal, conservative, hierarchical, internal, and external thinking styles are positively and significantly correlated with neuroticism; legislative, executive, global, local, liberal, hierarchical, and external thinking styles are positively and significantly correlated with openness; legislative, executive, global, local, liberal, hierarchical, and external thinking styles are positively and significantly correlated with conscientiousness; legislative, global, internal, and external thinking styles are positively and significantly correlated with agreeableness; legislative, judicial, global, liberal, conservative, hierarchical, monarch, and external thinking styles are positively and significantly correlated with extraversion; legislative, executive, judicial, local, conservative, and hierarchical thinking styles are positively and significantly correlated with surface learning approach (independent endogenous); And legislative, executive, judicial, global, liberal, conservative, and hierarchical thinking styles are positively and significantly correlated with deep learning approach (independent endogenous).

Using the path analysis, the hypotheses of this research namely the predicative role and the direct and indirect effects of (1) personality traits; (2) learning approaches (deep and surface), and (3) thinking styles (function, form, level, scope, and learning dimensions) on academic achievement were tested.

Model I

The effects of exogenous variables (personality factors) and independent endogenous variables (deep and surface learning approaches, and function dimension of thinking styles) on dependent exogenous variable (academic achievement) indicated that the model account for 55% of the variance in academic achievement. From among the
exogenous variables just factors such as agreeableness, neuroticism, conscientiousness, and extroversion had a significant effect on academic achievement. Their regression coefficients (beta) were +0.16, -0.14, +0.12, and +0.11 respectively. The regression coefficients of research's exogenous variables including openness and conscientiousness with deep learning approach respectively were equal to +0.36, and +0.20; and the regression coefficients of openness, neuroticism, and conscientiousness with surface learning approach respectively were equal to -0.22, -0.21, and -0.29. Thus it can be concluded that they have a significant effect on learning approaches (figure 2).

Also, the regression coefficients of openness, neuroticism, and conscientiousness with judicial, executive, and legislative thinking styles were equal to +0.15, +0.11, and +0.12 respectively; therefore they have a significant effect on these styles.

The regression coefficients of research independent endogenous variables including deep and surface approaches with judicial, executive, and legislative thinking styles (the dimension of functions) were equal to +0.15, -0.13, and +0.11 respectively; therefore they have a significant effect on the dimension of functions. The regression coefficients of judicial, executive, and legislative thinking styles (the dimension of functions) with academic achievement were equal to +0.30, -0.21, and +0.24; therefore the dimension of functions has a significant effect on academic achievement.

The exogenous variables' total effect on the target variable was significant. The total effect of endogenous variables including deep and surface intermediary variables, and judicial, executive, and legislative thinking styles on academic achievement were equal to +0.19, -0.16, and +0.15 respectively learning approaches by the intermediation of judicial, executive, and legislative thinking styles on academic achievement were equal to +0.27, and -0.23 respectively. Comparing the direct and total effects of the research variables identifies the important role of the research intermediary variables (learning approaches and thinking styles) in explaining the academic achievement.

A number of indicators of goodness-of-fit have been recommended to test a hypothesized model including Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), and Chi-Square statistic and its associated degrees of freedom (df). Here we used 4 indices for evaluation of model fit and the results (GFI= 0.97), (AGFI=0.95), (RMSE= 0.95), and (Chi-Square=8.45, df=3) indicated that the model provides a good fit to the data.

Also, the regression coefficients of openness, neuroticism, and conscientiousness with judicial, executive, and legislative thinking styles were equal to +0.15, +0.11, and +0.12 respectively; therefore they have a significant effect on learning approaches (figure 2).
The endogenous independent variables (deep and surface approaches) had a significant effect on global and local thinking styles (levels dimension). Their regression coefficients (beta) were +0.11, and -0.09 respectively. Global thinking style (levels dimension) had a significant effect on academic achievement but local thinking style had not a significant effect. Their regression coefficients (beta) were +0.06, and -0.04 respectively.

The exogenous variables' total effect on the target variable was significant. The total effect of exogenous variables including openness, neuroticism, conscientiousness, and extroversion by the intermediation of deep and surface learning approaches (as intermediary variables), and global and local thinking styles on academic achievement were equal to +0.19, -0.17, +0.15 and +0.12 respectively.

The endogenous independent variables' total effect on the target variable was significant. The total effect of endogenous variables including deep and surface learning approaches by the intermediation of global and local thinking styles on academic achievement were equal to +0.26, and -0.22 respectively. Comparing the direct and total effects of the research variables identifies the important role of the research intermediary variables (learning approaches and thinking styles) in explaining the academic achievement.

The indicators of goodness-of-fit (GFI= 0.96), (AGFI=0.94), (RMSE= 0.05), and (Chi-Square=12, df=5) indicated that the model provides a good fit to the data.

Model III

The effects of exogenous variables (personality factors) and independent endogenous variables (deep and surface learning approaches, and forms dimension of thinking styles) on dependent exogenous variable (academic achievement) indicated that the model account for 15% of the variance in academic achievement. Extroversion had a significant effect on hierarchical thinking style (forms dimension). Their regression coefficient (beta) was equal to +0.14. Interestingly, other styles which were present in the forms dimension including monarchic style, oligarchic style, and anarchic style were deleted from the model because the direct effect of exogenous variables (personality factors) and learning approaches on them was not significant as well as they had no direct effect on academic achievement.

The endogenous independent variables (deep and surface approaches) had a significant effect on hierarchical thinking styles (forms dimension). Their regression coefficients (beta) were +0.14, and -0.10 respectively. Hierarchical thinking style (forms dimension) had a significant effect on academic achievement and its regression coefficient (beta) was equal to +0.16.

The exogenous variables' total effect on the target variable was significant. The total effect of exogenous variables including openness, neuroticism, conscientiousness, and extroversion by the intermediation of deep and surface learning approaches (as intermediary variables), and hierarchical thinking styles on academic achievement were equal to +0.19, -0.16, +0.15 and +0.13 respectively.

The endogenous independent variables' total effect on the target variable was significant. The total effect of endogenous variables including deep and surface learning approaches by the intermediation of hierarchical thinking styles on academic achievement were equal to +0.27, and -0.22 respectively. Comparing the direct and total effects of the research variables identifies the important role of the research intermediary variables (learning approaches and thinking styles) in explaining the academic achievement.

The indicators of goodness-of-fit (GFI= 0.98), (AGFI=0.95), (RMSE= 0.04), and (Chi-Square=10, df=6) indicated that the model provides a good fit to the data.
Model IV

The effects of exogenous variables (personality factors) and independent endogenous variables (deep and surface learning approaches, and scopes dimension of thinking styles) on dependent exogenous variable (academic achievement) indicated that the model account for 22% of the variance in academic achievement. Openness and extroversion had a significant effect on liberal thinking style (scopes dimension). Their regression coefficients (beta) were equal to +0.16, and +0.13 respectively. Openness and neuroticism had a significant effect on conservative thinking style. Their regression coefficients (beta) were equal to -0.12, and +0.18 respectively.

The endogenous independent variables (deep and surface approaches) had a significant effect on liberal and conservative thinking styles. Their regression coefficients (beta) were +0.14, and -0.12 (deep approach); and +0.11, and +0.10 (surface approach) respectively. Liberal and conservative thinking styles (scopes dimension) had a significant effect on academic achievement and their regression coefficients (beta) were equal to +0.18, and -0.14.

The exogenous variables' total effect on the target variable was significant. The total effect of exogenous variables including openness, neuroticism, conscientiousness, and extroversion by the intermediation of deep and surface learning approaches (as intermediary variables), and liberal and thinking styles on academic achievement were equal to +0.20, -0.16, +0.14 and +0.13 respectively.

The indicators of goodness-of-fit (GFI= 0.99), (AGFI=0.94), (RMSE= 0.03), and (Chi-Square=8, df=4) indicated that the model provides a good fit to the data.

5 Discussion and implications

Considerable amount of research have examined the relationships between learning approaches and academic achievement (Biggs, 1998; Watkings and Hotty, 1981, as cited by Zhang 2003; Sadler-Smith & Tsang, 1998). From the Pintrich et al. points of view (1993) deep processing strategies are thought to lead to greater academic success than surface processing strategies. Our research found that learning approaches in the model which has been provided to explain the academic achievement play different intermediary roles. In other word, our results indicated that deep learning approach play an intermediary role while surface learning approach play an inhibitory role in studying the relationships between personality factors and academic achievement. Our results also showed that if we control the effect of personality factor the learning approaches may predict the academic achievement independently.

Research results indicated that neuroticism has a negative significant effect on academic achievement. Zhang (2003) emphasized that students with high emotional instability and low self-esteem (high neuroticism) avoid making
mistakes. Thus they feel more comfort with those tasks that require reproduction of learned materials. These findings are in line with the results of the research that have been conducted by Ruff et al. (2004), Masgeriuo et al. (1997r), Takomoto-Chack (1981 as cited by Diseth, 2003), McCrae (1978 as cited by Diseth, 2003), Blickle, (1996), (Schouwenburg & Kossowska, 1999), and Blickle (1996).

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The results also showed that openness has significant positive correlation to judicial, global, and liberal thinking styles; and has significant negative correlation to executive and conservative thinking styles. As mentioned above, persons with high score in openness are imaginative and creative (legislative). These persons tend to do tasks in different ways and don't like to follow affairs in conventional ways (liberal). One of the implied meanings for openness emphasizes that these persons are more willing to interact with other people (external). Also, these people criticize different ideas using differentiation and discrimination ability (judicial).

Finally, conscientiousness is related to a range of thinking styles especially hierarchical thinking style. As discussed before, conscientiousness is characterized by being purposeful, responsible, and to have a strong will. The conscientious persons strive hard to achieve their goals. They may act creatively (legislative) or analysis and process different ideas using differentiation and discrimination ability (judicial).

Conclusion

The results regarding the positive relationships between academic achievement and hierarchical, judicial, legislative, and liberal thinking styles are correlated positively; and executive and conservative thinking styles are correlated negatively with the students' academic achievement. The results of present research regarding the positive relationships between academic achievement and hierarchical, judicial, legislative, and liberal thinking styles are broadly in line with the results of research conducted by Sternberg and Grigorenko (1993, 1997) on the one hand; and its results regarding the negative effect of executive and conservative thinking styles are contradictory with the results of research conducted by Zhang (2001a, 2001b, 2002), Zhang and Sternberg's (1998), Bernard et al. (2002), and Cano-Garcia and Hallgess (2000).

The results of the present research regarding the effect of thinking styles on academic achievement point out that the thinking styles that are creativity generating and require higher levels of cognitive are of utmost importance in education field. As it was cited before Zhang (2001) divided thinking styles into two types. People who employed the Type I thinking styles (legislative, judicial, global, hierarchical, and liberal styles) tended to be norm-challenging and risk-taking and they were creativity
generating and required complex information processing. People preferred Type 2 thinking styles (executive, local, and conservative styles) required simplistic information processing, they tended to be norm-favoring and authority-oriented. Now, this question needs to be posed that why Type 2 or creativity generating thinking styles can be regarded as the facilitator of students' academic achievement. The answer is that because the study of effect of thinking styles on academic achievement put emphasis on the role of non academic variables on academic achievement. Thus, different studies using the theory of mental self-government indicate the determinant and predictive part that thinking styles could play in academic achievement. Sternberg (1988, 1997 as cited by Zhang 2004) proposed a comprehensive theory of mental self-government which explained the profile of style of an individual using a structure of a government. Thinking styles are somehow social in nature. Success in different subject matters may require different thinking styles thus 'different styles are suitable and effective for various tasks (Sternberg, 1997)'. Studying different subject matters indicate, unexpectedly, that students may have special talents for using specific thinking styles.

Another question need to be asked is that whether we can claim, by the back up of empirical findings and theoretical arguments, that the assessment of thinking styles is fruitless or not. To answer this question we should control the effects of personality factors and then study the direct effect of thinking styles on academic achievement and or study the indirect effect of personality factors on academic achievement. The results of present research indicated that the indirect effect of personality factors on academic achievement by the intermediation of thinking styles is great in comparison to the direct effect of personality factors on academic achievement. Thus, despite the fact that Zhang (2001, 2002) emphasized on an interface between the personality factors and thinking styles, there is no logical reasons that lead us to ignore the role of thinking styles in the study of academic achievement in parallel with personality factors.

The results of present research regarding the effect of learning approaches on thinking styles are in line with the results gained by Zhang (2000) and Zhang and Sternberg (2000). In fact it can be noted that the persons' approach to learning determines how their abilities will be employed both in terms of quality and quantity. Accordingly, learners with deep approach tend to use creativity- generating and complex thinking styles while learners with surface approach tend to use simplistic and norm-favoring thinking styles.

The indirect effect of openness and conscientiousness on academic achievement through deep learning approach was significant and positive, while the indirect effect of openness and conscientiousness on academic achievement through surface learning approach was significant and negative and the indirect effect of neuroticism on academic achievement through surface learning approach was significant and positive. Also, the indirect effect of openness through judicial thinking style, neuroticism through executive thinking style, conscientiousness through legislative thinking style, openness and extraversion through global and liberal thinking styles, neuroticism and openness through conservative thinking style, and extraversion through external thinking style on academic achievement was significant. The total indirect effect of openness, conscientiousness, neuroticism, and extraversion by intermediation of learning approaches and thinking styles dimensions on academic achievement was significant. In sum, the results of present research regarding the indirect effect and total effect of independent exogenous variables on dependent endogenous variable (academic achievement) emphasises on the intermediary role of learning approaches and thinking styles variables. Considering the practical implications of the present research are of utmost importance.

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