Connections between Modes of Thinking and Learning Approaches: Implications for Education and Research

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Abstract

This study aimed to examine connections between modes of thinking and approaches to learning. Participants were 1490 students attending to 9 high schools located in Ankara. The Style of Learning and Thinking-Youth Form and Revised Version of Learning Process Questionnaire were administered to these students. The connections between modes of thinking and approaches to learning were examined by path analysis. Results of the path analysis revealed that holistic and integrative thinking modes positively contributed to the deep strategy while the integrative thinking mode positively contributed to the deep motive and the surface strategy. These findings are consistent with the theoretical model. However, inconsistent with the theoretical model, the analytic thinking mode negatively contributed to the surface approach and the holistic thinking mode negatively contributed to the deep approach to learning. How educators could benefit from these findings to enhance the quality of learning outcomes is discussed.

Keywords: modes of thinking, approaches to learning, intellectual styles, 3P-model of learning

1. Introduction

Recently in educational sciences, researchers have mainly focused on the nature and the quality of learning and teaching and they have investigated the factors that affect the quality of learning and teaching. The factors pertaining to teachers/instructors, students, instructional methods, curriculum and learning environments interactively affect the learning and teaching processes. In terms of the students, individual differences in students' attributions are especially essential in learning process. One of these attributions is the "intellectual style". An "intellectual style" refers to individual's preferred ways of processing information, of dealing with tasks and of using their abilities (Biggs, 1987; Zhang & Sternberg, 2005). In the literature, there are some integrated models pertaining to the intellectual styles. One of them is "Threefold Model of Intellectual Styles" which has been proposed by Zhang and Sternberg (2005). In this model, style constructs have been classified into three types.

Type I intellectual styles indicate preferences for ill-structured tasks that require people to process information in a more complex way. Some examples of these styles are; intuitive and perceiving personality types, the concrete-random mind style, the deep approach to learning, the holistic mode of thinking. Type II intellectual styles indicate preferences for well-structured tasks that allow people to process information in a more simplistic way. Some of these intellectual styles are; the sensing and judging personality type, the concrete-sequential mind style, the surface approach to learning and the analytic mode of thinking (Zhang & Sternberg, 2005). Type III intellectual styles indicate preferences for both tasks that require higher levels of cognitive complexity and the tasks that require conformity to norms and lower levels of cognitive complexity. Some of these intellectual styles are; the introverted and extraverted personality types, the abstract random and abstract sequential mind styles and the integrative mode of thinking. It is stated that individual styles within a given type would be positively related to each other, but the styles in Type I group would be negatively related to styles in the Type II group and individual styles in Type III group would be moderately positively related to styles both in Type I and Type II groups (Zhang & Sternberg, 2005).

For the last two decades, the relationships between these intellectual styles and academic achievement, factors related to students (Zhang, 2002a, 2002b), teaching approaches (Zhang, 2001) and learning environments (Dart et al., 1999) have been investigated. Results of these studies have revealed the importance of the intellectual styles in terms of students' academic achievement. In addition, it is stated that rather than academic abilities, the

non-academic factors, such as modes of thinking, cognitive styles and approaches to learning are related to academic achievement. In another terms, the intellectual styles can explain the individual performance which is related to preferences of people in using their abilities. Students with the same abilities may use their abilities differently and according to this, their academic achievement may differ (Zhang, 2002a).

In terms of the relationships between intellectual styles included in "Threefold Model of Intellectual Styles", the relationships between modes of thinking and academic performance/academic achievement (Zhang 2002a, Zhang, 2007), between modes of thinking and thinking styles (Zhang, 2002a; Zhang, 2002b; Zhang, 2007), between modes of thinking and career interest types (Zhang & Fan, 2007) were investigated. Although this model suggests a relationship between modes of thinking and approaches to learning, no research directly investigating the relationship between these two intellectual style constructs could be found. Zhang (2002a) suggested to the teachers to take into account the modes of thinking of students when designing their instructional models. Likewise Biggs, Kember and Leung (2001) well explained that how teaching context including teaching and assessment methods and students' approaches to learning interactively affect the learning outcomes. These expressions indicate that teachers should consider together both students' modes of thinking and approaches to learning in teaching process. In this context, examining how the "modes of thinking" and "approaches to learning" are connected may provide a better picture of students' learning and (may) help teachers to select teaching strategies and to design educational activities in order to attain high-quality learning outcomes. Therefore in this current study it was aimed to investigate potential connection between modes of thinking and approaches to learning.

1.1 Modes of Thinking

The origin of the concept of modes of thinking is founded on the Torrance's (1981) concept of "hemispheric style" or "hemispheric thinking style" (Zhang, 2002a). Recently Zhang (2002a) considered these concepts in terms of the information processing and suggested using "modes of thinking" instead of these terms. Zhang (2002a) specified three modes of thinking: Analytic thinking mode, holistic thinking mode and integrative thinking mode. Individuals with an analytic mode of thinking tend to process information in a piecemeal, analytical and sequential way. These people are generally capable of performing tasks that require analyzing, planning and organization. Individuals with a holistic mode of thinking have a tendency to process information in an intuitive, gestalt-type and synthesized way. Students who are used to employing the holistic mode of thinking are more comfortable with complex and ambiguous tasks and problems. A tendency to process information in an interactive and dynamic way is called as integrative mode of thinking. Although everyone has a dominant mode of thinking, one could use primarily analytic or holistic mode of thinking depending on the specific task being tackled (Zhang, 2002a; Zhang, 2002b).

The importance of modes of thinking in learning and teaching process is explicated in the literature. Vengopal and Mridula (2007) pointed out that students' learning differences were not just related to understanding and thinking abilities of students. They state that an important source of these differences is their "styles of learning and thinking" named here as "modes of thinking". De Boer and Bothma (2003) stated that there was a distribution of modes of thinking in the classrooms. Considering students' modes of thinking when designing educational activities could help students develop their full potential to improve academic achievement. Therefore, it was suggested that teaching activities should be constructed to accommodate students' modes of thinking (De Boer & Bothma, 2003).

In addition to theoretical explanations, the empirical findings also demonstrate the importance of the modes of thinking in educational settings. The results of the studies in this field showed that the modes of thinking significantly predicted academic achievement/academic performance (Zhang, 2002a; Zhang, 2007). The results of another study indicated the role of the modes of thinking in making career choices (Zhang & Fan, 2007). In all of these studies, students' modes of thinking were measured by The Style of Learning and Thinking (SOLAT). Zhang (2002a) stated that the results of SOLAT had important implications for curriculum development, teaching strategies and assessment formats. Therefore, in the current study, this instrument was used to assess students' modes of thinking.

1.2 Biggs's Theory of Approaches to Learning

In this study, students' approaches to learning" was investigated within the framework of Biggs' 3P Model of Learning. "3P Model of Learning" provides a useful framework for understanding the ways in which learning occurs. This model distinguishes three sets of factors that are important in school learning: Presage factors include personal and situational factors which affect learning. The process factors are defined as "the factors determining the way of student goes about learning". Performance factors pertain to learning outcomes. In this

model, learning approach is considered as a composite of a motive and an appropriate strategy. He described three approaches to learning: deep approach (deep motive-deep strategy), surface approach (surface motive-surface strategy) and achieving approach (achieving motive-achieving strategy) (Biggs, 1987).

The most widely used measure of these three learning approaches is the Study Process Questionnaire (Biggs, 1987). However, Duff and McKinstry (2007) stated that in general, results of the studies which conducted with SPQ, suggested a two-factor structure rather than the three-factor structure. Also, Zhang (2001) expressed that results of the studies, which conducted with SPQ, supported the three-factor structure while others supported a two-factor (deep and surface approaches) structure. In the light of these findings, Biggs et al. (2001) developed the revised two-factor version of the Study Process Questionnaire (R-SPQ-2F). Both original and revised versions of SPQ were designed to measure approaches to learning of the college/university students so they were not applicable in this study. The parallel instrument to SPQ is Learning Process Questionnaire (LPQ; Biggs, 1987) designed for use in secondary schools. Kember, Biggs and Leung (2004) stated that similar arguments in terms of the dimensionality of SPQ were applied to LPQ. Therefore, these researchers explained that the original version needed revision and they developed the revised two factor version of Learning Process Questionnaire (R-LPQ-R-2F; Kember et al., 2004). The revised version of the questionnaire is stated to be a useful classroom evaluation tool. Therefore, in the current study, instead of SPQ versions or original version of LPQ, R-LPQ-2F (Kember et al., 2004) was chosen and approaches to learning were considered as a construct with two dimension: (a) deep approach and (b) surface approach (Kember et al., 2004). In another words, in this study, two-factor model has been adopted for students' approaches to learning.

The deep approach to learning is characterized by seeking meaning in the matter being studied and relating it to other experiences and ideas. Students employing deep learning strategies tend to relate ideas to existing knowledge and experience and this could lead them more integrated views. The deep approach to learning involves an intention to understand the real message of a text or the underlying purpose of an academic task. On the other hand, a surface approach to learning is characterized by memorizing facts or parts of the content of the study materials. Students adopting surface approach to learning tend to accept ideas and information presented in the material without query. These students pay attention to disconnected pieces of information directly (Biggs, 1999; Dart et al., 1999; Kember et al., 2004).

Biggs (1987) stated the role of approaches to learning in academic achievement and pointed out that a deep approach to learning could contribute positively to learning outcomes. The deep approach to learning is considered as an appropriate approach as students learn for understanding and derive enjoyment from the learning task. Adopting deep approach to learning could enable students to apply the acquired knowledge to the real world (Biggs et al., 2001). In the literature, it is stated that approaches to learning are malleable and dynamic in nature and therefore, the educators could change the quality of learning by encouraging students to adopt more efficient, deep learning approaches (Duff & McKinstry, 2007).

McCune and Entwistle (2000) conducted a small-scale longitudinal study and they investigated students' deep approaches to learning. Researchers considered "deep approach to learning" in terms of "intention to understand, relating ideas, seeking the main point". This conceptualization of deep approach to learning is similar to conceptualization of Bigg's 3P Model of Learning. Therefore, it is considered that making inferences based on the findings of this study is reasonable. In McCune and Entwistle's (2000) study, although positive changes in students' deep approaches to learning were found after an intervention program, these changes were relatively slight. The findings of this study have revealed the necessity and importance of the investigating the factors related to the deep approach to learning. These factors should be examined and considered when developing an intervention program and/or designing the learning environment to help students develop their approaches to learning. In this way, they encourage students to develop their approaches to learning which could positively contribute to learning (McCune & Entwistle, 2000).

In the Threefold Model of Intellectual Style, it is suggested that approaches to learning and modes of thinking are related. There is theoretical foundation for this connection. Deep approach to learning and holistic mode of thinking are categorized as Type I intellectual styles since both of them can be used to deal with tasks which require creative, abstract and complex thinking. Therefore, they should be positively correlated. Students who adopt a deep approach to learning want to work more in a creative way. In addition, students who adopt a deep approach to learning expect to understand what they really learn and to understand this they should be creative. Although creative thinking requires both of analytic and holistic modes of thinking, the essence of creative behavior calls for a holistic mode of thinking (Zhang & Sternberg, 2005). In addition, students who adopt a deep approach to learning try to find out the relationships between the task and the previous knowledge and to

integrate parts into a whole. Likewise, students with holistic mode of thinking solve problems through the understanding of relationships and they prefer seeing the whole picture. (Biggs, 1987; Zhang, 2002b).

Surface approach to learning and analytic mode of thinking are categorized as Type II intellectual styles because both of them require simplistic information processing. Since both surface approach to learning and analytic thinking mode can be used to deal with tasks which require concrete and simplistic thinking, they should be positively correlated. Students who adopt surface approach to learning aim to reproduce what is taught to meet minimum requirements. In order to accurately reproduce what is taught, a student needs to follow established rules while performing the learning task (Zhang & Sternberg, 2005). Likewise, students who are used to employing the analytic mode of thinking have a tendency to follow instructions while performing the task. In addition, students who adopt a surface approach to learning want to deal with tasks which are well-structured. Students with an analytic mode of thinking work better under well-structured situations. These students also like learning facts and they are good at memorizing facts. These characteristics could also be attributed to students adopting a surface approach to learning because these students concentrate on memorizing facts (De Boer & Bothma, 2003; Zhang, 2002b).

The integrative mode of thinking is categorized as Type III intellectual style and it manifests the characteristics of both Type I and Type II intellectual styles. Therefore, it would be related to both deep approach to learning (Type I) and surface approach to learning (Type II). These explanations indicate that there could be relationships between modes of thinking and approaches to learning (Zhang & Sternberg, 2005).

The theoretical base for the relationships between modes of thinking is found in the literature and the empirical findings indicate the importance of both modes of thinking (Zhang, 2002a; Zhang, 2002b; Zhang, 2007) and approaches to learning (Bernardo, 2003) in the learning process and academic achievement. However, no research that directly investigated how modes of thinking could be connected to approaches to learning could be found. Therefore, in this study it was aimed to examine the connections between modes of thinking and approaches to learning suggested by Threefold Model of Intellectual Style.

2. Method

2.1 Participants

This study was conducted with 1490 students attending 9 high schools in Ankara. These schools were selected based on cluster sampling method. In Ankara, there are seven central districts. The number of people living in two of them is more than the other districts and there are more general high schools in those districts. Therefore, four schools from these two districts and five schools from the other five districts were selected randomly. All students attending these high schools were included in this study. The participants were composed of 9th grade (n=664), 10th grade (n=454) and 11th grade students (n=372) with ages ranging from 14 to 17 (mean=16, SD=0.88).

The whole study group was randomly split into two sub-groups: Data obtained from the first group (n=745) were used to examine the psychometric properties of measures and the data obtained from the second group (n=745) were used to examine the relationships between the modes of thinking and approaches to learning. First group was comprised of 745 students (395 male and 350 female; mean for age $\bar{X}$=16.02, SD=0.87) and the second group was comprised 745 students (427 male and 318 female; mean for age $\bar{X}$=15.97, SD=0.99) from each grade levels.

2.2 Instruments

2.2.1 The Style of Learning and Thinking-Youth Form (SOLAT-Youth Form)

The SOLAT-Youth Form (Torrance et al., 1988) is a 28-item self-report measure of modes of thinking (as cited in Zhang, 2002a, p.334). The respondents were asked to choose one or both of the statements (a and b) in each item best describing their own learning and thinking style. Selecting the statement of "a" is scored on analytic mode of thinking sub-scale, selecting "b" is scored on holistic mode of thinking sub-scale and selecting both statements is scored on integrative mode of thinking subscale (Zhang, 2002a).

As reliability evidence for these measures, the Cronbach α coefficients were reported and these coefficients have varied between α=0.68-0.75 for the analytic scale, α=0.65-0.73 for the holistic scale, and α=0.82-0.83 for the integrative scale. The validity evidence for SOLAT measures was not reported in the literature but as Torrance (1988) stated its validity could be primarily drawn upon the validity evidence of the measures obtained from the SOLAT's earlier versions (as cited in Zhang 2002a, p. 336).

2.2.2 The Revised Version of Learning Process Questionnaire (R-LPQ-2F)

The revised version of Learning Process Questionnaire (R-LPQ-2F) has been developed by Kember et al. (2004). This questionnaire was chosen for this study since LPQ was developed to assess secondary school students' approaches to learning (Biggs, 1987). This questionnaire consists of 22 items rating students' approaches to learning on a 5-point scale. R-LPQ-2F measures two main dimensions of learning: Deep and surface approach to learning. Each of these dimensions has their own sub-dimensions of motive and strategy elements: Intrinsic interest and commitment to work (deep motive), relating ideas and understanding (deep strategy); fear of failure and aim for qualification (surface motive), minimizing scope of the study and memorization (surface strategy).

Kember et al. (2004) examined the psychometric properties of this questionnaire. The multidimensionality of the questionnaire was examined by testing several measurement models. Results revealed that these models fit the related data sets (Comparative Fit Indices (CFI) have varied between 0.80-0.97). The Cronbach α coefficients calculated for the measures obtained from "Deep Approach" and "Surface Approach" subscales have varied between α=0.82 and α=0. 71, respectively (Kember et al., 2004).

In this research, the Turkish Form of the R-LPQ-2F was used. R-LPQ-2F has been adapted by Çolak (2006) for Turkish high school students. The item-subscales' correlations have varied between 0.24-0.56. The α coefficients were calculated as α=0.79 and α=0.72 for measures obtained from "Deep Approach" and "Surface Approach" subscales, respectively.

2.3 Procedure

In this study, initially the adaptation study of "Style of Learning and Thinking-Youth Form" (SOLAT-Youth Form) was conducted. The instruction and statements of SOLAT-Youth Form were translated by four experts. Afterwards, these translations were examined by the author and another expert. In this way, the Turkish version of SOLAT-Youth Form has been formed. Turkish forms of both SOLAT-Youth Form and R-LPQ-2F were administered to all participants. The students were informed that their involvement in this study was voluntary.

2.4 Data Analysis

Initially, the psychometric properties of SOLAT-Youth Form and R-LPQ-2F measures were examined using data obtained from the first sub-group of participants. To get reliability evidence for these measures, the Cronbach α coefficients were calculated. For validity evidence for SOLAT measures, the item-subscales' scores correlations were calculated and a series of discriminant analysis was applied, for R-LPQ-2F measures a series of Confirmatory factor analysis (CFA) was applied. For CFA's, the correlation matrices were computed from raw data and subsequently analyzed using Robust maximum likelihood (Robust ML) method since the data did not show multivariate normality.

To examine the relationships between modes of thinking and approaches to learning, path analysis was applied to data obtained from second sub-group of participants. For parameter estimation, the maximum likelihood (ML) method was used (data showed multivariate normal distribution). For both confirmatory factor analysis and path analysis, as fit indices the CFI, Goodness-of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) values and Root Mean Square Error of Approximation (RMSEA) values (CFI, GFI and AGFI ≥.90 and RMSEA; ≤.08) have been chosen (Jöreskog & Sörbom, 1993). In addition, for measurement models, the criteria of "factor loadings should be above 0.25" has been considered (Raubenheim, 2004). CFA's were conducted on EQS 6.1, Cronbach α coefficients were calculated on SPSS 13.0 and path analysis were performed on the LISREL 8.7.

3. Results

3.1 Psychometric Properties of SOLAT-Youth Form and R-LPQ-2F

The psychometric properties of the measures obtained from Turkish versions of both SOLAT-youth form and R-LPQ-2F were examined. In order to examine the factor structure of SOLAT-Youth Form, a three-factor model (analytical, holistic and integrative thinking mode) was specified. SOLAT-Youth Form consists of 28 item but at each item participants are asked to select one or both of the statements (a, b or both). Selecting "a" is scored for Analytic subscale, selecting "b" is scored for Holistic subscale and selecting both "a" and "b" is scored for Integrative subscale. In this case, the measurement model identified for these measures includes 84 indicators/observed variables and three latent variables. This measurement model is complex and therefore, the attempt to test this model through CFA was failed because of the inadequate sample size (n=745) for this model. Because the validity evidence of SOLAT measures for Turkish students could not be obtained by CFA, to get this evidence, the item-sub-scales' scores correlations calculated. These correlation coefficients for the items comprising "Analytic Thinking Mode" subscale have varied between 0.30 and 0.58, (p<.01) for the items comprising "Holistic Thinking Mode" subscale have varied between 0.30 and 0.50 (p<.01) and for the items

comprising "Integrative Thinking Mode" subscale have varied between 0.42 and 0.73 (p<.01). These findings have indicated that these items could measure the respective modes of thinking.

As additional validity evidence for SOLAT measures, the discriminant analysis was applied for each of the item in SOLAT-Youth Form separately. In these analyses, item scores (1.0) were taken as dependent and the subscale scores (analytic, holistic and integrative subscale scores) were taken as independent variables. The accurate classification percentages obtained from the analysis conducted for the items of analytic sub-scale were found to vary between 61.1% and 74.7%. The accurate classification percentages calculated for the items of holistic subscale varied between 61% and 69.7%. The accurate classification percentages calculated for the items of integrative subscale varied between 73% and 83.1%. All these accurate classification proportions were higher than proportional chance criterion (50%). Therefore it was considered that the items included in SOLAT-Youth Form could differentiate the three modes of thinking accurately (beyond chance). All these findings have been considered as construct validity evidence for SOLAT measures.

Cronbach α coefficients were calculated as α=0.68, α=0.62 and α=0.88 for analytic, holistic and integrative thinking mode subscales respectively. Comparing the α coefficients calculated for the original form of SOLAT measures (α=0.68-0.75 for the analytic scale, α=0.65-0.73 for the holistic scale and α=0.82-0.83 for the integrative scale) shows that these coefficients are so similar. In addition, considering the α coefficient provides a lowest bound of reliability, these α coefficients can be said to indicate that SOLAT-Youth Form can provide reliable measures of the modes of thinking for Turkish high school students.

Afterwards the psychometric properties of the measures obtained from 22 items Turkish version of R-LPQ-2F were examined. To examine the factor structure of Turkish version of R-LPQ-2F, based on the original questionnaire, six measurement models were specified and tested through CFA. The fit indices calculated for these models were presented in Table 1 below.

Table 1. Fit indices calculated for the measurement models specified for Turkish form of R-LPQ-2F

Models	Items	$SB\text{-}\chi^2$ (d.f)	P	CFI	GFI	AGFI	RMSEA
Model 1 (with uncorrelated error terms): Items are indicators; deep motive, deep strategy, surface motive and surface strategy are factors	22	915.21 (203)	0.00	0.70	0.91	0.89	0.06
Model 2 (with correlated error terms): Items are indicators; deep motive, deep strategy, surface motive and surface strategy are factors	22	811.88 (198)	0.00	0.74	0.92	0.90	0.06
Model 3: Items are indicators; deep motive, deep strategy, surface motive and surface strategy are factors	21	641.00 (178)	0.00	0.79	0.93	0.91	0.05
Model 4: Items are indicators; deep motive, deep strategy, surface motive and surface strategy are factors	20	563.16 (159)	0.00	0.81	0.94	0.92	0.05
Model 5: Items are indicators; eight sub-components of the approaches to learning are factors	20	566.01 (149)	0.00	0.81	0.94	0.92	0.05
Model 6: Eight sub-components of the approaches to learning are indicators; deep motive, deep strategy, surface motive and surface strategy are factors	20	96.27 (14)	0.00	0.94	0.98	0.96	0.06

Initially, a four-factor correlated model (Model 1) was specified and tested. Although the fit indices calculated for this model indicated adequate model-fit, low CFI value indicated some specification problems. By examining the modification indices, five error covariances added between the suggested items (between items 17-13,

between items 9-5, between items 12-11, between items 14-2 and between items 15-3). Although Model 2 adequately fit the data, two factor loadings were found below 0.25 (-0.10 for item 18 and 0.14 for item 21) and one of them had negative sign. Therefore initially item 18 and afterwards item 21 were removed from the questionnaire and then Model 4 was specified. Because this model fit the data adequately, Model 4 was accepted as the valid model for R-LPQ-2F measures. Therefore later analyses were conducted based on the data obtained from 20-item form of the questionnaire. However, as the structural models tested in this research included the sub-components of deep and surface approaches to learning, Model 5 and Model 6 also were specified and tested. CFA solutions for Model 5 and Model 6 indicated that these models fit the data well and the items in the 20-item form of the questionnaire were appropriate (good) indicators of the respective constructs. Therefore it is reasonable to represent the sub-components of approaches to learning by subscales' scores in the structural model. These findings indicated that factor structure of these measures was verified for Turkish culture and 20-item Turkish form of the questionnaire could measure the sub-components of the approaches to learning.

Cronbach α coefficients calculated for the measures obtained from deep approach and surface approach subscales were α=0.79 and α=0.69 respectively. These Cronbach α coefficients indicate acceptable level of reliability. All of these findings have been considered as validity and reliability evidence of 20-item-R-LPQ-2F Turkish Form measures.

3.2 Connections between Modes of Thinking and Approaches to Learning

This study aims to examine the connections between modes of thinking and approaches to learning through path analysis. Before presenting path analysis' results, the correlation matrix for the variables included in this study was computed. The correlation matrix used for the path analysis is presented in Table 2.

Table 2. Matrix of correlations between the study variables

	AMT	HMT	IMT	II	CW	RI	Unders	FFail	AQ	Minss	Memor
AMT	1.00										
HMT	-0.38**	1.00									
IMT	0.54**	0.57**	1.00								
II	0.10**	0.07*	0.15**	1.00							
CW	0.19**	0.00	0.17**	0.29**	1.00						
RI	-0.05	0.25**	0.22**	0.25**	0.23**	1.00					
Unders	0.04	0.15**	0.17**	0.35**	0.28**	0.28**	1.00				
FFail	0.02	0.05	0.06	0.08*	0.07*	0.04	0.05	1.00			
AQ	0.05	-0.02	0.05	0.27**	0.13**	0.08*	0.23**	0.20**	1.00		
Minss	-0.08**	0.14**	0.05	-0.16**	-0.02	-0.05	-0.17**	0.14**	-0.08**	1.000	
Memor	0.00	0.09**	0.09**	-0.08**	0.07*	-0.04	-0.10**	0.16**	0.06	0.41**	1.000

**p<0.01; *p<0.5

Correlation coefficients shown in Table 2 have indicated that the modes of thinking are slightly correlated with the approaches to learning and most of them are significant (p<.05). Afterwards, the structural model which specified in this study was tested by path analysis. In this structural model, it was hypothesized that the holistic thinking mode would influence the sub-components of the deep approach to learning, the analytic thinking mode would influence the sub-components of the surface approach to learning and, the integrative thinking mode would influence the sub-components of both the deep and surface approaches to learning. Therefore in this model, analytic, holistic and integrative modes of thinking were specified as exogenous variables; each of the sub-components of approaches to learning was specified as endogenous variables. This model with standardized solutions is shown in Figure 1.
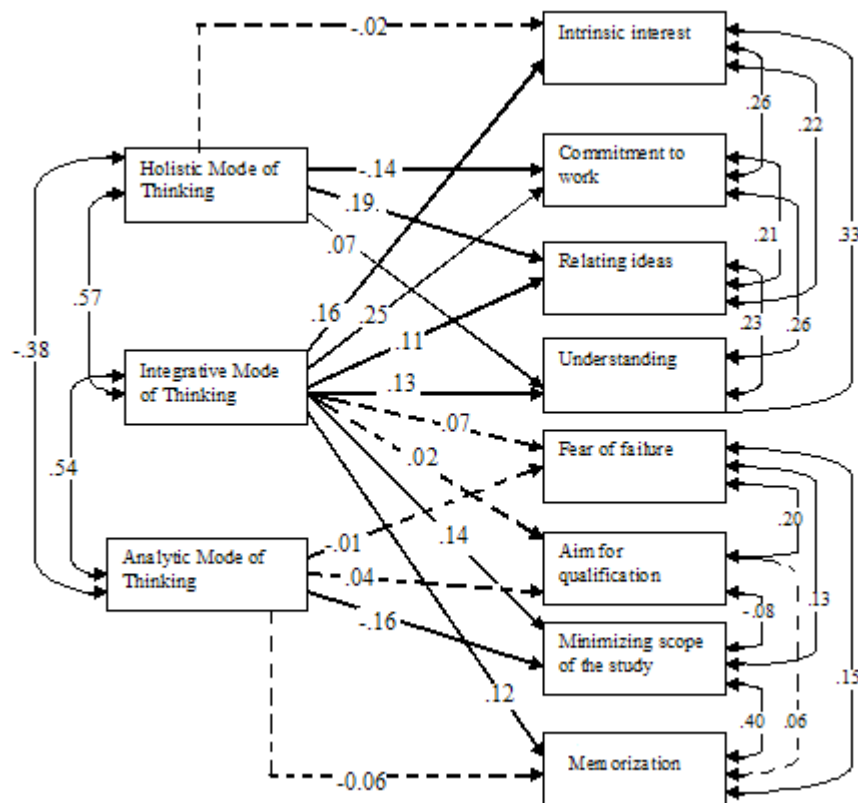
Figure 1. Model A: relations among modes of thinking and learning approaches

The fit indices calculated for the Model A (χ^2=170.80 (df=24, p<.01); CFI=0.93; GFI=0.97; AGFI=0.92; RMSEA=0.08), indicated that the model fit the data well and it meant that the model could explain the variation in the data. The model accounts for 7%, 4%, 3%, 2% and 2% of the variance in relating ideas, commitment to work, understanding, intrinsic interest and minimizing scope of the study, respectively. In this research, it was utilized completely standardized coefficients. Since fit indices implied a theoretically sound model, standardized path coefficients (β) were examined. Examining the individual standardized path coefficients, and t-values associated with them, it is seen that some of the pathways are statistically significant (these estimates are significant at .05). Although these coefficients indicated significant relationships between respective variables, the strength of these relationships were low. Looking at these coefficients it is seen that analytic thinking mode just significantly influences minimizing scope of the study (β=-0.16). However, holistic mode of thinking had statistically significant effects on commitment to work (β= -0.14), on relating ideas (β=0.19), and on understanding (β=0.07). Some of the links between integrative thinking mode and sub-dimensions of approach to learning are significant. It was found that integrative mode of thinking significantly influenced intrinsic interest (β=0.16), commitment to work (β=0.25), relating ideas (β=0.11), understanding (β=0.13), minimizing scope of the study (β= 0.14) and memorization (β=0.12).

Looking at the signs of these β weights, it is seen that analytic thinking mode negatively contributes to minimizing scope of the study. Likewise, holistic thinking mode negatively contributes to commitment to work. But, however, holistic thinking mode positively contributes to relating ideas and understanding. In addition, it was found that integrative mode of thinking positively contributed to sub-components of both deep and surface approaches to learning mentioned above. On the other hand, it was observed that analytic thinking mode did not significantly influence fear of failure (β= -0.01, p>.05), aim for qualification (β= 0.04, p>.05) and memorization (β=-0.06, p>.05). Likewise, it was found that the effect of holistic mode of thinking on intrinsic interest (β=-0.02, p>.05) and the effect of integrative thinking mode on fear of failure (β= 0.07, p>.05) and on aim for qualification (β= 0.02, p>.05) were not significant. In terms of the relationships within the sub-components of the deep approach to learning and surface approach to learning, separately, the strength of the relationships within the sub-components of surface approach to learning were found stronger than the relationships within the sub-components of the deep approach to learning.

4. Discussion

In studies conducted to investigate the intellectual style constructs included in the Threefold Model of Intellectual Style, the connections between modes of thinking, thinking styles, academic achievement/performance and career interest types were examined (Zhang, 2002a; Zhang, 2002b; Zhang, 2007; Zhang & Fan, 2007). But it was found that there was no research which had directly examined the connections between modes of thinking and approaches to learning. Different from the past research, the current research examined the connections between modes of thinking and approaches to learning.

At this study three hypotheses were made about the relationships between modes of thinking and approaches to learning: (I) holistic thinking mode would be related to the sub-components of deep approach to learning, (II) the analytic thinking mode would be related to the sub-components of the surface approach to learning and, (III) the integrative thinking mode would be related to the sub-components of both the deep and surface approaches to learning (Zhang & Sternberg, 2005). The results of the present study partially support the first and third hypotheses while the results do not support the second hypothesis (except the relationships observed between analytic thinking mode and minimizing scope of the study). Results of the path analysis revealed that most of the relationships between modes of thinking and approaches to learning were consistent with the theoretical model whereas a few relationships were inconsistent.

Consistent with the theoretical model, it was found that holistic thinking mode positively (and significantly) contributed to relating ideas and understanding. It means that students who prefer processing information in an intuitive, gestalt-type and synthesized way tend to relate things that they have learned to ideas and their experiences and also they try to deeply understand the study subjects. To gain a real understanding of what is learned, a student needs to be creative and to employ more complex information processing. In the literature it is stated that although creative thinking requires both analytic and holistic thinking mode, creativity is highly associated with the use of the holistic mode of thinking (Okayabashi & Torrance, 1984; Zhang, 2002b; Zhang & Sternberg, 2005).

Another important point is that holistic thinkers look at whole. They see the whole picture and for seeing the whole picture one should integrate the parts into a whole. Also it is stated that finding out the relations among ideas refers seeing the whole picture. In addition, a student with a holistic mode of thinking tends to process information in a synthesized manner. To able to process information in this manner, a student should understand the subject and relate it to the other subjects he/she already knows (Biggs, 1987; Okayabashi & Torrance, 1984; Zhang, 2002a). Supporting these findings, Zhang and Sternberg (2000) inferred that students who adopted deep approach to learning preferred using creativity generating and complex thinking styles.

Integrative mode of thinking was observed to be related to sub-components of both deep and surface approaches to learning. It makes sense because integrative mode of thinking includes the characteristics of the analytic and holistic mode of thinking. Results of this study revealed that students who had a tendency to process information in an interactive and dynamic way were more likely to be intrinsically interested in learning and to be committed to work. Students who were used to employing the integrative mode of thinking were observed to tend to relate ideas to previous knowledge and experience, to concentrate on the underlying meaning of a text, to memorize the learning subjects and to minimize the scope of the study (Zhang & Sternberg, 2005; Zhang, 2007).

Inconsistent with the theoretical model, it was found that analytic thinking mode negatively contributed to "minimizing scope of the study". It indicates that the more students prefer processing information in a piecemeal, analytical and sequential way, the less they narrow of the focus. This means that Type I constructs (analytic thinking mode and surface approach to learning) are negatively related in terms of the modes of thinking and approaches to learning (Zhang & Sternberg, 2005). However, as supporting this finding, Zhang (2002a) stated that processing information in an analytical manner is a good way for processing verbal information. In addition, Riding and Sadler-Smith (1997) expressed that analytics would need to have all the information laid out. Therefore individuals processing information in this way could need more explanation or comprehensive information about the learning subject. Because of this, while learning, they may prefer broadening the scope of the study not minimize.

In contrast to the theoretical model, it was found that the holistic mode of thinking negatively contributed to "committed to work". It suggests that the more students prefer processing information in an intuitive, gestalt-type and synthesized way, the less they commit time to their study. Also in the present study, there wasn't found significant relationship between the holistic mode of thinking and "intrinsic interest". These findings indicate that holistic thinking mode is not related the deep motive as in the way hypothesized in the theoretical model. These inconsistent findings could be due to the learning context including teaching strategies, nature of

the tasks, the type of the information given at schools, prior learning experiences of the students in the study group and the assessment techniques (Biggs, 1987).

Zhang and Sternberg (2000) has stated that assessment has a strong effect on students' approaches to learning. They argue that traditional assessment techniques lead students to adopt surface approach to learning and assessment techniques based on student-focused learning approach lead students to adopt deep approach to learning. Although Turkish Educational System is formed in accordance with the constructivism approach, the decisions related to the high school students particularly are still taken based on the examination scores such as Higher Education Exam and Undergraduate Placement Exam that consist of multiple-choice test items. These exams could cause students to get motivated to obtain high scores on these exams instead of encouraging them to achieve at school and learn the content. Students who have exam-focused goals tend to consider the tasks given to them at schools as an external burden and remember the course content just for assessment. Also, multiple-choice test items lead to memorization and they are insufficient in giving feedback for student's development. In this case, it is likely that a student with a holistic mode of thinking has surface motive toward school works. Another possible explanation for this inconsistent finding could be related to problems such as crowded classes, heavy workload and being dissatisfied with the job encountered at educational settings in Turkey. Although Turkish Educational System is based on the constructivist approach, because of these problems, sometimes teachers could prefer teacher-centered approaches to teaching and give students learning tasks which are not original and not real-life based. These tasks and learning content may not be attractive or interesting for students who are used to employ the holistic mode of thinking and therefore, these students could have a surface motive toward these tasks rather than having a deep motive (Zhang, 2007).

Inconsistently with the theoretical model, it was observed that neither the analytic nor the integrative mode of thinking was significantly related to any of the sub-components of the "surface motive". In addition, there is no significant relationship between the analytic mode of thinking and memorization. In summary, at this present study it was found that although most of the relationships specified in the structural model were statistically significant, these were weak relationships. However, some of the relationships found at this study were inconsistent with the theoretical model.

It is considered that, the effects of modes of thinking on learning approaches might have been overshadowed by the nature of the tasks and the study subject. In the literature, it is explained that modes of thinking and learning approaches are affected by learning tasks and study content. The analytic information processing is stated to be good way for processing verbal and abstract information. Therefore a student with an analytic mode of thinking favors learning tasks which involve these types of information. On the other hand, the holistic information processing is stated to be good way for processing nonverbal, spatial, concrete and visual information. A student who employs holistic mode of thinking favors learning tasks which involve these types of information. Therefore, although everyone has a dominant mode of thinking, an individual may employ any of the modes of thinking depending on the tasks being dealt with (De Boer & Bothma, 2003; Okabayashi & Torrance, 1984; Zhang, 2002a).

Likewise, it is emphasized that students' learning approaches are influenced by various contextual factors including courses, study topics and learning tasks. Therefore, students could adopt different approaches to learning according to the nature of tasks and content to be learned (Biggs, 1987). In addition, students who adopt surface approach to learning focus on the information in the learning material (Tempone, 2001). These statements indicate that although the study content and the nature of the learning task affect students' approaches to learning, these factors seem to be more important for surface approach to learning. Consistently, at the current study, it was found that sub-components of the surface motive to learning were not significantly related to any of the modes of thinking whereas the sub-components of the deep approach to learning were observed to be related to modes of thinking. It suggests that surface approach to learning could be more dependent on the learning content or tasks than deep approach to learning.

The debate above demonstrates the roles of the learning content and learning tasks for the modes of thinking and learning approaches. For future research, it could be suggested to investigate the relationships between the students' modes of thinking and approaches to learning by including learning tasks or courses, which participants are taught, as predictors in the model. Also, although weak relationships are observed at this study, it is considered that the present findings have a practical implication for educators.

5. Conclusions

The results of this study revealed that holistic mode of thinking was positively related to sub-components of the deep strategy and integrative mode of thinking was positively related to the deep approach to learning. Zhang

(2002a) reported that Type I intellectual styles positively contributed to academic achievement. Also in the literature, it is stated that high academic achievement is associated with deep approach to learning (Bernardo, 2003). In this context, educators could benefit from the findings of the current study in terms of the relationships between holistic and integrative modes of thinking and sub-components of deep approach to learning.

Modes of thinking are contended to be socialized (Zhang, 2002a). Likewise, learning approaches are not stable psychological traits. Therefore, modes of thinking and approaches to learning can be modified. Both modes of thinking and approaches to learning are influenced by learning content and tasks, teaching approaches as well as assessment methods (Biggs, 2001). In this context, there are several methods for modifying the modes of thinking which students are used to employing. By adopting a student-focused approach in teaching, a teacher constitutes a learning atmosphere in which students are allowed to be innovative while performing a learning task. By this way, teachers may cultivate creativity among students. Creative thinking is very important for raising students who are going to be capable of adapting themselves to the ever-changing world. Also, a student-focused approach to teaching may enable to teachers to encourage students to focus on bigger pictures of issues.

In addition, the student-focused approach to teaching requires using the assessment methods such as continually assessed projects, portfolios and appropriate essay questions. These assessment methods encourage students to think creatively and to demonstrate integrity of their learning and therefore, assessment influences students' modes of thinking (Zhang, 2001; Zhang, 2002a). Biggs (1987) argued that assessment has an impact on the ways of the students learn and think. The arrangements which can be made in terms of the teaching approaches, assessment methods and learning tasks, may lead students to be more holistic and integrative in processing information. Also teaching approaches, assessment methods and learning tasks affect the learning approaches that students adopt (Biggs, 1987).

Considering this explanation and the relationships between holistic and integrative mode of thinking and deep approach to learning observed in this study, it is concluded that it may be beneficial to adopt a student-focused approach in teaching, prepare educational activities and learning tasks which require to process information in an interactive and dynamic way to promote students to adopt more effective approaches to learning (De Boer & Bothma, 2003). Therefore, in summary, teachers/practitioners could obtain information about students' modes of thinking and approaches to learning by using SOLAT-Youth Form and R-LPQ-2F. Considering the connections observed in this study, they could differentiate their teaching/assessment techniques, materials and activities to accommodate their students' attributions which may enhance the quality of teaching and learning processes.

The importance of this study arises from the fact that there is no study investigating high school students' modes of thinking within the framework of this theoretical model in Turkey. It is believed that this study will provide contributions to educational practices in Turkey. Firstly, there was no applicable psychological instrument to measure Turkish high school students' modes of thinking in terms of analytic, holistic and integrative thinking modes. The adaptation study of SOLAT has been conducted as part of this research. Therefore, teachers could administer SOLAT-Turkish Form to high school students in their classes and examine that how students' modes of thinking differ according to learning tasks and content. By this way, teachers could recognize their students in terms of these attributions and could enhance in-class activities according to the diversity in the class with respect to these attributions. In addition, the results of this kind of research provide educators to investigate the implications of teaching practices for students in terms of their modes of thinking and approaches to learning and to assess the teaching practices from this point. In Turkish Educational System, a student-focused approach (constructivism) has been adopted and it is expected that this approach supports the development of holistic and integrative modes of thinking. In fact, the results of this kind of research would give information about how efficiently the in-class activities are prepared and applied in accordance with the constructivist approach.

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