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RELATIONSHIP AMONG THINKING STYLES OF MATHEMATICS TEACHERS AND THEIR USING OF PROCESS-BASED TEACHING METHODS

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ABSTRACT

The aim of present study is investigation on relationship among mathematics teachers' thinking styles and amount of their using of process-based teaching methods. This research is to determine that which one of thinking styles is the strongest predictor for using of methods of Process-based teaching by math teachers. The method of this research is descriptive and correlation one. The sample group is comprised of 103 mathematics teachers that are selected randomly, 55 female and 48 male. Instruments of research were questionnaires of Sternberg Thinking Styles and Process-based Teaching Methods (PTM). The Pearson correlation and analysis of regression are used. The results show that there is a positive relationship between thinking styles of Judicial, Liberal, External, Executive and Global with using of the PTM by math teachers. The Step wise regression analysis shows that for male teachers Liberal and Local thinking styles are the stronger predictors for using of PTM. But for female the only strong predictor was Liberal thinking style.

Keywords: Process-based, teaching methods and thinking styles.

INTRODUCTION

Teachers through the implementation of teaching methods provide appropriate learning environments. Teachers teaching methods are very diverse. In one categorizing they divided in result-based and Process-based Teaching Methods (PTM). In the PTM, enhancing of knowledge is not so important that abilities and skills. In these methods, students, in their selves, are considered as the fundamental base of education activities (Shabani, 2002). Therefore child-center methods can be considered a subset of the PTM. Constructivism methods which in them human is known as producer of his/her knowledge (Zahoric, 1995) are also in this category. In the PTM, in addition to activeness of students, social interaction of learners and creative thinking are important. Therefore in the PTM only the transfer of knowledge is not emphasized, but abilities such as communication, reasoning and characters of students are considered. The PTM are important because human perception from the world is critical, not passive (Shabani, 2002). In these methods students are more curious, responsible and creative (Armand, 1995). In this regard Freire (1989) suggested that teachers need to strengthen students' interest, challenges of intellectual processes, active thinking and discussion. Cooperative learning is one of the PTM that causes desirable changes in the characters of students.

Berliner and Gage (1975) also showed that in the PTM, quality of the learning is more than inactive teaching methods. Exploratory –teaching methods such as group discussion, guided, dialectic and problem solving methods can also be in the PTM subset. Cruickshank, Jenkins and Metcalf (2006) indicated that group discussion method increases motivation and changes learners' attitudes. The others exploratory teaching methods also make learners to think enhance their thinking skills and help them to find out that how knowledge is acquired.

A variable that can be related with the performance of teachers are thinking styles. Thinking styles are preference way for thinking (Kao, Lio and Sun, 2008). Experts agree that people have different patterns of thinking styles. Sternberg named these different methods of information processing as thinking styles. He believed that thinking styles changes during the life and they can be taught and people acquire their thinking styles through socialization (Razavi and Shiri, 2005). Thinking styles are not abilities but also they are preferred methods in information processing and the use of abilities (Zhang and Postiglion, 2001). In Sternberg's theory (1988 cited by Zhang, 2002) the metaphor of self- government is used to visualize how human mind works. Sternberg (1997 cited by Zhang, 2009) claimed that thinking style or self government of mind are13 that can be classified in five dimensions of functions, forms, levels, scopes and leanings. He also believed that Similar to different methods of governing over societies, there are different ways that people are using their thinking abilities (Kao, Lio and Sun, 2008 and Kastelz, 2001: 365).

Thirteen thinking styles have been classified into some category, according to their similarity. For instance, in one classifying they divided to the creative and non creative styles. The creative thinking styles are including legislative (being creative), judicial (evaluating the other people and their products), hierarchic (ranking their assignments), global (focusing on the totality of picture), and liberal (taking a new way for doing assignment) (Zhang and Higgins, 2008). Therefore, people that have a tendency to generate creativity and higher levels of cognitive complexity are placed in this category (Zhang, 2006). Non creative thinking styles are including, executive (implementing tasks according to commands), local (focusing on the details), monarchic (working on one task at any time) and conservative (using traditional methods of assignments) (Zhang and Higgins, 2008). Therefore, people that are more inclined to obey the norms and show lower levels of cognitive complexity are placed in this category (Zhang, 2006a). In another classification, Zhang and Sternberg re-conceptualize thirteen thinking styles in three categories. The first one is independent from context, generates creativity and has adaptability worth. Second kind is dependent to context, impulsive and has lower adaptability worth. The third one of styles is depend on specific demanded task and is dependent to content (Zhang, 2009).

Various factors such as culture, gender, age, parental styles, schools, various jobs, birth order and social-economic status can affect thinking styles (Imamipour and Seyf, 2003: 36). Culture plays a role in the evolution of thinking styles. Different cultures emphasize on different thinking styles. For example North America's culture gives more importance to innovation and legislative style and in Japan's culture executive and conservative thinking styles are emphasized. Gender also plays a role in thinking styles. For example Sternberg shows that men scores in legislative styles, global and internal styles are more than woman's scores but in judicial style men scores are less than women. Parents thinking styles are effective on development of thinking styles of their children. Different schools and jobs encourage different thinking styles. In most parts of the world, executive thinking style, local and conservative thinking style are encouraged (Yari, 1999). Correlation studies show that there is an overlap between thinking styles and personality characteristics (Zhang, 2001 and Zhang, 2002). Neuroticism positively associated with executive and conservative thinking styles but negatively related to the legitimate, hierarchical and liberal styles. Personality trait of extraversion positively associated with external style and negatively related with internal style. Agreeableness positively associated with legislative, judicial, liberal styles and external style. But it has a negative relationship with the legislative, judicial, liberal and internal styles. Conscientiousness positively was related to most of thinking styles but particularly was associated with the hierarchical style (Ibid). In another research personality trait of openness has had a positive relationship with the judicial, external, liberal and conservative thinking styles; neuroticism

with executive, local and conservative thinking styles; and dutifulness with legislative, hierarchical and external thinking styles (Shokri, Kadivar, Farzad, Sangari and Ganaei, 2006). Also thinking style 1 (production of creativity and complexity) positively is associated with the document that are involve with the compatibility values such as being open mind and conscientiousness (Zhang, 2009). Zhang in a study concluded that thinking styles are strong predictors for the development of identity. Also thinking styles that produce creativity, external style and hierarchic style are negatively correlated with the anxiety. However the conservative style was positively correlated with anxiety (Ibid). Sternberg suggests that thinking styles are related with creativity processes, problem solving and decision making (Imamipour and Seyf, 2003: 36). Mohammadi (2010) indicated that thinking styles of Liberal and Judicial predict 0.32 of creativity variance as a personality trait. In study of relationship between thinking styles and self-esteem and economic class, findings showed that with control of age there is overlap between thinking styles and self-esteem. Thinking style type1 was positively associated with self-esteem, while thinking style type 2 (executive) has had a negative relationship with self-esteem and economic situation (Zhang and postiglion, 2001). Kasravi, Kadivar, Farzad, Sangari, Zeinabadi and Ganaei (2006) showed that social-economic situation positively related with legislative, judicial, global, liberal, hierarchic and negatively related with executive, local and conservative thinking styles. Thinking styles and motivation of academic achievement are associated with behavioral outcomes (Fan and Zhan, 2009). Zhang and Sternberg showed that high academic achievement has positive correlation with conservative, hierarchic and internal styles and it has negative correlation with legislative, liberal and external styles. Also, thinking styles that cause creativity (type1) have had positive relationship with motivation for achieve success; and they have had a negative relationship with motivation for avoid failure. Thinking styles type 2 (executive) had a positive relationship with motivation for avoid failure; and styles type 3 (come along with task and position) was associated with motivation for achieve success (Ibid).

Zhang and Sternberg asserted that thinking styles can be taught (Zhang, 2006b).Therefore according to the effect of thinking styles on cognitive processes and individual performance, the main purpose of this study is to determine relationship between math teachers thinking styles and amount of their using from process-based teaching methods. Accordingly the research questions are as below: 1) is there any relationship between thinking styles and using of process-based teaching methods by math teachers? 2) Whether gender plays an effective role in relationship between thinking styles and the using of process-based teaching methods by math teachers?

METHODOLOGY

A correlational design was used to find out the pattern of relationship among the variables of research. Further, step-wise regression analysis was worked out to determine the most contributing predictors. Using of process-based teaching methods has been used as dependent variable and thinking styles as independent variables. The statistical population consists of 142 math teachers in Zahedan. The sampling was conducted by using a systematic random method. The sample size was determined by using Morgan's table equal to 103 math teachers. Mean while 53% of them were woman; 80.5% have had BA degree and 47.5% have had more than 20 years experience in teaching.

Instruments

1) Questionnaire of process-based teaching methods (PTM): This questionnaire is a researcher made one that determines amount of teachers' using of teaching methods such as exploratory methods, group discussion and skill learning; in which instead of increasing the student knowledge, they develop processes such as thinking skills, social skills and study skills in students. This test includes 18 questions that responders will offer their answer on the Likert scale. In this study, the internal consistency was obtained by Cronbach's alpha equal to .82 which indicates an acceptable internal consistency.

2) Thinking styles questionnaire: this questionnaire was designed by Sternberg but because the original questionnaire was too long (104 questions), Mohammadi (2010) reduced the questionnaire to 36 questions, 9 thinking styles and for each one 4 questions. This questionnaire evaluates Legislative, Executive, Judicial, Global, Local, Liberal, Conservative, Internal and External thinking styles. The estimation of reliability of each of these scales by using Cronbach's alpha is as follow: Legislative .74, Executive .62, Judicial .73, Global .61, Local .79, Liberal .82, Conservative .63, Internal .73 and External .83.

RESULTS

A summary of descriptive results are presented below.

Table 1: Descriptive results of research variables

Variables	Mean	Out of Mean	Std. Deviation
Using of PTM	65.04	54	7.2
Legislative	15.7	12	2.64
Executive	16.24	12	2.41
Judicial	15.7	12	2.58
Global	11.28	12	2.05
Local	12.02	12	3.2
Liberal	16.33	12	2.63
Conservative	9.99	12	2.14
Internal	11.12	12	2.38
External	15.23	12	2.24

Results of table 1 show that means of Liberal, Executive, Legislative and Judicial thinking styles are more than questionnaire's means. Conservative, Internal and Global thinking styles are below the mean of questionnaire. Results that related to research questions are presented below.

Question 1) is there any relationship between thinking styles and using of process-based teaching methods by math teachers?

Results table 2 indicate that using of PTM is significantly ($p \leq 0.01$) and positively correlated with thinking styles of Judicial ($r = .34$), Liberal ($r = .46$) and External ($r = .33$). Also, using of PTM is correlated positively with Executive($r = .17$) and Global ($r = .18$) thinking styles and these correlations were significant ($p \leq 0.05$).

Table 2: Results of correlation between using of PTM and thinking styles

Variables	**R**
Legislative	.10
Executive	* .17
Judicial	** .34
Global	* .18
Local	-.11
Liberal	** .46
Conservative	-.05
Internal	.08
External	** .33

**p ≤ 0.01 *p ≤ 0.05 N= 103

The result of the Durbin Watson test was 1.74. Therefore the Stepwise Regression Analysis test was used and the results are represented in Table 3.

Table 3: Summery of Stepwise Regression Analysis

Steps	**Std. Predictors**	**Adj. β**	**R^2 R^2**	**F Change**	**Partial Change**	**Correlation**
1	Liberal	** 0.46	0.20	0.21	**27.2 (1,101)	0.46
2	Liberal External	** 0.39 * 0.20	0.23	0.03	* 4.48(1,00)	0.39 0.21
3	Liberal External Local	** 0.41 ** 0.24 ** -0.21	0.27	0.04	** 6.13 (1,99)	0.41 0.25 -0.24

Durbin- Watson = 1.74 **p ≤ 0.01 *p ≤ 0.05
Dependent Variable: *using of process-based teaching methods*

The Table 3 shows that Liberal thinking style was the strongest predictor and entered the equation first, followed by External and then Local thinking styles. The first predictor accounted for 20% of the variance in using of PTM by math teachers (F = 27.2, df = 1, 101, p≤ 0.01). In the second step, the combination of the two predictors accounted for 23% of the variance in using of PTM (F = 4.48, df = 1, 100, p≤ 0.05). In the third step, the combination of the three predictors accounted for 27% of the variance in using of PTM (F = 6.13, df = 1, 99, p≤ 0.01).

According to the Standard Correlation Coefficient (β), the Regression Equation for the three standard variables is represented below:
Using of PTM = Z 0.41 «Liberal» + Z 0.24 «External» - Z 0.21 «Local»

To examine the unique contribution of each variable to prediction of using of PTM, a partial correlation was calculated. Findings showed that relationship between Liberal style and using of PTM was $r_{y1.23}$ = 0.41, even after removing variance associated with External and Local styles. Also a partial correlation between External and using of PTM was $r_{y2.13}$ = 0.25, after removing variance associated with Liberal and Local styles. A partial

correlation between Local and using of PTM was $r_{y3.12}$ = -0.24, removing variance associated with Liberal and External styles.

Question 2) whether gender plays an effective role in relationship between thinking styles and the using of process-based teaching methods by math teachers?

Table 4: Results of correlation between using of PTM and thinking styles of men and women.

	For men	For women
Variables	R	R
Legislative	17	0.02
Executive	.05	** 0.34
Judicial	** .35	** 0.37
Global	.04	* 0.29
Local	.12	** -0.40
Liberal	** .38	** 0.53
Conservative	-.05	-0.03
Internal	.18	-0.05
External	** .31	** 0.43

**p ≤ 0.01 *p ≤ 0.05 N= 103

Table 4 shows that the shared correlations for the two gender were between styles of Judicial (r = .35), Liberal (r = .38) and External (r = .31) whit using of PTM. But men are different from women in thinking styles of Local, Executive and Global. That is, in these variables the correlations were significant only for men: Local r = -.40 and executive r =.34 (p ≤ 0.01); Global r = .29 (p ≤ 0.05).

Separated analyses demonstrated two different prediction models for men (in the first step, for Liberal R^2 = 0.27 and in the second step, for Liberal + Local R^2 = 0.41, p≤ 0.01) and for women (in only one step, for Liberal R^2 = 0.13, p≤ 0.01).

DISCUSSION

The main purpose of this study was to determine the stronger predictors of using of PTM by math teachers. The results of statistical analysis of research question (1) showed strong positive relationship among the Liberal, Judicial and External thinking styles and using of PTM. The Liberal thinking style was the strongest predictor that predicted 20% of the using of PTM variance. The thinking styles of External and Local, respectively, add 3% and 4% to this prediction. Thus, these three variables predict 27% of using of PTM variance that is a good prediction. Therefore, when math teachers had more the Liberal, Judicial and External thinking styles, they have used more of process-based teaching methods. These results indicate some of teachers' traits that are associated with using of PTM through which teachers can develop some of fundamental ability and skills in students.

These findings confirm the general research results such as Sternberg suggestions that thinking styles are related with creativity processes, problem solving and decision making (Imamipour and Seyf, 2003, Mohammadi, 2010) and Zhang and postiglion (2001) results that showed thinking style type1 was positively associated with self-esteem. Fan and Zhan (2009) indicated that thinking styles are associated with behavioral outcomes. Also, Zhang (2002) indicated that conscientiousness positively was related to most of thinking styles. Regard to research question (2), gender differentiations showed that the stronger predictors for using of PTM by male teachers are Liberal and Local thinking styles. But for female the only strong predictor was Liberal

thinking style. Also in this study, Local, Executive and Global thinking styles were important factors only for men. This finding indicates that gender is important in decision about traits the effect teaching methods. Previous researches show some differences between men and women. For example, Sternberg shows that men scores in legislative styles, global and internal styles are more than woman's scores but in judicial style men scores are less than women (Yari, 1999). However there is not a lot of study about gender differentiation in the correlation or causal investigations.

Processes-based teaching methods are important (Shabani, 2002). In these methods students are more curious, responsible and creative (Armand, 1995). Therefore thinking styles of Liberal and Local are important in using of processes-based teaching method by men math teachers. Liberal thinking style is also important in women math teachers. Accordingly, these findings have to be considered in employment of teachers. Also, developing of specific thinking styles has to be put into workshops programs of teachers.

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