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Measuring Thinking Styles of Pre-service and Early Career Teachers: Validation of a Revised Inventory

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Abstract: The early phase is the decisive period for the teachers' career. Intellectual styles (particularly thinking styles) play a vital role in teachers' professional development. With the purpose of measuring thinking styles of teachers at the early phase, this study was designed to validate a revised inventory of thinking styles (TSI-R2) for pre-service and early career teachers. A sample of pre-service teachers (n = 248) were invited to join the pilot study and a sample of teachers with one year work experience (n = 252) participated in the main study. Exploratory factor analysis, confirmatory factor analysis and reliability analysis were performed. The results suggested that with slight modification, TSI-R2 was a reliable and valid instrument to measure thinking styles of pre-service teachers and early career teachers, which has some implications to enhancing teacher education and development.

Keywords: *Early career teachers; pre-service teachers; thinking styles; validation.*

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Introduction

The early phase (1-3 years' experience) of teaching career matters the most for teachers' professional development (Clement & Wilkins, 2011; Huberman et al., 1989). Soon after early career teachers enter the teaching profession, numerous problems begin emerging that pose as a long-standing headache haunting the terrain of teacher education (Ryan, 1974; Varah et al., 1986; Xu, 2012). Consequences of these problems can be devastating. One most direct consequence, as many researchers (Buchanan et al., 2013; Kutsyuruba & Tregunna, 2014; Varah et al., 1986) have observed, is that early career teachers may have to learn to "swim" as soon as possible, or otherwise they will "sink" equally fast. What is even worse is the alarming rate of turnover and attrition among early career teachers (Buchanan et al., 2013; Ingersoll, 2001). To "sink or swim" may also be a function of early career teachers' individualized ways of dealing with these problems, which can be conceptualized as intellectual styles (Zhang & Sternberg, 2005). This is partly because, as Day (2012) put it, "teaching at its best is an intellectual and emotional endeavor" (p. 8). There is much research (e.g., Adler & Aranya, 1984; Cheng et al., 2016; Thomas, 2013; Zhang & Jing, 2014; Zhang & Sternberg, 2002) on intellectual styles in educational settings. According to Zhang (2012), intellectual styles (particularly thinking styles and teaching styles) play an important role in teachers' professional development. Notwithstanding the existence of ample evidence supporting the relationship between intellectual styles and teachers' professional development, there is still a paucity of research focusing on whether and how early career teachers can survive, or thrive in, the eventful transition period with different types of intellectual styles. For long, successes and failures in educational settings have been attributed mainly to such traditional individual differences as ability, motivation, and personality. These classic variables, however, cannot suffice to tell the whole story of individual differences, as Zhang (2012) argued. In this regard, intellectual styles may provide a window into a better understanding of early career teachers' "sink or swim" in terms of professional development. Intellectual styles are "people's preferred way of processing information and dealing with tasks" (Zhang & Sternberg, 2005, p. 2), including multiple style constructs, such as cognitive style, learning approach, decision-making and problem-solving style, thinking style, and teaching style (Zhang, 2013; Zhang & Sternberg, 2005). Under the umbrella term of intellectual styles, early career teachers' thinking style is the particular focus of our research interest. Thinking styles are "a preferred way of thinking... [and] expressing or using one or more abilities" (Sternberg & Grigorenko, 1997, p. 202). Inventories for measuring thinking style have been developed and revised (TSI-R2; Sternberg et al., 2007) (TSI; Sternberg & Wagner, 1992). Their reliability and

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validity have been confirmed in various populations (Alborzi & Ostovar, 2007; Bernardo et al., 2002; Park et al., 2005; Zhang & Higgins, 2008). However, most research has conducted validation examination among students. There seems a lack of study on how the inventories work with teachers, especially early career teachers. Therefore, the current study aimed to examine validity and reliability of a revised version of thinking style inventory with a pre-service teacher sample.

Literature Review

Intellectual Styles

Intellectual styles are “people’s preferred way of processing information and dealing with tasks” (Zhang & Sternberg, 2005, p. 2). As a generic term, intellectual styles encompass every conceivable style construct, be it style-rooted or not, such as conceptual tempo, field dependence/independence, cognitive style, learning approach, mind style, decision-making and problem-solving style, career personality type, thinking style, and teaching style (Zhang, 2013; Zhang & Sternberg, 2005). Over decades, intellectual styles have been a topic of special interest across fields (e.g., personality, identity, vocational psychology, cognitive psychology, organizational behaviors, teacher education, and student development) and cultures (e.g., the United States, Hong Kong, Mainland China, Spain, the Philippines, and Korea) (Cheng et al., 2016; Doménech-Betoret & Gómez-Artiga, 2014; Park et al., 2005; Saxena & Aggarwal, 2011; Torrance & Mourad, 1978). In the last three decades, efforts invested in the field of styles have yielded six major integrative models (see the review of Zhang, 2013). These models are: 1) Curry’s (1983) “Onion” model; 2) Miller’s (1987) model integrating cognitive styles and processes; 3) Riding and Cheema’s (1991) model of cognitive styles; 4) Grigorenko and Sternberg’s (1995) model of style tradition; 5) Zhang and Sternberg’s (2005) threefold model of intellectual styles; and 6) Sadler-Smith’s (2009) duplex model of cognitive styles. Among these models, Zhang and Sternberg’s (2005) threefold model of intellectual styles has attracted growing attention and has been extensively researched relating to diverse constructs, such as psychological development, organizational commitment, anxiety, creativity, and students’ academic achievements (e.g., Cheng et al., 2016; He, 2006; Park et al., 2005; Zhang, 2009).

According to the threefold model (Zhang & Sternberg, 2005), all extant intellectual styles converge on three types: Type I, Type II, and Type III. Type I styles are more creativity-generating, suggesting an orientation toward the autonomy, the unstructured, the higher levels of cognitive complexity, and the nonconformity. Type II styles are more norm-favoring, denoting an inclination for the authoritative, the structured, the lower levels of cognitive complexity, and the conformity. Type III styles, however, are a swinging *pendulum* “manifesting the characteristics of either Type I or Type II styles” (Zhang, 2013, p. 22), contingent on the nature of tasks or contexts. Under the umbrella term of intellectual styles, style constructs from 10 most researched individual style models are subsumed in Zhang and Sternberg’s (2005) threefold model. These 10 individual style models include, for example, Biggs’ (1991) learning approaches, Witkin et al.’s (1971) field dependence/independence, Holland’s (1973) career personality types, and, in particular, Sternberg’s (1997) thinking styles.

Sternberg (1997) proposed a mental self-government theory, arguing that, as is the case with government sectors that differ in functions, people differ in their ways of managing their daily activities. Such different ways of managing daily activities are people’s thinking styles. Using this metaphor, Sternberg (1997) brought forward 13 thinking styles: the legislative (handling problems in one’s own way), executive (following instructions), judicial (evaluating people or objects), monarchic (concentrating on one thing at a time), hierarchical (prioritizing tasks), oligarchic (tackling tasks without priorities), anarchic (attending to whatever task that arises), global (thinking holistically), local (focusing on concrete details), internal (working on one’s own), external (working in groups), liberal (seeking novel solutions), and conservative (conforming to established laws) styles.

Drawing on both empirical evidence and theoretical conceptualizations, Zhang (2002b) re-categorized these 13 thinking styles into three types. This is the foundation for constructing the threefold model (Zhang & Sternberg, 2005). Type I intellectual styles (Type I styles hereafter) include five thinking styles: the legislative, liberal, judicial, global, and hierarchical styles. Type II intellectual styles (Type II styles hereafter) include four thinking styles: the executive, conservative, monarchic, and local styles. The remaining four thinking styles are Type III: the oligarchic, anarchic, internal, and external styles. Style constructs from the other nine individual style models can likewise fall into any of the three types with which they have characteristics in common. For example, Type I styles can incorporate deep learning approach (Biggs, 1991), artistic career personality type (Holland, 1973), field independence (Witkin et al., 1977), and so on. Type II styles, in the meantime, can embrace surface learning approach (Biggs, 1991), conventional career personality type (Holland, 1973), field dependence (Witkin et al., 1977), and so on.

Consistent findings have been reported from previous research (e.g., Biggs, 1991; Holland, 1994; Witkin et al., 1977; Zhang, 2004b, 2015; Zhang & Jing, 2014) indicating that Type I styles are more adaptive and strongly associated with desirable outcomes (e.g., optimism, creativity, openness, and a clearer sense of identity), whereas Type II styles are more maladaptive, relating to undesirable outcomes (e.g., pessimism, conservativeness, neuroticism, and a lack of sense of identity). For example, Stansfield and Hansen’s (1983) early study of 250 college students’ performance in a second language course revealed that field independent students scored higher in test performance than did their field dependent peers. Most recently, through reviewing numerous studies (experimental and interventional) on thinking

styles over decades, Zhang (2015) concluded that Type I styles were superior to Type I styles in aspects concerning “general intelligence/ability, creativity, and developmental outcomes” (p. 185).

Zhang and Sternberg’s (2005) threefold model of intellectual styles is superior to the other integrative models in at least three ways. First, the threefold model is inclusive of all style labels, whereas each of the other models is even intolerant of the same styles with different labels. The second notable strength of the threefold model is that, by clustering all styles into three types, it has broken down the barriers in between all the models, thus providing a “common conceptual framework for styles” (Zhang, 2013, p. 23). Third, the threefold model has articulated its stand on three long-time controversies in the field of styles, positing that most styles are value-laden rather than value-free; that styles are in large part malleable; and that styles may overlap across theories.

Thinking Styles

Thinking styles are “a preferred way of thinking... [and] expressing or using one or more abilities” (Sternberg & Grigorenko, 1997, p. 202). In the present research, thinking styles were operationalized drawing on the threefold model. Much empirical evidence has indicated that thinking styles can help to make a difference in terms of self-efficacy, using one’s abilities, scientific giftedness, self-esteem, and so on (e.g., Cheng et al., 2016; Park et al., 2005; Zhang, 2010a; Zhang et al., 2012). In the meantime, understanding prospective teachers’ thinking styles may provide an insight into the relationship between these teachers and their learning environments. As Sternberg (1997) maintained, “[w]hen your profile of thinking styles is a good match to an environment, you thrive. When it is a bad match, you suffer” (p. x). Later, Zhang (2013) further argued for an environment-style congruence, positing that individuals develop certain intellectual styles favored by the contexts that matter. As a final note, Sternberg’s (1997) theory on thinking styles gives full consideration to the three traditions in the field of styles (i.e., “cognition-centered”, “personality-centered”, and “activity-centered”) (Zhang, 2013).

As suggested by the literature, intellectual styles do have a bearing on identity-related constructs. Research (e.g., Dozier et al., 2014; Lenz et al., 1993; Leong, 2014) drawing on Holland’s (1973) career personality types (one style model of intellectual styles) has suggested that intellectual styles are strongly associated with vocational identity. Also, studies (Zhang, 2002a, 2004a, 2008, 2010b; Zhang & He, 2011) based on Sternberg’s (1997) theory on thinking styles (another style model of intellectual styles) has demonstrated the relation between intellectual styles and psychosocial identity such as Chickering’s (1969) vocational purposefulness and Erikson’s (1968) identity development stages. One converging finding from prior research is: Type I creativity-generating styles rather than Type II norm-conforming styles positively contribute to psychosocial development.

There is evidence supporting the relations of intellectual styles to the four indicators of teacher identity (i.e., teacher self-efficacy, organizational commitment, motivation to teach, and job satisfaction). Findings have been mixed, however.

As regards the relationship between intellectual styles and teacher self-efficacy, in an experimental study among 178 pre-service teachers, Yeh (2006) conducted a training on guided teaching practices via a computer-simulation program. Results demonstrated that the Type I judicial thinking style was in strong relationship with analytical learning and reflective thinking that served as mastery experience to bring improvement in personal teaching efficacy. Yu and Zhu (2011) investigated the thinking styles of secondary school teachers from Hong Kong (N=94) and Macau (N=37). Results revealed that the Type I legislative styles significantly predicted the participants’ higher levels of efficacy in maintaining student-centered relationship characterized by helpfulness and freedom, whereas the Type II executive style was significantly associated with higher levels of efficacy in teacher-centered relationship highlighting strictness. More recent studies (Cheng et al., 2016; Zhu, 2013) also obtained similar findings.

With respect to the relationship between intellectual styles and organizational commitment, there are a handful of studies (e.g., Engstrom et al., 2010; Wypianski et al., 2001; Yoo, 1999) drawing on personality types (one style model of intellectual style (Myers, 1979). Evidence is also available from studies (e.g., Adler & Aranya, 1984; Chen et al., 2010; Thomas, 2013) harnessing Holland’s (1973) theory of career personality types (another style model of intellectual styles). Findings from these studies have converged on an understanding: when employees’ personality types or career personality types and their work environments are matched, they would tend to be committed to their organizations. Most recently, Zhang and Jing (2014) conducted a study further exploring the association between intellectual styles, based on Sternberg’s (1997) theory on thinking style, and organizational commitment as manifested through Meyer and Allen’s (1991) theory. This study recruited 370 faculty members from 15 higher educational institutions in Beijing, Mainland China. The researchers found that Type I teaching styles were positively related to affective commitment and normative commitment, whereas Type II teaching styles were positively related to continuance commitment and normative commitment.

Research on the association between intellectual styles and motivation to teach/learn has generated inconsistent findings. For example, drawing on Sternberg’s (1997) theory on thinking styles, Park et al. (2005) found that the learning motivation of 179 Korean scientific gifted students was significantly related to all the three types of thinking styles, particularly the Type II monarchic style. Similarly, based on the MBTI style model (Myers, 1979), Ayoubi and

Ustwani (2014) found that students of Type II Judging personality type (N=89) in Syria had a higher academic motivation, as defined by their like level for subjects, than did their peers with Type I Perceiving personality type. However, another two studies using Sternberg's (1997) theory reported different findings. In one study, Fan and Zhang (2009) examined the thinking styles of 238 Chinese university students against their achievement motivation as determined by Atkinson's (1964) theory (i.e., motivation to approach success versus motivation to avoid failure). In this study, the Type I liberal style was the primary positive contributor to the participants' motivation to approach success, whereas the Type II conservative style was the major positive predictor of motivation to avoid failure. In the other study, Zhu and Zhang (2011) surveyed 917 university students in Mainland China. Results revealed that intrinsic and task-focused motivation was negatively predicted by the Type II conservative style; and positively predicted by the Type I global and liberal styles and the Type II monarchical style at once.

Research on the interrelationships between thinking styles and teacher identity, though with mixed findings, has shed some light on teacher education. Therefore, it is of special value to investigate the thinking styles of pre-service teachers and new teachers, which would provide some implications for fostering their teacher identity and consequently enhance teacher development. To achieve that, it is necessary to prepare and customize a robust tool for examining these teachers' thinking styles. This is the aim of our study.

It should be noted that only two Type I (i.e., legislative and liberal) and two Type II (i.e., executive and conservative) styles were of interest in the present research. There are two reasons for selecting these four styles. First, all Type III styles were excluded because the highly task-dependent Type III styles are excluded in Grigorenko and Sternberg's (1995) conceptualization of thinking styles in teaching. Second, as defined in Sternberg's (1997) mental self-government theory, the Type I legislative style is directly opposite of the Type II executive style; and so is the Type I liberal style of the Type II conservative style (see also Zhang, 2008). Sharp contrast between these four selected styles would help to yield findings with better comparability and interpretability.

Methodology

Participants

Two independent samples participated in the current research. The sample one for the pilot study were 248 (55 males and 193 females) prospective teachers, aged $22.57 \pm .51$ years, just graduating from the Teachers College in a university in mainland China. The sample two participants for the main study were 252 (48 males and 204 females) first-year school teachers, aged 24.68 ± 1.32 years, who had accomplished their first year teaching work. Among them, 143 (57%) were teaching in senior high schools, 81 (32%) in junior high schools, and 28 (11%) in elementary schools. The participants ($n = 500$ in total) were later evenly split into two data subsets, either with approximately 250 cases. A sample of 250 participants were acceptable for factor analysis (see review of Kyriazos, 2018).

Measurement

Thinking styles were assessed by the Thinking Styles Inventory-Revised (TSI-R; Sternberg et al., 2007), the second revised version of the Thinking Styles Inventory (TSI; Sternberg, 1997). The developers evaluated theories and research on cognitive styles and proposed a mental self-government approach for the elucidation of thinking styles (Sternberg, 1997; Sternberg & Grigorenko, 1997). Based on the mental self-government theory, the developers scrutinized empirical evidence of interviews and focus groups with teachers and students and constructed the inventory measuring thinking styles in educational settings (Sternberg, 1997). In its full form, the TSI contains 65 items measuring 13 different thinking styles. The participants rated the items on a seven-point Likert scale (1= "not at all well"; 7= "extremely well") to indicate the degree to which they felt each item described the way in which they usually carried out tasks. Two sample items are: 1) "I like situations where I can use my own ideas and ways of doing things" (liberal); and 2) "When faced with a problem, I like to solve it in a traditional way" (conservative). The TSI-R2 has proved to be a reliable and valid instrument in studies across cultures, including but not limited to the United States, Hong Kong, Mainland China, Spain, Korea, the Philippines, and Iran (Alborzi & Ostovar, 2007; Bernardo et al., 2002; Park et al., 2005; Zhang & Higgins, 2008). A recent study (Zhu & Zhang, 2011) conducted in the Chinese context, for example, reported that the Cronbach's alpha values for the TSI-R2 were in the range of .62 (global) and .85 (liberal). Produced via an exploratory sequential pattern, the content validity of the TSI measurement has to some degree been ensured (Tabachnick & Fidell, 2007).

In the present research, however, only two Type I (i.e., the legislative and liberal) thinking styles and two Type II (i.e., the executive and conservative) thinking styles were retained containing 20 items. The original English version was translated into Chinese so that the Chinese participants could better understand the items. The translation and back-translation were carefully reviewed by experienced researchers and early career teacher representatives.

Data Collection

The pilot study was conducted among prospective teachers right after their graduation ceremony, during July 1st-5th, 2019, followed by the main study among first-year teachers on September 25th, 2019. The researchers approached these participants during class recesses. Brief oral instructions given and consent forms signed, the Thinking Styles Inventory-Revised II was administered together with the demographic sheet. All responses were returned in 30 minutes.

At the end of each study, opinions and comments were invited from randomly chosen participants. These opinions and comments not only helped to improve the intelligibility of inventory items, but also cautioned the researcher against biased results from, for example, ambiguous wording or vague instructions.

Data Analysis

Since the TSI-R2 had not been validated among the population of early career teachers, both an exploratory factor analysis (EFA) and a confirmatory factor analysis (CFA) were performed. The sample of pre-service teachers and the sample first-year teachers were merged (total $n = 500$) and was randomly split into two groups of approximately equal size by the SPSS 23. The results of random sample selection created the first half of the sample for the EFA ($n = 249$) and the second half of the sample for the CFA ($n = 251$) (Fokkema & Greiff, 2017; Gerbing & Hamilton, 1996). EFA was conducted to investigate the factors underlying the TSI, and the principal axis factoring methods with promax rotation were chosen for assessing the factor structure because it was theoretically assumed that the factors constructing thinking styles are highly likely to be correlated (Gorsuch, 2013). The factor solutions yielded by EFA may suggest necessary modifications of the questionnaire including rewording, reloading and even deleting. The revised factor solutions later were tested by CFA using AMOS 23 with the second half of the sample with 251 cases. The latent variables identified by the EFA and the observed variables were included in the CFA model. Good model fit indices were expected: Chi-square/df ratio less than 3, CFI, GFI and NFI greater than .90, TLI greater than .90, RMSEA less than .06, and SRMR less than .08 (Schumacker & Lomax, 2004). Finally, internal consistency of the TSI-R2 was also examined by calculating alpha reliability coefficients.

Results

Exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and reliability analysis were run.

Exploratory Factor Analysis

An Exploratory Factor Analysis was performed with the first half of sample ($n = 249$). The principal axis factoring methods with promax rotation were used to extract factors and explore the factor structure. Four factors with eigenvalue over 1.0 were extracted. The initial four-factor structure and rotated factor loading of each item are presented in Table 1. Factor loadings below the absolute value of .40 were suppressed, as a factor loading cut-off of .40 was chosen a priori suggested by psychometric literature (Tabachnick & Fidell, 2007).

The factor solutions explained a total of 43.12% of the variance in thinking styles. The four extracted factors corresponded to the theoretical taxonomy of Type I and Type II thinking styles. Two items theoretically belonging to the executive thinking styles, however, loaded on the factor denoting conservative thinking style, namely, Item 11 (.58) and Item 12 (.46). One item, Item 16 (.45), theoretically belonging to the conservative thinking style, loaded on the factor denoting executive thinking style. In addition, communalities of these three items were found to be lower than .40: Item 11 (.38), Item 12 (.29), and Item 16 (.31). This suggested a further examination on the three items.

Table 1. Factor Loadings of 20 Items of TSI-R2

Original Scale	Item No.	Factors			
		1	2	3	4
Type I	Lib1	.677			
	Lib2	.674			
	Lib4	.645			
	Lib3	.644			
	Lib5	.620			
	Leg2		.619		
	Leg4		.607		
	Leg1		.597		
	Leg5		.571		
	Leg3		.565		

Table 1. Continued

Original Scale	Item No.	Factors			
		1	2	3	4
Type II	Cons4	19		.837	
	Cons3	18		.824	
	Cons5	20		.713	
	Exe1*	11		.582	
	Cons2	17		.565	
	Exe2*	12		.463	
	Exe4	14			.811
	Exe5	15			.787
	Exe3	13			.759
	Cons1*	16			.454

Note. Lib: liberal; leg: legislative; Exe: executive; Cons: conservative. * Item examined further.

Based on the suggestions made earlier at the end of the pilot study, the TSI-R2 was slightly modified prior to the Confirmatory Factor Analysis. Three problematic items (Items 11, 12, and 16) were reworded in view of comments received during the EFA study, as follows:

Original Item 11: I like to figure out how to solve a problem following certain rules.

Revised Item 11: I like to figure out how to solve a problem following established rules.

Original Item 12: I am careful to use the proper method to solve any problem.

Revised Item 12: I carefully choose the proper method to solve problems.

Original Item 16: I stick to standard rules or ways of doing things.

Revised Item 16: I stick to established rules or ways of doing things.

Based on the factor loadings and meanings, the items were summarized as liberal thinking style, legislative thinking style, executive thinking style and conservative thinking style.

A Confirmatory Factor Analysis was conducted on the second half of the sample ($n = 251$) to examine the four-factor solution of the EFA. The four latent variables were the four factors of thinking styles and the 20 observed variables were the 20 items.

Initial results of the CFA were: $\chi^2/df = 119.13$, $p < .001$, GFI = .91, RMSEA = .08, CFI = .92, and NFI = .91. Slight modifications were made, following Meyers et al.'s (2013) approach, whereby error variances of four pairs of items (Items 1 and 2; Items 2 and 5; Items 11 and 12; Items 19 and 20) were correlated to reduce χ^2 values, based on their theoretical connections. Better fits were resulted, $\chi^2/df = 42.01$, $p < .001$, GFI = .94, RMSEA = .05, CFI = .96, NFI = .95, TLI = .94, and SRMR = .06. Figure 1 presents the path diagram of the final model.

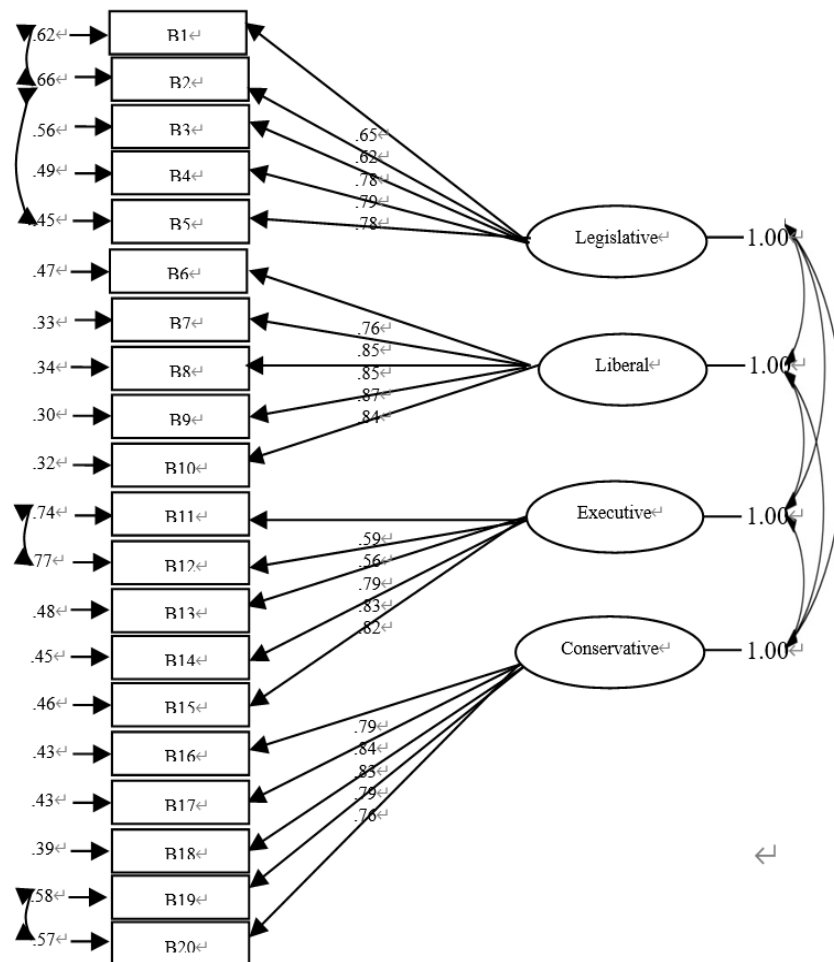


Figure 1. Confirmatory factor model of the TSI-R2 ($n = 251$)

Reliabilities of the TSI-R2 were calculated at two levels. At the style type level, Cronbach's alpha coefficients were .89 for Type I thinking styles and .85 for Type II thinking styles. At the individual style level, Cronbach's alpha coefficients were .87 (legislative), .90 (liberal), .83 (executive), and .88 (conservative). These alpha coefficients were in the same range as those in previous studies (e.g., Yu & Chen, 2012; Zhang & He, 2011). Reliability analysis further showed that the TSI-R2 had sound internal reliability because all the CR values were well above .70, according to Hair et al.'s (2010) criteria. To sum up, the modified TSI-R2 with 20 items under four factors applied well to the sample of pre-service teachers and first-year teachers of this study.

Discussion

The current study examined reliability and validity of the Thinking Styles Inventory-Revised II. With the results of EFA, CFA and reliability analysis, modifications were made. The final revised version was found to be reliable and valid to measure thinking styles of pre-service teachers and early career teachers.

In the final version of the TSR-R2, 20 items regarding to four styles within Type I (legislative and liberal) and Type II (executive and conservative) styles were included in the inventory; all items regarding to Type III styles were excluded. The Type III styles items were excluded in advance because the Type III styles are highly task-dependent. Driven on Grigorenko and Sternberg's (1995) conceptualization of thinking styles in teaching, only Type I (legislative and liberal) and Type II (executive and conservative) styles were particularly measured by the TSR-R2.

The data analysis validated the Type I/Type II version of the thinking style inventory. Although all the Type III items were eliminated, the revised one performed well with the sample of early career teachers. The reason might be, as defined in Sternberg's (1997) mental self-government theory, the Type I legislative style is directly opposite of the Type II executive style; and so is the Type I liberal style of the Type II conservative style (see also Zhang, 2008). Sharp contrast between these four selected styles would help to yield findings with better comparability and interpretability, suggesting the Type I/Type II version inventory a robust tool for examining thinking styles. In addition, the downsized inventory was kept to a reasonable length so as to help the participants maintain concentration when responding to the questions.

With modifications of dimensions and minor changes of item wording, the TSR-R2 is proved to be reliable and valid to measure thinking styles of pre-service teachers and early career teachers. This suggests that there probably exist differences in thinking styles between teachers at early phase and experienced in-service teachers. Such differences have been repeatedly evidenced by existing literature (Contreras et al., 2020; Kao & Mou, 2020). This finding of the current study seems to add weight to the argument that there is sharp contrast across teachers at different career phases in their cognition, beliefs and behaviors. This has some implications for future research. First, given the differences in thinking styles between early career teachers and veteran teachers, when researchers investigate teacher development, the early stage should not be ignored. Furthermore, a number of teacher factors—for example, teachers' teaching styles, teacher identity, teacher effectiveness (Algan, 2020) — are reported to be closely related to teachers' thinking styles. Therefore, understanding teachers' thinking styles at the early stage would enhance understanding how various individual differences in teachers are shaped and developed. Although recent studies have documented increasing empirical evidence of early career teachers' thinking styles (e.g., Algan, 2020; Güner & Erbay, 2021), a customized tool is in need to examine this specific teacher cohort. In this vein, the TSR-R2 could be employed in future research which aims to intervene teachers' thinking styles at the early stage.

Conclusion

The purpose of the present study was to validate the TSR-R2 questionnaire for measuring pre-service and early career teachers' thinking styles. Guided by Grigorenko and Sternberg's (1995) conceptualization of thinking styles, major modifications were proposed, that is, to retain the original Type I and Type II dimensions and eliminate the Type III from the original version. Later, reliability and validity of the proposed version were examined. With further minor changes in language of three items, the proposed new version was proved to be reliable and valid with the sample. Given the good performance of the inventory, the TSI-R2 generally is a promising measurement for assessing thinking styles of early career teachers.

Limitations

The first limitation of this validation study is that it has only examined the revised questionnaire in a single cultural context. The revised version has been proved to perform well with Chinese pre-service and early career teachers, but it does not necessarily mean it adapts to teachers within differential cultural contexts. The second methodological limitation is related to the sample size. As suggested by literature, a factor analysis sample of 200-300 is just graded as fair (see review of Kyriazos, 2018). The issue of sample size has critical effects on the precision of all statistical estimates, including those made in EFA and CFA. However, the current study failed to recruit more participants to join this validation test because of the comparatively small population of early career teachers. We understand that it is of great importance to conduct psychiatric measurements of teachers at their early career phase. Therefore future, research is needed to design larger scale studies among this teacher cohort. What is also worth mentioning is that this study failed to use multiple extraction rules to determine the number of factors (Williams et al., 2010). Multiple extraction techniques should be adopted in further explorations.

Recommendations

In future research, scholars could conduct research to address the limitations. First, a cross-culture study appears to be valuable. To validate the TSR-R2 questionnaire with teacher participants from various cultural background is critical to enhance reliability and validity. The problems of the methodology should also be addressed. For example, a sample of more than 300 participants would be better to validate the modified inventory. If multiple techniques are used to extract and identify factors in the EFA, the factor solutions would be more convincing.

This study has only focused on a comparatively narrow scope of thinking styles. Since teachers' thinking styles are merely one facet of the sophisticated construct — intellectual styles, it would be significant to examine thinking styles together with other teacher variables under the umbrella of intellectual styles, for example, teaching styles, cognitive styles, decision-making and problem-solving styles. Furthermore, we suggest to integrate the TSR-R2 questionnaire with the measurements of other teacher variables (e.g., teaching identity, teaching effectiveness). Incorporated into the construct of teacher characteristics, this questionnaire could be employed by multi-facet studies which may make greater contributions to academic work.

Authorship Contribution Statement

Z. Li: Conceptualization, design, analysis, writing. B. Li: Conceptualization, design, analysis, editing/reviewing.

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