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Profiles of Mathematics Teachers' Job Satisfaction and Stress and Their Association with Dialogic Instruction

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Abstract: High-quality mathematics instruction is a primary element for quality education and the sustainable development of society. Some studies have highlighted the critical role of teacher job satisfaction and stress on their instruction. However, limited research has focused on the combinational influence of job satisfaction and stress on mathematics teachers' dialogic instruction. This study aims to examine their combinational influence on mathematic teachers' dialogic instruction using latent profile analysis and draws three conclusions. First, this study found three profiles: high job satisfaction and very low stress, very low job satisfaction and high stress, and moderately high job satisfaction and slightly high stress. Second, latent profile membership was differentially related to self-efficacy and leadership support. Third, mathematics teachers with very low job satisfaction and high stress were less likely to implement dialogic instruction compared to teachers in other profiles. This study also provides implications based on these results.

Keywords: teachers job satisfaction; teacher stress; dialogic instruction; mathematics teacher; latent profile analysis

Citation: Hwang, S. Profiles of Mathematics Teachers' Job Satisfaction and Stress and Their Association with Dialogic Instruction. *Sustainability* **2022**, *14*, 6925. https://doi.org/10.3390/su14116925

Academic Editors: Hongbiao YIN, Ronnel Bornasal King and Guoxiu Tian

Received: 23 April 2022
Accepted: 3 June 2022
Published: 6 June 2022

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1. Introduction

High-quality mathematics instruction is a primary element for quality education and the sustainable development of society [1,2]. The current reform movement in mathematics education has emphasized the importance of dialogic instruction [2–5]. In dialogic instruction, teachers are expected to work as facilitators of student conversation and wait for students to find answers to problems using conjecture, argument, and justification [3]. However, studies show that some US teachers are reluctant to implement dialogic instruction [6–8]. Thus, it is critical to determine the factors affecting mathematics teachers' implementation of dialogic instruction.

Increasing studies have reported the relationships between mathematics teacher job satisfaction and stress in teaching practice [9,10]. Because job satisfaction and stress are linked to teachers' commitment, engagement, emotional exhaustion, student support, self-efficacy, and burnout, teacher job satisfaction and stress influence their instructional practice [11–15]. Considering dialogic instruction requires teachers' intensive effort and commitment [4], we could assume that mathematics teachers with high job satisfaction and low level of stress are more likely to implement dialogic instruction. However, most researchers have separately examined the influence of job satisfaction and stress on teacher instruction (e.g., [10,12,16,17]), based on a variable-centered approach [18,19]. Thus, we have little information about the combinational influence of mathematics teachers' job satisfaction and stress on dialogic instruction.

Moreover, most previous studies did not consider heterogeneity within the teacher population by assuming that the associations between factors can be applied to all teachers in the same way (e.g., [14,17,20–22]). However, the association between teacher job satisfaction and stress with dialogic instruction might vary based on different teacher

profiles. Some mathematics teachers are more likely to implement dialogic instruction than other teachers.

Considering the limitations of previous studies, this study adopted a person-centered approach [18]. The person-centered approach helps examine not only the existence of different teacher subgroups (i.e., profiles) within a population [19,23,24] but also the combinational influence of mathematics teachers' job satisfaction and stress, which operate simultaneously [10,21]. In particular, this study used latent class analysis (LCA), which "allows for a description of individuals by classifying them into mutually exclusive subgroups" [25] (p. 551). This study then examined the relationships between predictor variables (i.e., teacher internal and external factors) and latent profile memberships and between latent profile memberships and dialogic instruction. In particular, this study used data drawn from Trends in International Mathematics and Science Study (TIMSS) 2015 for US mathematics teachers, which were selected from a nationally representative sample.

2. Literature Review

2.1. Conceptual Framework

This study used the job demands–resources model [15] as a foundation for the conceptual framework (see Figure 1). According to the model, individual and organizational outcomes (e.g., job satisfaction, commitment, and teacher performance) are related to job resources, personal resources, and job demands. The job resources relate to school climate, social support, and leadership support. The personal resources include teacher mental and emotional competencies, self-efficacy, and adaptability. These two resources boost the outcomes and buffer the negative effects of job demands on the outcomes. In addition, the job demand (e.g., workload and student misbehavior) lessens the positive effects of two resources on the outcomes and negatively affects the outcome.

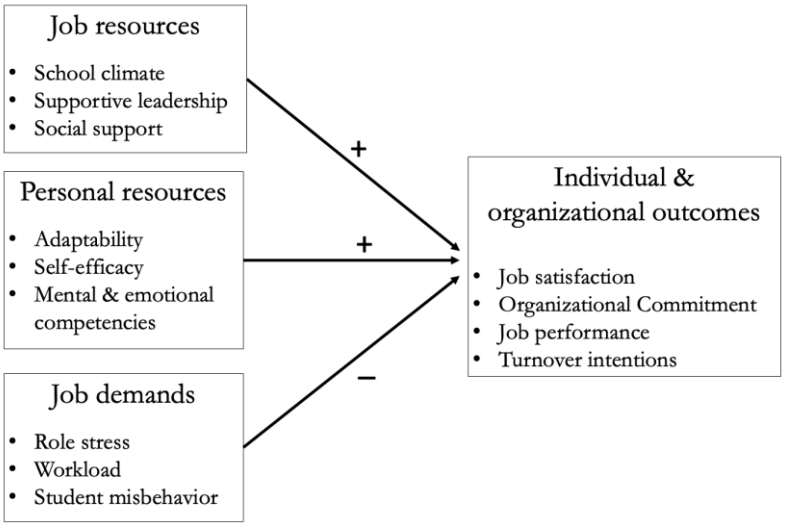

Figure 1. Job demands–resources model (adapted from Bakker and Demerouti [15]).

This study revised the job demands–resources model [15] considering the research purposes and the characteristics of TIMSS data. Figure 2 depicts the revised model used for this study. The revised model only focused on mathematics teachers' dialogic instruction as a distal outcome compared to the original model. Moreover, job resources, personal resources, and job demands were combined and reclassified into teacher internal and external factors. Because this study used job satisfaction and stress as latent profile indicators and examined other teacher personal characteristics (e.g., gender), the original model did not fit the current study's variable structure.

Additionally, TIMSS data did not include some elements of the job demands–resources model (e.g., adaptability and mental and emotional competencies) [7,26]. In summary, building upon previous research on teacher job satisfaction and stress [14,16,17,21,22,27,28], teacher internal factors contain self-efficacy, gender, years of teaching, and college major, whereas teacher external factors include leadership support, school safety, student behavior, school condition, and colleague support. These covariates predict mathematics teachers' latent profile membership, which influences their implementation of dialogic instruction.

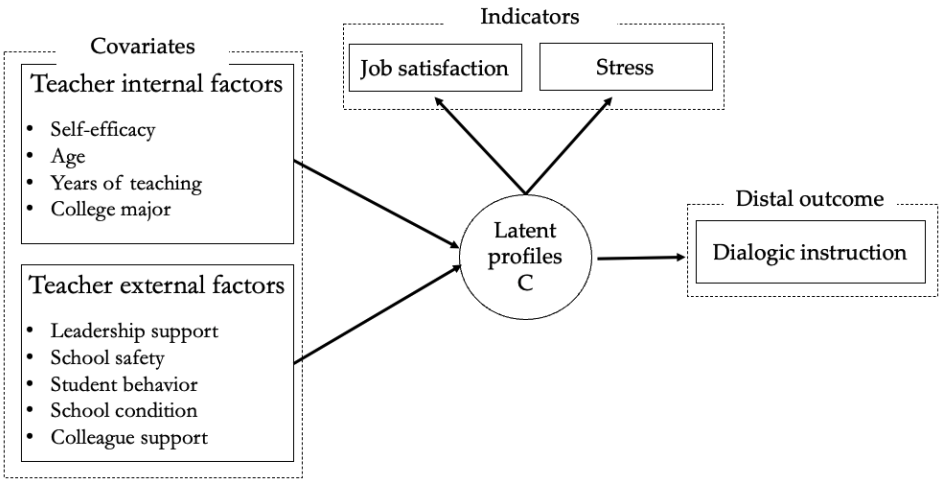

Figure 2. Conceptual framework of this study.

2.2. Teacher Job Satisfaction

Job satisfaction is a status of emotion aroused during the interaction with the people and environment in the workplace [13,21]. Teachers evaluate job satisfaction by comparing desired job environment with incumbent status [15]. Thus, job satisfaction contains both emotional and cognitive aspects [20]. In this perspective, teacher job satisfaction can be defined as "the sense of fulfillment and gratification that teachers experience [and evaluate] through their work as a teacher" [29] (p. 43).

Evans [30] conceptualized teacher job satisfaction as a component of job fulfillment and job comfort. The job fulfillment indicates teachers' satisfaction with their performance (or accomplishment), whereas the job comfort relates to teachers' satisfaction with their job conditions. Similarly, the Teaching and Learning International Survey (TALIS) [31] classified teacher job satisfaction across two dimensions, including satisfaction with the profession ("If I could decide again, I would still choose to work as a teacher") and satisfaction with the current work environment (e.g., "I enjoy working at this school").

As teacher job satisfaction is linked to teacher retention, burnout, self-efficacy, commitment, motivation, and student performance, substantial research has been conducted to understand factors predicting teacher job satisfaction [11,14,17,20,32]. Those studies have confirmed that teacher intrinsic and extrinsic factors are related to their job satisfaction. The intrinsic factors include self-efficacy, age, gender, years of teaching, and college major. Regarding self-efficacy, most studies have reported a significant positive relationship between teacher self-efficacy and job satisfaction [12–14,21,32]. For example, Sun and Xia [32] examined TALIS 2013 data, which consisted of 117,876 teachers from 34 countries. They reported that teacher self-efficacy directly affected job satisfaction and mediated the relationship between school leadership and job satisfaction.

However, researchers have reported mixed findings regarding the relationship between job satisfaction and other personal variables. In a study examining 434 Chinese teachers' job satisfaction, Bolin [33] reported that male teachers and teachers with greater years of teaching were likely to have a high level of job satisfaction. However, Toropova

et al. [22] examined 195 Swedish mathematics teachers in TIMSS and reported that female teachers had higher job satisfaction than male teachers. Because male teachers were dissatisfied with low salaries and lack of promotion, they viewed teaching as insufficient for male adults [34]. Moreover, Toropova et al. [22] reported that the relationships between job satisfaction with college major, years of teaching, and types of teacher certification were not significant.

The extrinsic factors include leadership support, school safety, student behavior, school condition, and colleague support. Johnson and Kraft [35] examined 25,135 US teachers in 1142 schools and found that the supportive school environments were the most significant factors that affect teacher job satisfaction. They reported that the conceived social conditions—school culture, principal leadership, and relationships with colleges—are more related to teacher job satisfaction than the working environment (e.g., school building conditions and resources). Because a positive school climate helps teachers develop their professional identity and self-efficacy, teachers in such schools are more likely to experience positive emotions [14,21].

These findings are supported by a recent study by Toropova et al. [22]. The authors found that teacher workload, cooperation with colleagues, self-efficacy in teaching, and student behavior were strongly linked to job satisfaction. Similar findings were also reported by the study of Zakariya [14], who examined 3951 Norway teachers participating in TALIS 2018. These findings revealed that teachers with heavy workloads, disruptive students, and unsupportive leaders and colleagues are likely to have low job satisfaction, whereas teachers who receive professional support from their leaders and colleagues and teach disciplined students are likely to have high job satisfaction.

2.3. Teacher Stress

Teacher stress refers to "the experience by a teacher of unpleasant emotions resulting from aspects of the work as a teacher" [11] (p. 1786). Studies have reported that approximately 30% of teachers experience extreme stress due to their job, which is more severe than ordinary adults [27,36]. For example, Steiner and Woo [27] surveyed 2075 US adults and reported that 78% of US teachers frequently experienced job stress, which was almost double than that of other employed adults (40%).

Similar to job satisfaction, teacher stress is linked to teacher health, burnout, commitment, performance, and student learning outcomes [15,35,37]. Therefore, it is critical to understand the potential stressors and help teachers reduce job-related stress, including classroom stress and workload stress [38]. According to the job demands–resources model [15], stress is caused by a higher level of demands and greater lack of resources than one's expectations. Thus, potential stressors could be classified into internal and external factors. Regarding teacher internal factors, Klassen and Chiu [21] examined 1430 teachers in Canada and reported a negative relationship between teacher self-efficacy and stress. Researchers in Norway [12], US [39], and Spain [37] also reported similar findings.

Moreover, studies have reported that female teachers are likely to have a higher level of stress than male teachers, though the difference was small [21,37]. Researchers have posited that female teachers might be more sensitive to student misbehavior than male teachers, which leads to different levels of classroom stress [21]. However, the relationship between years of teaching and stress was not significant [21,37].

The external factors included student misbehavior, parent pressure, heavy workload, lack of support from school leaders and colleagues, time pressure, high stack testing, and low-quality school conditions [16,27,28,40,41]. For example, in a study examining 523 teachers in Norway, Skaalvik and Skaalvik [12] concluded that teachers with low student motivation, lack of leadership support, and value conflicts with colleagues were likely to have a high level of stress. Studies examining teachers in Greece [16], US [40], and Uganda [41] also reported the effects of external factors on teacher stress.

In another study examining 180 teachers in China, Hu et al. [42] reported that the effect of school climate (i.e., teacher external factors) on teacher stress was mediated by

teacher self-efficacy. These findings revealed that when teachers have a high level of self-efficacy, they might interpret poor school conditions more optimistically, since teacher self-efficacy might help them overcome the limitations of school climate, which in turn reduces their stress [42–44].

2.4. Mathematics Teachers' Teaching Practice

Mathematics educators have emphasized the importance of dialogic instruction [2–4]. The National Council of Teachers of Mathematics (NCTM) [2] in the US highlighted that mathematics instruction "should be centered on engaging students in solving and discussing tasks that promote reasoning and problem solving" (p. 10). Mathematics educators have suggested similar arguments in the UK, China, South Korea, and the Netherlands [5,45,46].

Unlike direct instruction, where teachers dominate classroom discourse, limit student engagement, and directly explain mathematical concepts, the dialogic instruction encourages student engagement, discussion, participation, and investigation [3,4,46]. Mathematics teachers facilitate student collaboration and share their authority with students. Moreover, they provide cognitively challenging tasks to stimulate students' mathematical thinking and discussions [3,4,47]. Because students' ideas are respected, justified, and examined by their peers, students who learn mathematics with dialogic instruction tend to develop mathematics motivation and positive attitudes toward mathematics [45,48]. In turn, these students tend to acquire accurate mathematical understanding and achieve high performance [4,45,48,49]. However, some US mathematics teachers implement direct instruction by limiting student discussion and engagement [6–8,50].

Researchers have identified various factors affecting mathematics teachers' dialogic instruction, including knowledge [51], beliefs [52], self-efficacy [46], and types of teacher certification and major [53]. Meanwhile, some researchers have claimed that teachers' job satisfaction and stress affect their teaching practices [6,9,10,28,46]. In a study examining 132 mathematics teachers in Belgium, Opdenakker et al. [9] reported that teachers with a high level of job satisfaction were willing to invest more time and effort to support students' learning and encourage their participation in mathematics lessons. In another study, Klusmann et al. [10] examined the relationship between mathematics teachers' occupational well-being (e.g., job satisfaction and stress) and instructional practice. The authors reported that teachers with a high level of well-being tended to support student cognitive autonomy (i.e., teachers let students devise their own strategies).

In addition, teachers with a low level of job satisfaction and high level of stress tend to dominate classroom discussion due to the low level of self-efficacy in teaching and high levels of burnout and attrition [11,14,28,46]. Therefore, we could assume that when mathematics teachers have a high level of job satisfaction and low stress level, they are apt to implement dialogic instruction more to maximize student engagement and discussion [6,28,46]. However, previous studies did not examine the combinational influences of job satisfaction and stress on dialogic instruction or consider heterogeneity within the teacher population (e.g., [10]). Thus, less is known about the relationship between mathematics teachers' job satisfaction and stress and their dialogic instruction across different teacher profiles.

2.5. The Present Study

Today's societies are becoming more complex and changing rapidly. Individuals are confronted with new difficulties that they have little experience with, including economic, natural, and viral disasters [54,55]. To achieve sustainable development in our society, the United Nations and OECD have emphasized the importance of quality education and qualified teachers, who could help equip students with various competencies and skills [55–57]. Although there is a lack of agreement regarding qualified teachers, mathematics educators have highlighted that qualified mathematics teachers should implement dialogic instruction [4]. Because students experience collaboration, investigation, critical

thinking, and discussion to solve cognitively challenging real-life problems [3], students might be empowered to contribute to sustainable development. Moreover, mathematics teachers' dialogic instruction positively affects student mathematics motivation and achievement, which lead to suitable educational development [45,48]. Thus, understanding the factors affecting teachers' implementation of dialogic instruction is critical.

To overcome the limitations of previous studies, this study adopted a person-centered approach, wherein teachers were classified based on their characteristics [24]. This approach helps more accurately understand the relationship between teacher job satisfaction, stress, covariates (i.e., teacher internal and external factors), and the implementation of dialogic instruction.

As illustrated in Figure 2, this study first identified mathematics teacher profiles by using two indicators, including job satisfaction and stress. Then, the study examined how covariates predict their profile memberships, which allows researchers to understand the influence of covariates on teacher variations. Last, the relationship between profile memberships and dialogic instruction was examined. The research questions examined in this study are as follows:

RQ 1. What are the latent profile memberships of mathematics teachers?

RQ 2. What are the significant covariates predicting the latent profile memberships of mathematics teachers?

RQ 3. How are latent profile memberships related to mathematics teachers' implementation of dialogic instruction?

3. Methods

3.1. Data Sources and Participants

This study used TIMSS 2015 US grade 8 mathematics data to examine the research questions. TIMSS is implemented by the International Association for the Evaluation of Educational Achievement and is widely used by international researchers to compare and enhance the educational systems of different countries [7]. TIMSS researchers examined fourth- and eighth-grade students' mathematics and science achievement and surveyed students, parents, teachers, and school leaders to determine the factors that affect student achievement. TIMSS researchers recruited participants using a stratified cluster sampling method [26]. They first chose representative schools in each country and selected one or two classrooms from the schools. In TIMSS 2015, teachers in 44 countries and their students participated in the assessment. The US grade 8 mathematics data consisted of 429 mathematics teachers from 246 schools and their students. However, we only included 370 teachers' data, as 59 teachers did not provide data on job satisfaction, stress, and dialogic instruction. Of the participants, 122 teachers majored in mathematics or mathematics education at college (32.9%). A total of 245 teachers were female (66.3%), and the average years of teaching for participants was 13.35 (ranging from 1 to 43).

3.2. Measures

All data used in this study are openly available from TIMSS database (https://timssandpirls.bc.edu/timss2015, accessed on 13 January 2022). The validity of the individual scales was examined by TIMSS researchers [26]. The information on the study variables, including Cronbach's α and sample questions, are presented in Table 1. All items were reverse-coded to enhance interpretability. For example, the high scores of leadership support indicated that mathematics teachers receive sufficient support from their school leaders. The lowest Cronbach's α was 0.78 (school safety), which suggests that all scales had high internal consistency [58].

Table 1. Information of major study variables (Adapted from TIMSS 2015, Mulls).

Variable (#, α)	Range	Sample Questions
LCA indicator variables		
Job satisfaction (7, 0.93)	1 (very often)–4 (never or almost never)	- I am content with my profession as a teacher - I am satisfied with being a teacher at this school
Stress (8, 0.79)	1 (agree a lot)–4 (disagree a lot)	- I have too many administrative tasks - I have too many teaching hours
Covariates		
Self-efficacy (9, 0.92.)	1 (very high)–4 (very low)	- I have confidence in inspiring students to learn mathematics - I have confidence in developing students' higher-order thinking skills
Leadership support (3, 0.89)	1 (very high)–5 (very low)	- Amount of instructional support provided to teachers by school leadership - School leadership's support for teachers' professional development
School Safety (3, 0.78)	1 (agree a lot)–4 (disagree a lot)	- I feel safe at this school - This school has clear rules about student conduct
Student behavior (3, 0.93)	1 (agree a lot)–4 (disagree a lot)	- The students behave in an orderly manner - The students respect their teachers
School condition (7, 0.83)	1 (Not a problem)–4 (serious problem)	- The school building needs considerable repair - Teachers do not have adequate instructional materials and supplies
Teacher cooperation (7, 0.90)	1 (very often)–4 (never or almost never)	- I collaborate in planning and preparing instructional materials - I visit another classroom to learn more about teaching
Distal outcome		
Dialogic instruction (7, 0.80)	1 (every or almost every lesson)–4 (never)	- I ask students to explain their answers - I encourage classroom discussions among students

Note. # indicates the number of items; α indicates Cronbach's alpha. All items were reverse-coded.

3.2.1. Latent Profile Indicators

The latent profile indicators consisted of job satisfaction and stress scales. Teachers reported their job satisfaction, with seven items asking about their satisfaction with their profession (e.g., "I am content with my profession as a teacher") and current work environment (e.g., "I am satisfied with being a teacher at this school"). The stress scale consisted of eight items. Instead of directly measuring the degree of stress, TIMSS researchers asked the degree of overburden teachers feel at work, following previous studies [59], such as workload stress (e.g., "I have too many administrative tasks") and classroom stress (e.g., "I have too many teaching hours").

3.2.2. Covariates

Covariates consisted of teacher internal and external factors. Regarding internal factors, self-efficacy, gender, years of teaching, and teacher major were used. The eight items used for the self-efficacy scale asked about mathematics teachers' confidence in implementing instructional strategies and enhancing student participation in classes ("I have confidence in inspiring students to learn mathematics"). Gender (1: female; 2: male) and

teacher major (1: other majors; 2: major in mathematics or mathematics education) were coded as a binary variable.

The teacher external factors consisted of the following five scales: leadership support, school safety, student behavior, school condition, and teacher cooperation. The leadership support scale examined teachers' reflections on their school leaders' support for their instruction and professional development with three items (e.g., "Amount of instructional support provided to teachers by school leadership"). The school safety scale assessed teachers' evaluation of school safety and rules with three items (e.g., "I feel safe at this school"). The student behavior scale consisted of three items and assessed teachers' perceptions about their students' behavior toward teachers and school property (e.g., "The students are respectful of the teacher"). The school condition scale consisted of seven items asking about the conditions of school facilities (e.g., "The school building needs significant repair") and instructional resources (e.g., "Teachers do not have adequate instructional materials and supplies"). The teacher cooperation scale asked the degree of teacher collaboration on mathematics instruction (e.g., "I collaborate in planning and preparing instructional materials") with seven items.

3.2.3. Outcome Variable

The outcome variable was mathematics teachers' dialogic instruction and was measured through seven items. The items asked the frequencies of dialogic instructional activities, which could enhance student investigation (e.g., "I link new content to students' prior knowledge"), participation (e.g., "I ask students to explain their answers"), and discussion (e.g., "I encourage classroom discussions among students").

3.3. Data Analysis

All values were transformed into z-scores (mean = 0, standard deviation = 1) for LPA, and missing data were handled using full information maximum likelihood. Mplus 8.2 was used for data analysis. Regarding RQ 1, a series of LPAs was performed using two latent profile indicators (job satisfaction and stress) to determine the optimal number of profiles. Based on the previous literature [18,19,24,60,61], several fit criteria were used to identify the best fitting model. First, Akaike information criteria (AIC), Bayesian information criteria (BIC), sample-size adjusted BIC (SABIC), and entropy values were examined. The lower AIC, BIC, and SABIC values indicate the better model fit, whereas the higher entropy value indicates the better model fit. While there is no consensus regarding the cutoff value for entropy, an entropy value greater than 0.60 is considered acceptable [60].

Second, the following two likelihood ratio tests were used: Lo Mendell Rubin maximum likelihood ratio test (LMRT) and bootstrap likelihood ratio test (BLRT). The nonsignificant LMRT and BLRT values for the k profile can be interpreted as the model with a $K - 1$ profile has a more accurate classification than a model with a K profile [24]. Third, the sample size of individual profiles was examined. A profile with a small sample size ($n < 50$) could not be used to represent the characteristics of participants [18]. Thus, a model where all profiles had at least 50 teachers was selected.

Moreover, when selecting the final model, theoretical reasonableness and meaningful interpretation of the classification were considered. After defining the optimal number of profiles, each teacher was assigned to one of the most likely profiles. Then, the model constraint command in Mplus was used to determine significant mean differences in job satisfaction and stress between profiles.

For RQ 2, this study implemented multinomial logistic regression analysis to examine whether the covariates predicted the profile membership of mathematics teachers. For RQ 3, this study explored significant mean differences in mathematics teachers' implementation of dialogic instruction (i.e., distal outcome) according to their different profiles. For these analyses, this study used a three-step approach [61,62].

4. Results

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics of the study variables. The Pearson's correlation analysis indicated that teacher job satisfaction and stress were not related to gender, years of teaching, and teacher major. The job satisfaction was negatively associated with stress (r = −0.34), and the relationships with other variables were positively significant. However, stress was negatively related to most variables, except for dialogic instruction. These results indicated that the variables that might enhance teacher job satisfaction (e.g., leadership support) were likely to reduce their stress, whereas the variables that might decrease teacher job satisfaction (e.g., low level of self-efficacy) were likely to increase their stress.

Table 2. Descriptive statistics of study variables.

No	Variable	*M*	*SD*	Pearson's r Correlations										
				2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Job satisfaction	3.28	0.67	−0.34 **	0.31 **	0.46 **	0.29 **	0.42 **	0.30 **	0.32 **	0.27 **	−0.04	0.03	0.03
2	Stress	2.64	0.57		−0.10 *	−0.29 **	−0.17 **	−0.19 **	−0.28 **	−0.13 *	−0.02	−0.09	−0.03	0.00
3	Leadership support	3.59	0.83			0.26 **	0.27 **	0.39 **	0.36 **	0.51 **	0.19 **	0.00	0.06	0.07
4	School safety	3.57	0.57				0.04	0.62 **	0.38 **	0.17 **	0.04	0.01	0.10	0.03
5	Student behavior	2.99	0.86					0.16 **	0.37 **	0.20 **	0.14 **	−0.06	0.09	0.00
6	School condition	3.35	0.59						0.06	0.26 **	0.86	0.00	0.03	0.03
7	Teacher cooperation	2.58	0.72							0.24 **	0.23 **	−0.04	−0.09	0.06
8	Self-efficacy	3.06	0.58								0.49 **	0.07	0.14 **	0.07
9	Gender	1.34	0.47									−0.13 *	−0.05	−0.03
10	Years of teaching	13.36	90.63										0.05	0.10
11	Teacher major	1.67	0.47											0.11 *
12	Dialogic instruction	3.34	0.49											

Note. Gender (1: female; 2: male) and teacher major (1: other majors; 2: major in mathematics or mathematics education) were coded as a binary variables. * $p < 0.05$. ** $p < 0.01$.

4.2. Identification of Latent Profiles

The LPAs were performed using two indicators, including job satisfaction and stress (see Table 3). The LPA was stopped at the four-profile model because the p-values of LMRT and BLRT were greater than 0.50, indicating the three-profile model is better than the four-profile model [24]. Moreover, the four-profile model contained two groups with less than 50 participants, which means that the two groups could not be used due to the "trustworthy generalization" [18] (p. 889) issue. Thus, this study excluded the four-profile model and compared fit indices of the two- and three- profile models. While the entropy value of the two-profile model was higher than the three-profile model, the results of AIC, BIC, SABI, LMRT, and BLRT supported the three-profile model. Considering the entropy value is relatively inaccurate, and BLRT, BIC, and SABIC outperformed the other tests [18,24], this study selected the three-profile model as the best fitting model for the data.

Table 3. Fit indices for LCA models (n = 370).

Model	AIC	BIC	SABIC	Entropy	LMRT	BLRT	Profile Sizes
2 profiles	2038.35	2065.75	2043.54	0.69	0.032	<0.001	119; 251
3 profiles	2029.07	2063.20	2036.48	0.63	0.042	<0.001	51; 94; 225
4 profiles	1995.94	2046.81	2005.57	0.72	0.46	0.16	42; 137; 161; 30

4.3. Description of Latent Profiles

Table 4 shows the description of the latent profiles. Profile 1 consisted of 51 teachers (13.8%). They showed the highest level of job satisfaction and the lowest level of stress. Profile 2 comprised 94 teachers (25.4%). They showed the lowest level of job satisfaction and the highest level of stress. Profile 3 consisted of 225 teachers (60.8%) and was characterized by a moderately high level of job satisfaction and a slightly high level of stress.

Table 4. Description of the latent profiles.

Variable	Profile 1 (n = 51, 13.8%)		Profile 2 (n = 94, 25.4%)		Profile 3 (n = 225, 60.8%)		Significant Mean Differences
	M	*SD*	*M*	*SD*	*M*	*SD*	
Job satisfaction	0.73	0.10	−1.30	0.06	0.42	0.17	2 < 1 **; 2 < 3 **
Stress	−1.60	0.34	0.63	0.06	0.14	0.11	1 < 2 **; 1 < 3 **; 3 < 2 **

Note. ** $p < 0.01$.

Mean differences were examined to determine the characteristics of each profile. Profiles 1 ($M = 0.73$) and 3 ($M = 0.42$) had significantly higher job satisfaction scores than profile 2 ($M = -1.30$). While the job satisfaction score of profile 1 was higher than profile 3, the difference was not significant. Regarding stress, profile 2 ($M = 0.63$) had a significantly higher score than profiles 1 ($M = -1.60$) and 3 ($M = 0.14$). Additionally, the mean difference between profiles 1 and 3 was significant. Considering the distinctive characteristics of individual profiles, they were labeled as high job satisfaction and very low stress (profile 1), very low job satisfaction and high stress (profile 2), and moderately high job satisfaction and slightly high stress (profile 3). Figure 3 illustrates the standardized mean scores of the three profiles.

Figure 3. Standardized mean scores of three profile model.

4.4. Prediction of Latent Profile Membership

The prediction of latent profile membership was examined using covariate analyses. Profiles 2 to 3 were used as reference profiles. The analysis results are presented in Table 5 with logits and odds ratios (*OR*). First, the very low job satisfaction and high stress (profile 2) was used as a reference profile. When comparing profile 1, self-efficacy and leadership support was significant. Furthermore, when comparing profile 3, self-efficacy, leadership support, and student behavior were significant. These findings revealed that mathematics teachers who had a high level of self-efficacy and received sufficient support from school leaders tended to have a higher level of job satisfaction and lower level of stress than their counterparts. Moreover, teachers who taught disciplined students were more likely to be in profile 3 than profile 2.

Second, moderately high job satisfaction and slightly high stress (profile 3) was used as a reference profile. When comparing high job satisfaction and very low stress (profile 1), no significant difference was observed across all covariates.

Table 5. Covariate relationships by latent class.

Profile	Covariates	Reference Profile					
		Profile 2			Profile 3		
		B	*SE*	OR	*B*	*SE*	OR
Profile 1	Leadership support	0.99 **	26	2.71	0.18	0.22	1.19
	Student behavior	0.49	29	1.64	0.09	0.27	1.09
	Teacher cooperation	0.03	24	1.03	0.06	0.21	1.06
	School condition	−0.59	33	0.55	−0.40	0.32	0.67
	School Safety	0.33	30	1.39	0.21	0.29	1.23
	Self-efficacy	0.52 *	23	1.67	0.17	0.22	1.19
	Gender	0.30	21	1.34	0.26	0.17	1.30
	Years of teaching	0.17	20	1.19	0.24	0.17	1.28
	Teacher major	−0.05	22	0.95	−0.01	0.19	0.99
Profile 3	Leadership support	0.82 **	20	2.27			
	Student behavior	0.41 *	17	1.50			
	Teacher cooperation	−0.03	17	0.97			
	School condition	−0.20	18	0.82			
	School Safety	0.12	17	1.13			
	Self-efficacy	0.34 *	15	1.41			
	Gender	0.03	16	1.03			
	Years of teaching	−0.07	14	0.93			
	Teacher major	−0.03	16	0.97			

Note. OR indicates odds ratio. * $p < 0.05$. ** $p < 0.01$.

4.5. Relationship between Latent Profile Membership and Dialogic Instruction

A series of mean difference tests were implemented to compare the distal outcome. Table 6 reports the mean of the dialogic instruction scores for three profiles. The dialogic instruction scores of profiles 1 ($M = 0.19$) and 3 ($M = 0.09$) were significantly higher than profile 2 ($M = -0.31$). While the dialogic instruction scores of profile 1 were higher than that of profile 3, the difference was not significant. These results indicated that, generally, mathematics teachers with higher job satisfaction and lower stress were more likely to implement dialogic instruction than teachers with the very low job satisfaction and high stress profile.

Table 6. Comparison of distal outcome across profiles.

Distal Outcome	Profile 1		Profile 2		Profile 3		Significant Mean Differences
	M	*SD*	*M*	*SD*	*M*	*SD*	
Dialogic instruction	0.19	0.16	−0.31	0.12	0.09	0.07	2 < 1 **; 2 < 3 **

Note. ** $p < 0.01$.

5. Discussion

Mathematics teachers' dialogic instruction is one of the critical factors affecting student achievement and motivation [3,45,48,49]. Thus, it is important to understand the factors that affect mathematics teachers' dialogic instruction to assist with implementation of this method. This study specifically examined the latent profile memberships of US mathematics teachers and investigated the covariates predicting their latent profile

memberships. The relationship between latent profile memberships and the implementation of dialogic instruction was also examined using the person-centered approach [24].

Regarding RQ 1, this study found three profiles. Profile 1 was the high job satisfaction and very low stress group (n = 51, 13.8%). The study findings revealed that teachers in this profile had a high level of job satisfaction and a very low level of stress, which may be the most desirable teacher group. Profile 2 had a very low job satisfaction and high stress (n = 94, 25.4%). Teachers in this profile were characterized by a very low level of job satisfaction and high level of stress, which may be the most undesirable teacher group and suffers from low well-being status [10]. Teachers in the two profiles showed a negative relationship between job satisfaction and stress scores, which was consistent with previous studies (e.g., [38]). Thus, it would be safe to say that factors positively affecting teachers' day-to-day experiences were likely to reduce their stress, or vice versa.

However, teachers in profile 3 (n = 225, 60.8%), with moderately high job satisfaction and slightly high stress, showed a seemingly counterintuitive pattern. While they had a moderately high level of job satisfaction, they also had a slightly high level of stress. This pattern might be explained by the multi-dimensional characteristics of teacher stress. Researchers have reported that teacher stress consists of workload and classroom stress [21]. Therefore, it is possible that teachers who were satisfied with their working environment (low level of workload stress) might be dissatisfied with their student behavior (high level of classroom stress). However, this study used teacher stress as a single construct, which might lead to different outcomes than previous studies [21,38]. Therefore, further studies are required to verify this assumption by dividing teacher stress into two different domains.

Regarding RQ 2, this study examined the differences in profile membership by using covariates, including teacher internal (self-efficacy, gender, years of teaching, and teacher major) and external factors (leadership support, school safety, school condition, and teacher cooperation). Except for self-efficacy, teacher internal factors did not affect profile membership. These results corroborated some studies reporting the nonsignificant influence of years of teaching and on job satisfaction on stress (e.g., [22,37]). In addition, these results contradict other studies that found a significant effect of gender and years of teaching on job satisfaction and stress (e.g., [21]).

These mixed findings might be explained in two ways. First, this study examined the combinational effect of teacher job satisfaction and stress using LPA [24,60]. Thus, their effect on teachers might be different from the previous studies, which examined the relationships separately. Second, the relationship between teacher personal characteristics and their job satisfaction and stress might vary according to countries and types of teaching subjects [33]. This study examined US mathematics teachers, who showed high turnover rates compared to other countries [63,64]. Ingersoll et al. [63] estimated that the turnover rate of the US mathematics teachers due to a high level of stress and low level of job satisfaction every year is 15%. Consequently, the relationship between a teacher's personal characteristics and their job satisfaction and stress might differ from other teachers. Therefore, further studies are needed to clarify those relationships.

This study also found that teacher-self efficacy was linked to mathematics teachers' profile membership. Teachers with a high level of self-efficacy were more likely to have a high level of job satisfaction and a low level of stress. This finding confirmed the findings of previous studies [13,14,32,44,46] that showed teacher self-efficacy buffered teachers' job-related stress and helped teachers overcome challenges in school, which, in turn, enhanced their job satisfaction.

Regarding teachers' external factors, leadership support had a significant effect on profile memberships. This result indicated that teachers with a higher level of leadership support were more likely to be in the profiles with higher job satisfaction and lower stress. This result is consistent with the findings of the previous studies reporting the relationship between leadership support and job satisfaction and stress [22,32,42]. The current study examined leadership support, focusing on the support for teacher instruction and

professional development. Thus, we could assume that support from school leaders might help teachers develop instructional practice and classroom management skills. Because these teachers could more easily manage student behavior and engagement and achieve instructional goals, their job satisfaction was enhanced, and stress was reduced [21].

Moreover, this study found the significant effect of student behavior on latent class membership between profiles 2 and 3. When comparing the very low job satisfaction and high stress group with the moderately high job satisfaction and slightly high stress group, student behavior was significant. That is, when teachers successfully managed student behavior, and students behaved in an orderly manner, mathematics teachers were likely to have higher job satisfaction and lower stress.

Interestingly, unlike some previous studies reporting the effect of teacher cooperation and school condition on teacher job satisfaction and stress [12,22,35], this study could not find such relationships. Additionally, all covariates were nonsignificant in differentiating the high job satisfaction and very low stress group from the moderately high job satisfaction and slightly high stress group. Therefore, we could assume that other variables, which were not examined in this study, might affect their job satisfaction and stress. For example, Abel and Swell [59] reported the effect of the poor salary and promotion system on US teacher stress. Therefore, future studies should include other variables to better understand the predictors affecting teacher job satisfaction and stress.

Regarding RQ 3, the implementation of dialogic instruction status significantly differed. Mathematics teachers with high job satisfaction and very low stress ($M = 0.19$) and moderately high job satisfaction and slightly high stress ($M = 0.09$) were more likely to implement dialogic instruction than teachers with very low job satisfaction and high stress ($M = -0.31$). Therefore, this study concluded that the levels of teacher job satisfaction and stress are associated with their dialogic instruction. These results were in line with the job demand–resource model [15], which describes that teacher job and personal resources positively affect individual outcomes, such as commitment and job performance. Mathematics teachers with high job satisfaction and very low stress and moderately high job satisfaction and slightly high stress had higher self-efficacy in teaching mathematics and received more support from their leaders than teachers with very low job satisfaction and high stress. Therefore, they could lessen job related stress at schools and implement dialogic instruction, for which teachers need to provide more time, effort, and commitment with sufficient perseverance to enhance student engagement, discourse, and investigation [2–4,46]. In addition, mathematics teachers with very low job satisfaction and high stress were likely to dominate classroom discourse and limit student participation, representing students' passive roles and teachers' active roles, due to their low self-efficacy and limited leadership support.

However, the differences between high job satisfaction and very low stress and moderately high job satisfaction and slightly high stress were not significant. A possible explanation was that the job satisfaction scores of the two profiles were quite similar (profile 1 = 0.73, profile 3 = 0.42). While the two groups were significantly different in both stress score and combinational influence of job satisfaction and stress, the nonsignificant job satisfaction score resulted in a similar level of dialogic instruction. Therefore, further studies can be conducted to validate these assumptions.

6. Limitations

This study has several limitations. First, the study sample consisted of US grade 8 mathematics teachers only. While they were selected from the nationally representative sample [26], they had a higher turnover rate than teachers in other contexts [64]. This difference may have caused different findings from previous studies. Therefore, analyzing teachers from other contexts might result in different results. Second, this study did not measure teacher knowledge and beliefs. Mathematics teachers adjust their instruction according to these [51,52]. Therefore, regardless of their job satisfaction and stress, some teachers may not implement dialogic instruction due to their low mathematical

knowledge and teacher-centered beliefs. Third, this study did not observe mathematics teachers' instructional practices. Instead, teachers' implementation of dialogic instruction was examined based on their responses to survey items. Therefore, this study could not ensure that their dialogic instruction in classrooms was aligned with their survey response. Forth, this study could not guarantee the directionality between the study variables. Because this study used cross-sectional data, the cause and result relationships might differ from the assumption of this study. For example, this study posited that self-efficacy influenced latent profile members based on previous studies [15]. However, it is possible that teachers' low job satisfaction and high stress negatively lead to a low level of self-efficacy. To shed light on the directionality between various variables, longitudinal studies should be implemented.

7. Conclusions and Implications

This study has three novelties. First, this study examined the combinational effect of job satisfaction and stress on dialogic instruction based on a person-centered approach [18,19]. This method helps researchers overcome the limitations of previous studies in which the effect of job satisfaction and stress were independently examined and heterogeneity within the teacher population was ignored (e.g., [10,12]). Using the person-centered approach could provide more accurate information on the relationship between teacher job satisfaction, stress, and dialogic instruction. Second, this study considered various covariates. While some previous studies evaluated the influence of covariates on teacher job satisfaction, stress, and instruction practices, they were likely to consider either teacher internal or external factors (e.g., [13,20]), which might lead to inaccurate conclusions. However, this study considered both teacher internal and external factors as covariates. Thus, it could provide a more accurate conclusion.

The third novelty of the study is examining mathematics teachers' dialogic instruction. Previous studies on teacher job satisfaction and stress examined teachers' commitment, burnout, and turnover as outcome variables (e.g., [11,12,27]). While those are important topics, we have limited information on how teachers' job satisfaction and stress affect their job performance in classrooms. High-quality mathematics instruction is a primary element for quality education and the sustainable development of society. Moreover, mathematics teachers' dialogic instruction is strongly related to their students' mathematics achievement and motivation [45,48,49]. Thus, examining factors that facilitate or hinder mathematics teachers' implementation of dialogic instruction is a critical issue.

This study has the following three conclusions: First, this study found three profiles, consisting of high job satisfaction and very low stress, very low job satisfaction and high stress, and moderately high job satisfaction and slightly high stress. Second, latent profile membership was differentially related to self-efficacy and leadership support. Teachers with a high level of self-efficacy and receiving sufficient support from school leaders were likely to have a high level of job satisfaction and low level of stress. Third, mathematics teachers with very low job satisfaction and high stress were less likely to implement dialogic instruction than teachers in other profiles.

Previous studies focused on mathematics teachers' knowledge [51] and beliefs [52] to understand their implementation of dialogic instruction. The findings of this study enhance our knowledge of the factors predicting mathematics teachers' dialogic instruction. Considering the positive influences of self-efficacy and leadership support on teacher job satisfaction, stress, and dialogic instruction, the study suggests the following implications. First, as a practical implication, school leaders need to provide support to enhance mathematics teachers' self-efficacy. Self-efficacy refers to one's "beliefs in one's capabilities to organize and execute the courses of action to produce given attainment" [65] (p. 3). One's self-efficacy is affected by the following four factors: mastery experiences (e.g., previous successful experiences), vicarious experiences (e.g., observing others' success), social persuasion, and emotional arousal. Bandura et al. [65] also highlighted that the mastery experience is the most important predictor of self-efficacy. Similarly, Tschannen-Moran and

Hoy [66] explained that teacher efficacy is determined by three factors: efficacy for student engagement, instructional strategies, and classroom management. Therefore, school leaders should help mathematics teachers experience success in mathematics teaching in which teachers could accurately deliver mathematical knowledge with active student engagement and well-managed classroom environments.

For example, school leaders might provide professional development to help teachers acquire mathematical knowledge and strategies, which could enhance their instructional skills [67] and facilitate student engagement in mathematics learning [68]. Additionally, school leaders might recruit mentor teachers. Mathematics teachers could observe and learn from mentor teachers' instruction (vicarious experiences) and acquire mathematics teaching skills [69]. The mentor teachers could also provide verbal feedback and advice regarding mathematics teaching, student management, and school lives (social persuasion). These efforts could positively affect mathematics teachers' self-efficacy in mathematics teaching, job satisfaction, and stress, resulting in their implementation of dialogic instruction.

Second, as a research implication, the framework of the job demands–resources model [15] needs to be scrutinized. The model posits that job resources (school climate, social support, and leadership support), personal resources (teacher mental and emotional competencies, self-efficacy, and adaptability), and job demands (workload and student misbehavior) affect individual and organizational outcomes (e.g., job satisfaction and teacher performance). However, the current study's findings revealed that only teacher self-efficacy and leadership support had a significant effect on the profile memberships of teacher job satisfaction and stress. Student behavior was partially significant, and other variables, including teacher cooperation, school condition, school safety, teacher gender, years of teaching, and college major, were not linked to mathematics teachers' profile membership. Considering this study only examined individual outcomes focusing on mathematics teachers' dialogic instruction, the differences between the job demands–resources model and our findings might be natural. However, given the different associations between variables, it is valuable to examine the strength of each element of the model. For example, among the elements of job resources, some elements (e.g., leadership support) might be more strongly related to individual and organizational outcomes. Moreover, it is possible that personal resources were stronger indicators than job resources and job demands, or vice versa. Therefore, further studies should be conducted to examine the job demands–resources model in more detail. These efforts might affect both teacher job satisfaction and stress and their implementation of dialogic instruction, which positively affects student achievement and the sustainable development of society [1,2,4,45]

Funding: This research received no external funding.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are openly available in TIMSS data repository at https://timss2015.org/ (accessed on 13 January 2022).

Conflicts of Interest: The authors declare no conflict of interest.

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