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ORIGINAL ARTICLE

# Job satisfaction of mathematics teachers: an empirical investigation to quantify the contributions of teacher self-efficacy and teacher motivation to teach

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## Abstract

The shortage of mathematics teachers necessitates deliberate efforts to retain high-quality ones in many parts of the world. This puts teacher job satisfaction in the spotlight since satisfied teachers are likely to retain their jobs. Thus, the purpose of this study is twofold. The first is to quantify the influence of teacher self-efficacy and teacher motivation on teacher job satisfaction. The second is to investigate the patterns of changes in teacher job satisfaction across gender, age, and work experience. Using both descriptive and inferential statistics, we analysed the dataset of 1304 Norwegian mathematics teachers to address two research questions. The results showed that both teacher self-efficacy and social utility motivation have a significant influence on teacher job satisfaction with an additional mediating role of teacher self-efficacy. Contrary to our expectations, personal utility motivation has a negative influence on teacher job satisfaction. We found that women had significantly higher teacher job satisfaction than men. Also, we found a high-low–high pattern of changes in teacher job satisfaction in ascending order of teachers' age and work experience. One practical implication of these findings is exposing an appropriate time (i.e. at a low stage of job satisfaction) for interventions targeted at teacher job satisfaction to be effective. We discussed other implications of these findings concerning which constructs, gender, and age groups of teachers to prioritise for interventions that would reinforce the job satisfaction of mathematics teachers.

**Keywords** Interventions · Job satisfaction · Mathematics teachers · Self-efficacy · Structural equation modelling

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## Introduction

A dream of many organisations including educational institutions is to retain high-quality ones amongst their employees. Educational policymakers and school administrators strive to keep teachers who are motivated to teach, believe in their competence to teach, and more importantly, teachers who are satisfied with the teaching profession (Skaalvik & Skaalvik, 2011; Zakariya, 2020a). This is because the effects of attrition of high-quality teachers extend from teachers' well-being to students' academic progress and development (Carver-Thomas & Darling-Hammond, 2019). In the literature, an accumulation of evidence suggests that teacher job satisfaction is a crucial factor that makes teachers remain in their teaching profession (Madigan & Kim, 2021; McConnell, 2017; Skaalvik & Skaalvik, 2011). Teacher job satisfaction relates to the feeling of enjoyment and fulfilment of teachers with their teaching jobs (Ainley & Carstens, 2018). It is a gratification of the profession by in-service teachers themselves. As such, for this study, we operationalise teacher job satisfaction as job satisfaction with the profession (Ainley & Carstens, 2018). Teachers who are satisfied with the profession are likely to stay in their jobs. On the other hand, dissatisfied teachers in the profession are prone to attrition and are more likely to leave the profession (Heffernan et al., 2022; Kelly et al., 2019). Therefore, an understanding of teacher job satisfaction as it concerns its predictors is a critical step in retaining high-quality teachers.

Previous studies suggest that teacher self-efficacy and teacher motivation are crucial factors that bolster teacher job satisfaction (Jung & Woo, 2022; Liu et al., 2020; Toropova et al., 2021; Zakariya, 2020a). By teacher self-efficacy, we mean teachers' beliefs about their competence to teach with the actualisation of the intended learning outcomes. It encompasses teachers' beliefs of their competence to organise multiple instructional strategies and techniques of teaching to facilitate learning in the classroom. Admittedly, teacher self-efficacy is a multi-dimensional construct (Ainley & Carstens, 2018). However, this conceptualisation presupposes the operationalisation of teacher self-efficacy using teacher self-efficacy in instruction amongst its dimensions (Ainley & Carstens, 2018). There is a positive relationship between teacher self-efficacy and job satisfaction (Toropova et al., 2021; Zakariya, 2020a). That is, teachers with a high sense of self-efficacy reported satisfaction with their jobs. On the other hand, teachers with a low sense of self-efficacy are dissatisfied with the profession.

As for teacher motivation to teach, it is the reason that prompted teachers to choose teaching as a job. In this study, we operationalise teacher motivation to teach based on two dimensions: personal utility and social utility. The former is concerned with teachers' driving into the profession because teaching provides job security, a stable career path, and a stable income whilst the latter is concerned with teachers' driving into the profession by their quest to make a meaningful and positive difference in the lives of their students and society (Ainley & Carstens, 2018). These dimensions are important as they resonate with theoretically established intrinsic and extrinsic types of motivation as propagated by Ryan and Deci (2020). Evidence shows a non-trivial positive relation between

teachers' motivation to teach and job satisfaction (Jung & Woo, 2022; Liu et al., 2020). However, most of the previous studies (e.g. Jung & Woo, 2022; Liu et al., 2020; Zakariya, 2020a) do not focus on mathematics teachers. The findings of such studies may not be generalised to Norwegian mathematics teachers given the peculiarity of mathematics teaching and learning in secondary schools. This peculiarity could stem from the egalitarian work environment, reasonable conditions of service, and job security in Norwegian society. In addition, the limited studies (e.g. Jentsch et al., 2023; Toropova et al., 2021) that have focused on mathematics teachers were conducted outside the Norwegian borders and in some instances (e.g. Jentsch et al., 2023; Toropova et al., 2021) using a relatively small sample size. This sparsity of studies creates a knowledge gap that the present study intends to fill.

Therefore, the purpose of this study is to quantify the contributions of teacher self-efficacy and teacher motivation to the job satisfaction of Norwegian lower secondary school mathematics teachers. In addition, we studied the patterns of changes in mathematics teacher job satisfaction according to gender, age groups, and work experience. The main reason for conducting this study on Norwegian lower secondary school mathematics teachers is to address the existing knowledge gap regarding their job satisfaction. Also, they form the largest group, in terms of number, of mathematics teachers in Norway according to our data source, i.e. TALIS — Teaching and Learning International Survey (OECD, 2019a). TALIS is an international survey that has been conducted every 5 years since 2013. It is sponsored by the Organization for Economic Co-operation and Development (OECD). It seeks empirical data on issues that concern teachers, school leaders, and the teaching environment for informed decisions on the improvement of teaching and learning across the world. We chose to use data from TALIS in this study because TALIS is the largest, most rigorous, and most comprehensive international teacher survey to the best of our knowledge. Whilst studies on teacher job satisfaction have been conducted in general, there is a scarcity of research specifically focusing on the Norwegian mathematics teacher community. By investigating the contributions of teacher self-efficacy and motivation to job satisfaction in this specific context, the study aims to provide unique insights into the factors influencing the satisfaction levels of Norwegian mathematics teachers. Additionally, exploring the patterns of changes in mathematics teacher job satisfaction across gender, age groups, and work experience will contribute to the understanding of potential variations within the Norwegian mathematics teacher community. This study recognises that these demographic and experiential factors may have implications for job satisfaction, and by examining their impact, it seeks to provide a comprehensive analysis of the dynamics at play. Furthermore, we contend that understanding the situation for Norwegian mathematics teachers will be relevant to the international education community in terms of the practical and theoretical implications of the study coupled with its methodological relevance for replication studies.

In specific terms, we set to address the following research questions: (1) to what extent do teacher self-efficacy and teacher motivation contribute to the job satisfaction of Norwegian lower secondary school mathematics teachers? (2) How does mathematics teacher job satisfaction vary across gender, age groups, and work experience? Providing empirical evidence to address these questions will shed light

on job satisfaction and its relationship with self-efficacy and motivation to teach amongst Norwegian mathematics teachers. The findings will provide some cues to educational stakeholders and policymakers on what bolsters teacher job satisfaction as a proxy for retaining high-quality mathematics teachers within and outside the Norwegian borders. That is, the insights gained from this research can help in the development of targeted interventions, support systems, and strategies to enhance job satisfaction and well-being amongst Norwegian lower secondary school mathematics teachers and beyond.

## Conceptual framework

### Conceptualising teacher job satisfaction

There are several definitions of teacher job satisfaction in the literature. These various definitions have been linked with the incoherent conceptualisations of the baseline concept of "job satisfaction" (Evans, 1997). However, one of the most commonly referenced definitions of job satisfaction is that of Locke (1969) who defined it as "the pleasurable emotional state resulting from the appraisal of one's job as achieving or facilitating the achievement of one's job values" (p. 316). To Locke, job satisfaction is a self-evaluation of the match between what one wants from a job and the perceived ability of the job to provide the wants. Evans (1997) built on this to describe job satisfaction as a feeling of being in "*a state of mind determined by the extent to which the individual perceives her/his job-related needs to be being met*" (p. 328, italics in the original). In the educational context, Ainley and Carstens (2018) defined teacher job satisfaction as "the sense of fulfilment and gratification that teachers experience through their work as a teacher" (p. 43). Building on this definition, we conceptualise teacher job satisfaction as the extent to which teachers feel teaching mathematics matches their expectations of becoming teachers.

Given that our conceptualisation of teacher job satisfaction emphasises teachers' dispositions towards teaching, we draw on the 2018 TALIS operationalisation of *teacher job satisfaction with the profession* as a measure of the construct. Admittedly, teacher job satisfaction is a multi-dimensional construct as documented in the literature (e.g. Zakariya et al., 2020). In addition, the TALIS 2018 technical team also identified three dimensions of teacher job satisfaction in their conceptual framework for the international survey (Ainley & Carstens, 2018). However, only one of these three dimensions (i.e. teacher job satisfaction with the profession) is consistent with the conceptualisation of teacher job satisfaction in this study. The selection of *teacher job satisfaction with the profession* over other dimensions of teacher job satisfaction as operationalised by the TALIS 2018 team is based on the specific focus and conceptualisation of teacher job satisfaction chosen by the researchers. Whilst job satisfaction can be influenced by various factors, the researchers have determined that, for their study, the dimension of teacher job satisfaction related to the profession itself is most relevant.

### Conceptualising teacher self-efficacy

Teacher self-efficacy draws directly on some theoretical postulates of the agentic social cognitive theory as propagated by Albert Bandura (Bandura, 1997, 2001, 2012). According to Bandura (1997), self-efficacy has to do with the "beliefs in one's capabilities to organise and execute the courses of action required to produce given attainments" (p. 3). These beliefs about an individual's competence form a crucial drive for individuals to expend their effort in executing tasks and persist in the tasks despite obstacles (Bandura, 2012; Zakariya, 2021). Related to the teaching and learning of mathematics, we define teacher self-efficacy as teachers' beliefs about their competence to teach mathematics such that the intended learning outcomes of the subject are actualised. It is a matter of what teachers can do and not what teachers will do within the available resources in the classrooms. Drawing on the social cognitive theory, teacher self-efficacy has four sources of influence. The first two sources are mastery and vicarious experience (Bandura, 1997, 2012). That is, experience gained through self-interpretation of previous attainments (e.g. successful teaching) and the ones gained by watching other people execute an action (in this case, teaching). The last two sources of teacher self-efficacy are verbal/social persuasions and physiological or affective states (Bandura, 1997, 2012). That is, teachers draw on feedback and their emotional states such as motivation to foster their beliefs on their competence to teach.

Putting the theoretical arguments into perspective, an implication of the social cognitive theory on the construct is observed in its multi-dimensional operationalisation. For instance, the TALIS 2018 technical team identified three dimensions of teacher self-efficacy. These dimensions are teacher self-efficacy in instruction, classroom management, and student engagement (Ainley & Carstens, 2018). Consistent with our conceptualisation of teacher self-efficacy which focuses on the actual teaching in the classrooms, we used teacher self-efficacy in instruction to operationalise the self-efficacy of mathematics teachers in this study. This choice of ours means that the finding of this study will be limited to teacher self-efficacy in instruction. However, this limitation has a positive side since it will avail us of an opportunity to investigate teachers' beliefs about their competence with a focus on their instructional practices in the classrooms.

### Conceptualising teacher motivation

Teacher motivation encompasses the reasons for choosing teaching as a profession. In other words, teacher motivation addresses the question of why individuals choose to be teachers (Richardson & Watt, 2014). Several theories have been proposed as frameworks to conceptualise teacher motivation to teach. Some of these theories, e.g. achievement goal theory, expectancy-value theory, and self-determination theory, are student-centred theories which have been recontextualised to teachers' practices (Butler, 2014; Richardson & Watt, 2014; Roth, 2014). Two prominent theoretical foundations of teacher motivation are the tripartite and the FIT-Choice frameworks (Goller et al., 2019; Kyriacou et al., 1999; Roness & Smith, 2010; Watt

& Richardson, 2015). The tripartite framework postulates that teachers are motivated to teach based on three drives: intrinsic, extrinsic, and altruistic (Chuene et al., 1999; Kyriacou et al., 1999). The intrinsic drive has to do with inherent aspects of teaching itself (e.g. a desire to use one's knowledge of the teaching subject) whilst the extrinsic drive is concerned with aspects of teaching that are not inherent in the teaching itself such as stable employment and pay rate (Kyriacou et al., 1999). The altruistic drive has to do with the values (e.g. teaching is worthwhile and it is an opportunity to contribute to societal development) associated with teaching in society (Chuene et al., 1999).

On the other hand, the FIT-Choice framework postulates that teachers draw on seven sources for their motivation to teach. These sources are prior teaching and learning experiences, intrinsic teaching values, personal utility values, social utility values, social influences, perceived teaching abilities, and fallback careers (Watt & Richardson, 2012, 2015). It appears that both the tripartite and FIT-Choice frameworks have more in common than differences. For instance, the intrinsic teaching value and the perceived abilities of the FIT-Choice framework can be grouped under the intrinsic motivation of the tripartite framework. Similarly, social utility values go with altruistic motivation whilst personal utility values, social influences, and fallback careers are in line with extrinsic motivation. Building on these overlaps, some researchers (e.g. Ainley & Carstens, 2018) operationalised teacher motivation to teach using two dimensions: personal utility motivation to teach and social utility motivation to teach. In TALIS 2018, personal utility motivation to teach covers aspects of extrinsic motivation whilst the social utility motivation to teach covers both intrinsic and altruistic motivation. We agree with the TALIS 2018 technical team and follow their operationalisation of teacher motivation using the two dimensions.

### Relationships between the research constructs

Relationships between teacher job satisfaction, teacher self-efficacy, and teacher motivation have a theoretical basis from the social cognitive career theory (Lent & Brown, 2006). The theory posits that several social cognitive, environmental, and behavioural factors influence job satisfaction in the educational context (Lent & Brown, 2006). Of relevance to the present study amongst these factors are teacher self-efficacy and teacher motivation. For instance, Duffy and Lent (2009) used the social cognitive career theory to show that teacher self-efficacy has a positive impact on teacher job satisfaction. That is teachers who reported high confidence in their competence to teach were satisfied with the profession. On the other hand, teachers who were dissatisfied with the profession reported low confidence in their competence to teach. In an independent study, Zakariya (2020a) also reported a significant relationship between self-efficacy and job satisfaction of mostly STEM teachers. As regards the teachers of mathematics, Toropova et al. (2021) not only reported a positive relationship between self-efficacy and job satisfaction but also that teacher self-efficacy moderates the effect of students' behaviour on teacher job satisfaction. That is, the job satisfaction of teachers with a high sense of self-efficacy is less affected by students' unruly behaviour as compared to teachers with a low sense of self-efficacy (Toropova et al., 2021). Based

on both theoretical and empirical evidence, we hypothesise that self-efficacy has a significant positive effect on job satisfaction amongst Norwegian mathematics teachers.

Also, teacher motivation to teach is a crucial social cognitive factor that affects job satisfaction from the social cognitive career theory perspective. This is because both personal and social utility motivation to teach is part of the 'work conditions and outcomes' construct conceptualised in social cognitive career theory (Lent & Brown, 2006). Few studies have empirically investigated the relationship between teacher motivation to teach and teacher job satisfaction. Yet, the results of these limited studies are promising. For instance, Liu et al. (2020) draw on TALIS 2018 data of 3123 teachers in 196 secondary schools in China to show that both the personal and social utility motivation to teach have significant effects on teacher job satisfaction. They also found that the effect of social utility motivation to teach on teacher job satisfaction is greater than that of the personal utility motivation to teach. In a more recent study, Jung and Woo (2022) also used TALIS 2018 data to show that social utility motivation to teach significantly influenced teacher job satisfaction in Korea. Even though these studies were neither conducted within the Norwegian borders nor focused on mathematics teachers they helped in formulating our research hypotheses. We take insights from these studies and the social cognitive career theory perspective to hypothesise that both personal and social utility motivation to teach have positive effects on job satisfaction amongst Norwegian mathematics teachers.

Furthermore, a plausible relationship between the research constructs could be the mediating effect of teacher self-efficacy between teacher motivation and teacher job satisfaction. This mediating role of teacher self-efficacy can be argued from two perspectives. First, theoretical evidence suggests that there is a feedback relationship between personal, social, and behavioural factors such as teacher self-efficacy and teacher motivation to teach (Bandura, 2001; Lent & Brown, 2006). Building on this evidence, we expect some effects of teacher motivation (a social-environmental factor) to be transmitted through teacher self-efficacy (a personal factor) to teacher job satisfaction. The second perspective to buttress the mediating role of teacher self-efficacy may be argued from previously documented empirical evidence. Given that there is a positive effect of teacher motivation on teacher job satisfaction (Jung & Woo, 2022; Liu et al., 2020), and that significant correlations between both personal and social utility motivation to teach and teacher self-efficacy exist (Liu et al., 2020), we expected the direct effect of teacher motivation on teacher job satisfaction to be mediated by teacher self-efficacy. Thus, we hypothesised that the effects of both personal and social utility motivation to teach on job satisfaction are mediated by the self-efficacy of Norwegian mathematics teachers. Figure 1 presents an overview of the hypothesised relationships between the research constructs.

## Methods

### Participants

The participants in this study were 1304 lower secondary school teachers who taught mathematics at the time the TALIS 2018 was conducted in Norway. They formed 31.39% of the total number of lower secondary school teachers who participated in the TALIS 2018 survey. They were amongst 20 teachers in each school that

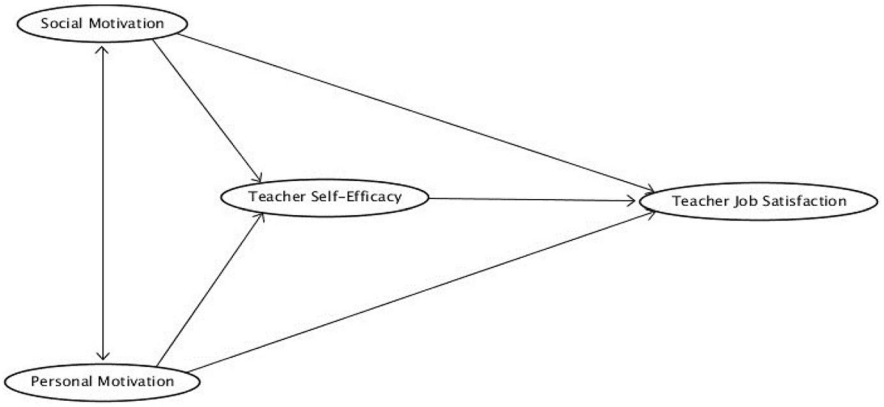



**Fig. 1** Hypothesised model of relationships between the research constructs

were probabilistically sampled across 200 participating lower secondary schools in Norway. They included 708 women and 596 men. Their age distribution was as follows: 25–29 years (157), 30–39 years (345), 40–49 years (427), 50–59 years (214), and 146 teachers are 60 years and above. Further, their work experience as teachers is distributed as follows: 0–10 years (558), 11–20 years (438), 21–30 years (175), 31–40 years (113), and 17 teachers were over 40 years. Moreso, three teachers had missing values in the work experience item of the questionnaire. Through the probabilistic sampling procedure, we can ascertain that the sample of this study is representative of its population in terms of number, age distribution, gender distribution, and work experience. The presented sample data further corroborate this fact.

## Measures

The teacher job satisfaction with the profession scale has four items that operationalised and measured teacher job satisfaction in this study. The four items seek teachers' perceptions of the teaching job concerning the advantages and disadvantages of being a teacher and fulfilment or regret of their decision to choose teaching as a profession over other jobs (OECD, 2019b). The teachers were asked to register their level of agreement with the scale items on a four-point Likert scale format from 'strongly disagree' to 'strongly agree'. A sample item of the scale is "If I could decide again, I would still choose to work as a teacher" (OECD, 2019b, p. 302). Two of the items were negatively framed so they were reverse coded before the analysis. The validity and reliability of the scale have been extensively studied by the TALIS 2018 team (OECD, 2019b). The point estimate of the omega reliability coefficient (Raykov & Marcoulides, 2016) of the scale was computed using the data of only the Norwegian lower secondary school mathematics teachers and found to be 0.798 within the 95% confidence interval of [0.776, 0.820]. This coefficient confirms the reliability of the teacher job satisfaction scale in the sample of this study.

The teacher self-efficacy in instruction scale also has four items that operationalised and measured teacher self-efficacy in this study. The four items seek teachers' responses about how often they can do the following in the classrooms: generate good questions, utilise different methods of assessment, change their modes of instruction, and render alternative explanations to confused students (OECD, 2019b). The teachers were asked to indicate the frequency with which they can implement the scale items on a four-point Likert scale format from 'not at all' to 'a lot'. A sample item of the scale is "Use a variety of assessment strategies" (OECD, 2019b, p. 285). The point estimate of the omega reliability coefficient (Raykov & Marcoulides, 2016) of the scale was computed using the data of only the Norwegian lower secondary school mathematics teachers and found to be 0.701 within the 95% confidence interval of [0.676, 0.726]. This coefficient confirms the reliability of the teacher self-efficacy scale in the sample of this study.

For the motivation to teach scale, a four-item subscale and a three-item subscale were used to operationalise and measure personal utility motivation to teach and social utility motivation to teach, respectively. The four items of personal utility motivation to teach subscale seek teachers' perceptions of the significance of job security, steady career, and reliable income in their decisions to become teachers. Three items of the social utility motivation to teach subscale seek teachers' perceptions of the significance of altruistic values of teaching such as helping children and making societal impacts on their decisions to become teachers. On both subscales, the teachers were asked to indicate their level of agreement with the subscale items on a four-point Likert scale from 'not important at all' to 'of high importance'. A sample item from the personal utility motivation to teach subscale is "Teaching provided a reliable income" whilst that of the social utility motivation to teach subscale is "Teaching allowed me to provide a contribution to society" (OECD, 2019b, p. 220). The point estimates of omega reliability coefficients (Raykov & Marcoulides, 2016) were computed using the data of only the Norwegian lower secondary school mathematics teachers. We found the reliability coefficient for the personal utility motivation to teach subscale to be 0.835 within the 95% confidence interval of [0.822, 0.849]. Also, we found 0.758 within the 95% confidence interval of [0.736, 0.779] to be the reliability coefficient for the social utility motivation to teach scale. Further, we found a reliability coefficient of 0.828 for the whole scale within the 95% confidence interval of [0.815, 0.841]. These coefficients confirm the reliability of the two scales for teacher motivation to teach.

Further, we found a reliability coefficient of 0.828 for the whole scale within the 95% confidence interval of [0.815, 0.841]. These coefficients confirm the reliability of the two scales for teacher motivation to teach.

### Data analysis

The procedure for data analysis followed a two-stage approach. In the first stage, we investigated the validity of factor structures of the research constructs using confirmatory factor analysis (CFA). This allowed us to detect and correct any misspecification in the factor structures of the research constructs and then compute

the reliability coefficients. In the second stage, we tested the consistency of the full hypothesised model (Fig. 1) with the generated data using structural equation modelling as a means to address the first research question. We studied the normality distributions of the generated data for each research construct and the pattern of missing values. We found that there was neither excess kurtosis nor excess skewness and the missing values were completely random with less than 4% on each research construct. Therefore, we treated the generated data as continuous for all the research constructs. In stage 1 and stage 2, we used the maximum likelihood with robust standard error (MLR) estimator to estimate the model parameters. We used a combination of goodness of fit criteria to judge the consistency of the models with the generated data. These are non-significant chi-square values or ratio of the chi-square values to the degree of freedom of less than 3, comparative fit index ($CFI \geq 0.95$), Tucker-Lewis index ($TLI \geq 0.95$), standardised root mean square residual ($SRMR \leq 0.08$), and root mean square error of approximation ($RMSEA \leq 0.06$). These values are consistent with the recommended values of an excellent model fit in the literature (Hu & Bentler, 1999).

To study the patterns of changes in teacher job satisfaction in relation to their gender, age, and work experience, we used structural equation modelling to compute the factor scores of the evaluated one-factor model of the teacher job satisfaction scale. We deleted 44 teachers who had missing values on the four items of teacher job satisfaction. We standardised and transformed the factor scores of the remaining 1260 lower secondary school mathematics teachers (686 women) to have a mean of 2.5 and a standard deviation of 1.290. This transformation was necessary to make the factor scores comparable to the initial four-response type format of the teacher job satisfaction scale. Then, we used the independent sample *t*-test to investigate the mean comparison of the factor scores between female and male teachers.

## Results

### Measurement models and the reliability estimates

Following the procedure presented in the last section, we present the results of the first stage of the analytical procedure. These concerned CFAs of the generated data for a single-factor model of each construct of the study. In addition, the results include the CFA of a two-factor teach motivation to teach model with two correlated factors: personal utility motivation to teach and social utility motivation to teach. Except for the teacher job satisfaction scale, we evaluated only one model per construct. In the case of the teacher job satisfaction scale, we evaluated two models in which the second model is an improvement on the first model. Table 1 presents the goodness of fits resulting from the evaluated models.

The presented results in Table 1 revealed some interesting findings. The results in the first column (model 1A) show the goodness of fit statistics of the evaluated one-factor teacher job satisfaction model. The statistics show that there is a poor fit of the model with the generated data. Guided by the modification indices,

we improved upon model 1A by adding an error covariance between item 3 — *I regret that I decided to become a teacher* and item 4 — *I wonder whether it would have been better to choose another profession* of the teacher job satisfaction scale. This improvement yields an excellent model fit with generated data as presented in the second column of Table 1 (model 1B) in which all the goodness of fit statistics are within the recommended ranges (Hu & Bentler, 1999). Conceptually speaking, the addition of error covariance makes sense since item 3 and item 4 are the only two negatively worded items on the scale. As such, the negative wordings of the items must have necessitated the error covariance in the model. The addition of the error covariance is also in line with the recommendation for such model improvement in the literature (Zakariya, 2020b).

The presented results in Table 1 show an excellent model fit of the one-factor teacher self-efficacy model with the generated data. Although the chi-square value is significant with its ratio to the degree of freedom close to 3.0. The values of other fit statistics which are within the recommended ranges of an excellent fit provide credence to the acceptability of the model fit. Further, Table 1 shows excellent model fits for one-factor personal utility motivation to teach (model 3), social utility motivation to teach (model 4), and the two-factor teacher motivation to teach (model 5). The goodness of fit statistics that are all within the recommended ranges for these models corroborate our excellent model fit deduction. The excellent model fits for model 1B, model 3, model 4, and model 5 suggest that there is consistency between the models and the generated data for the respective constructs. That is, the items of these scales measure what they are purported to measure. It is important to remark that the goodness of fit statistics give information only on the global fit of the models with generated data. For the local fit of the models, we investigated the factor loadings and the residuals of the scale items which also confirmed acceptable models for the research constructs.

It was after investigating the factor structures of each research construct that we computed the reliability coefficients using the latent version of the omega coefficient (Raykov & Marcoulides, 2016). The results of this reliability computation were presented in the "Measures" section of this article. We chose to use the omega coefficient instead of the popular Cronbach alpha as the reliability estimate because

**Table 1** Selected goodness of fits statistics of the evaluated models

| | Job satisfaction (model 1A) | Job satisfaction (model 1B) | Self-efficacy (model 2) | Personal motivation (model 3) | Social motivation (model 4) | Motivation (model 5) |
|---|---|---|---|---|---|---|
| $\chi^2$-value | 63.927 | 1.425 | 6.497 | .515 | .001 | 31.622 |
| $p$-value | .001 | .233 | .039 | .773 | 0.000 | .003 |
| chi − squared$\chi^2/df$ | 31.964 | 1.425 | 3.248 | .258 | 0.000 | 2.432 |
| CFI | .942 | 1.000 | .993 | 1.000 | 1.000 | .993 |
| TLI | .827 | .998 | .979 | 1.000 | 1.000 | .989 |
| SRMR | .033 | .004 | .013 | .002 | 0.000 | .024 |
| RMSEA | .157 | .018 | .042 | .001 | 0.000 | .033 |

of the improved accuracy of the former over the latter in the reliability estimate (Raykov & Marcoulides, 2016). After investigating the construct validity and reliability of the research constructs, we proceeded to stage 2 of the analytical procedure.

### Structural models and the hypothesis testing

Following the procedure of data analysis as presented in the "Methods" section, we present the results of the second stage of the analytical procedure. These concern the evaluation of consistency between the hypothesised model of the relationship of the research constructs (Fig. 1) and the generated. The results show an excellent model fit with significant a chi-square value (chi-squared $\chi^2 = 137.133, p = .0002$) but $\chi^2/df = 1.652$, $CFI = .990$, $TLI = .987$, $SRMR = .024$, and $RMSEA = .022$. These results confirm the consistency of the model with the generated data and simultaneously confirm the trustworthiness of the parameter estimates. Figure 2 shows the estimates of the effects of one construct on another as hypothesised and evaluated. The full evaluated model that contains the factor loadings, regression, weights, factor correlations, and residuals is available in the Appendix.

The presented results in Fig. 2 show that there was a significant positive effect ($\beta = .137, p = .001$) of teacher self-efficacy on teacher job satisfaction. That is, Norwegian mathematics teachers with a high sense of self-efficacy were satisfied with the teaching profession. On the other hand, those teachers with low self-efficacy reported low satisfaction with the teaching profession. The finding supports the postulated relationship between self-efficacy and job satisfaction amongst Norwegian lower secondary teachers. As postulated in the present study, Fig. 2 shows that there are significant effects of both personal utility motivation to teach ($\beta = -.124, p = .001$) and social utility motivation to teach ($\beta = .171, p = .001$) on teacher job satisfaction. Contrary to our expectation, the effect of personal utility motivation to teach on teacher job satisfaction is negative. That is, Norwegian mathematics teachers with low levels of personal utility motivation are satisfied with the teaching profession, whilst those with a high level of personal utility motivation reported low satisfaction with the teaching

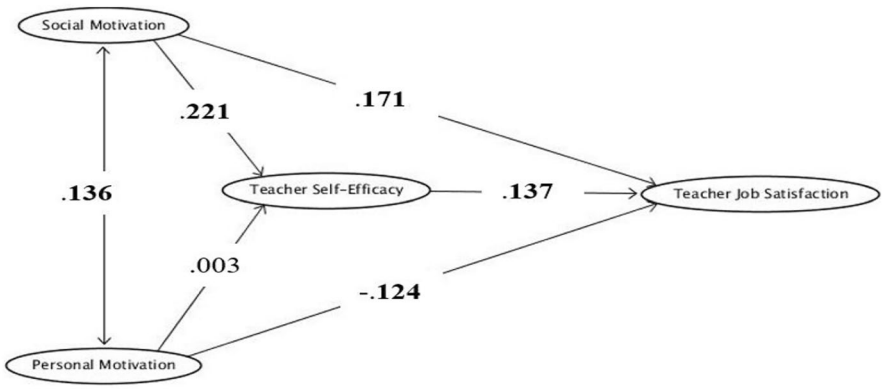



**Fig. 2** Evaluated model of relationships between the research constructs

profession. For social utility motivation to teach, the finding indicates that Norwegian mathematics teachers with a high level of the social utility of teaching are satisfied with the teaching profession. In addition, those teachers with a low level of the social utility of teaching reported low satisfaction with the teaching profession.

The presented results in Table 2 show that the effect of social utility motivation to teach on teacher self-efficacy is significant ($\beta = .221, p = .001$) whilst the effect of the personal utility motivation to teach on the latter is not significant ($\beta = .003, p = .935$). That is, Norwegian lower secondary school mathematics teachers with a high level of the social utility of teaching have significant self-efficacy for teaching. Meanwhile, the reverse is the case for Norwegian lower secondary mathematics teachers with a low level of social utility motivation to teach. On the other hand, the observed lack of significant effect of personal utility motivation to teach on teacher self-efficacy is noteworthy. The results confirm the hypothesised relationship between the research constructs except for the non-significant positive effect of personal utility motivation to teach on self-efficacy amongst Norwegian lower secondary school teachers. The double-headed arrow between the two dimensions of motivation to teach in Fig. 2 carries the expected standardised correlation ($r = .136, p = .001$) between the dimensions. This correlation is significant as expected since the two dimensions are hypothesised to measure the same construct of teacher motivation to teach.

To quantify the mediating role of teacher self-efficacy between teacher motivation and teacher job satisfaction as well as to compute the total effect of the former on the latter, we conduct a partial mediation analysis of the evaluated model in Fig. 2. Table 2 presents the estimates of the mediating effects of teacher self-efficacy as well as the total effects of motivation to teach on job satisfaction amongst Norwegian lower secondary school teachers.

The presented results in Table 2 show that teacher self-efficacy significantly mediates the effect of social utility motivation to teach on teacher job satisfaction with an effect size ($\beta = .030, p = .003$) that falls within the 95% confidence interval [0.014, 0.047]. On the other hand, the mediating effect of teacher self-efficacy between personal utility motivation to teach and teacher job satisfaction is not significant ($\beta = .0004, p = .935$). These mediating effects have implications for the total effect of each dimension of teacher motivation to teach on teacher job satisfaction. As shown in Table 2, for instance, the estimate of the total effect of social utility motivation to teach on teacher job satisfaction improved to a significantly higher value ($\beta = .201, p = .001$) within the 95% confidence interval [0.138, 0.264]. In addition, the estimate of the total effect of personal utility motivation to teach on teacher job satisfaction improved to a slightly higher value ($\beta = -.123, p = .001$) within the 95% confidence interval $[-0.177, -0.069]$. The findings from Table 1 through Fig. 1 to Table 2 put together provide empirical evidence on the extent to which teacher motivation to teach and teacher self-efficacy influence one another and their contributions to the job satisfaction of Norwegian lower secondary school mathematics teachers.

**Table 2** The mediating role of teacher self-efficacy between motivation and job satisfaction of mathematics teachers

| Effect from | Mediating effect of teacher self-efficacy | | | | Total effects on teacher job satisfaction | | | |
|---|---|---|---|---|---|---|---|---|
| | Lower 5% | Estimate | Upper 5% | *p*-value | Lower 5% | Estimate | Upper 5% | *p*-value |
| Personal utility motivation to teach | −.008 | .0004 | .008 | .935 | −.177 | −.123 | −.069 | .001* |
| Social utility motivation to teach | .014 | .030 | .047 | .003* | .138 | .201 | .264 | .001* |

*Significant at 95% confidence interval

### The patterns of changes in teacher job satisfaction

The descriptive statistics of teacher job satisfaction for female teachers (mean = 2.625, standard deviation = 1.272) and male teachers (mean = 2.352, standard deviation = 1.299) show a mean difference of 0.273. The result of the independent sample *t*-test shows a significant mean difference between the female and male teachers, $t(1258) = 3.758, p = 0.001$. Although, both female and male mathematics teachers are relatively satisfied with the teaching profession. This result shows that there is a statistically significant difference in satisfaction with teaching between female and male teachers, rather than emphasising the magnitude of the difference.

For the patterns of changes in teacher job satisfaction across age groups and work experience, we investigated the mean distributions across these groups. Figure 3 presents the pattern of mean distributions for both age groups and work experience.

The results shown in Fig. 3 reveal an average of 2.60 for teacher job satisfaction across the six age groups and an average of 2.54 for teacher job satisfaction across the five work experience groups. More importantly, Fig. 3 shows that teacher job satisfaction follows a similar pattern of change in different age groups and according to the number of years of working as a teacher. The figure shows that young mathematics teachers (below 30 years of age) are highly satisfied with the teaching profession. Job satisfaction is low amongst teachers between 30 and 49 years (the lowest average job satisfaction occurs in the age group 40–49 years) before it starts to improve again. The teachers from 50 years and above sustain improved job satisfaction but it is not as high as that of the young teachers. In addition, the analysis of variance (ANOVA) test showed there was a significant difference in job satisfaction between the teachers' age groups, $F(5, 1254) = 2.379, p = .037$. However, Tukey's HSD (honestly significant test) showed that the only groups with a significant pairwise mean difference ($meandifference = .353, p = .044$) were teachers in the age groups 25–29 years and 40–49 years.

Similarly, Fig. 3 shows that mathematics teachers in Norway at first are satisfied with the teaching profession. However, this initial job satisfaction suffers setbacks

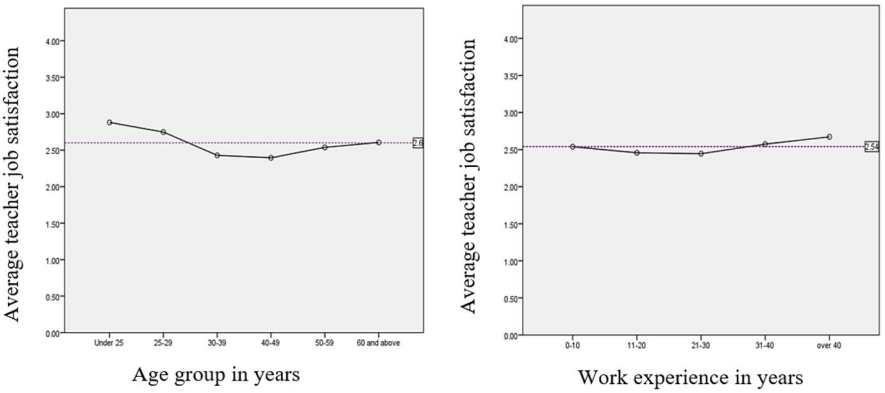



**Fig. 3** The patterns of changes in teacher job satisfaction across age groups and work experience

until they teach for about 30 years before they start to experience improved job satisfaction again. Unlike the teacher job satisfaction across age groups, the ANOVA test showed that there was no significant difference in the job satisfaction between the teachers' work experience groups, $F(5, 1254) = 2.379, p = .037$. These patterns of teacher job satisfaction across age groups and work experience have implications for the timing of interventions that would reinforce teacher job satisfaction. These implications will be discussed in the next section. In the meantime, we probe the patterns of changes in teacher job satisfaction across age groups and work experience for both female and male lower secondary school mathematics teachers in Norway. We think this probing is necessary since female mathematics teachers have significantly higher job satisfaction than male mathematics teachers in Norway. We present the results of this investigation in Fig. 4.

The presented results in Fig. 4 make explicit the points of convergence and divergence in teacher job satisfaction across age and work experience groups of female and male lower secondary school teachers in Norway. For teacher job satisfaction across age groups, Fig. 4 shows that women under 25 years have higher job satisfaction than men. They both have equal job satisfaction in the age range of 25–29 years and then follow a decline in job satisfaction before sustaining a common improved job satisfaction from 50 years and above. More so, teacher job satisfaction of women is consistently higher than that of men in all the age groups except for the group where equality of teacher job satisfaction occurs. As for the teacher job satisfaction across work experience, women start with a higher teacher job satisfaction than men in the group 0–10 years. Unlike men who suffer a decline in teacher job satisfaction before picking up after 20 years of teaching mathematics, women show a further increase in job satisfaction before a decline after 20 years of teaching mathematics. Figure 4 also shows that both women and men have almost the same teacher job satisfaction in the group 21–30 years before they sustain improved teacher job satisfaction as they continue to work as teachers. The findings from Figs. 3 and 4 demonstrate the changes in teacher job satisfaction across the gender, age groups, and work experience of Norwegian lower secondary school mathematics teachers.

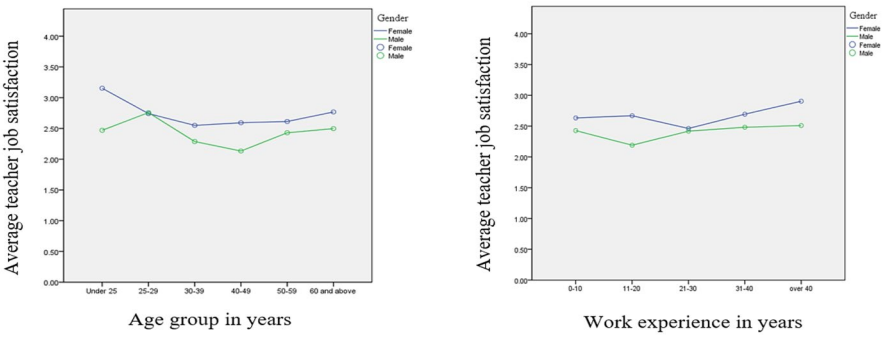



**Fig. 4** The patterns of changes in teacher job satisfaction across age groups and work experience for female and male mathematics teachers

## Discussion

In this study, we drew on the TALIS 2018 data for lower secondary school mathematics teachers in Norway to quantify the effects of teacher self-efficacy and teacher motivation to teach on teacher job satisfaction. Further, we studied the patterns of changes in teacher job satisfaction across gender, age groups, and work experience. We analysed the generated data using both descriptive and inferential statistics including some techniques of structural equation modelling. The results are revealing, and we discuss them in subsequent paragraphs.

We found a significant positive effect of teacher self-efficacy on the job satisfaction of mathematics teachers in Norway. This finding is interpreted to mean that Norwegian mathematics teachers who believe they can frequently generate good questions, utilise different methods of assessment, change their modes of instruction, and render alternative explanations to confused students are more satisfied with the teaching profession. On the other hand, Norwegian mathematics teachers who rarely utilise these instructional practices are often dissatisfied with the teaching profession. This finding corroborates the findings of previous studies (e.g. Duffy & Lent, 2009; Toropova et al., 2021; Zakariya, 2020a) that reported a positive influence of teacher self-efficacy on teacher job satisfaction whilst complementing them by focusing on the Norwegian mathematics teachers. By implication, policymakers and educational stakeholders may use interventions that focus on the frequent use of classroom instructional practices such as generating good questions, utilising different methods of assessment, using multiple modes of instruction, and rendering alternative explanations to confused students as proxies to reinforce job satisfaction of mathematics teachers. Such interventions can be in the form of teachers' training or professional development that emphasises teacher self-efficacy in instruction.

The results of this study show mixed findings for the effects of teacher motivation to teach on teacher job satisfaction in Norway. For social utility motivation to teach, as expected, the construct has a positive significant influence on the job satisfaction of Norwegian mathematics teachers. That is the Norwegian mathematics teachers who ranked high amongst those who claimed that they chose teaching as a profession because of its altruistic values such as helping children and making societal impacts were more satisfied with the profession than those who ranked low on the scale. This finding is line in with the findings of previous studies (e.g. Jung & Woo, 2022; Liu et al., 2020) that reported a positive relationship between this aspect of motivation and teacher job satisfaction. For personal utility motivation to teach, the influence of the construct on teacher job satisfaction was significant but unexpectedly negative. That is the Norwegian mathematics teachers who ranked high amongst those who claimed that they chose to teach because teaching provides job security, a steady career, and reliable income were not as satisfied with the profession as those who ranked low on the scale. This finding is contrary to the report by Liu et al. (2020) who showed otherwise.

Meanwhile, one can defend the plausibility of the negative effect of teacher utility motivation to teach on teacher job satisfaction by considering some peculiarities of Norwegian society. For instance, societal value for the teaching profession is high

in Norway, and it is even higher than the OECD average (OECD, 2019a). Thus, the personal utility of teaching may be overshadowed by this high societal value for the profession. Another peculiarity of Norway that could explain the unexpected relation is the egalitarian structure of the society that impacts salaries across different professions. Admittedly, lower secondary school teachers in Norway earn a comparatively good salary in the international context, and they reported higher satisfaction with salaries than the OECD average (OECD, 2019a). However, they could have comparatively the same salaries in other professions. This might make them not see the connection between a reliable income (as a motivating factor for choosing teaching) and job satisfaction. In addition, a significantly high number of teachers (90%) have tenured contracts in Norway (OECD, 2019a). Thus, they might not see steady career opportunities and job security as motivating factors for choosing to teach since tenure contracts have systematically been the norm in the profession. Be that as it may, this finding highlights the significance of social utility motivation to teach over personal utility motivation to teach as a proxy to enhance the job satisfaction of mathematics teachers in Norway.

Another crucial finding of this study is the significant mediating role of teacher self-efficacy between social utility motivation to teach and teacher job satisfaction. This finding highlights that teacher self-efficacy has another role to play in addition to its influence on teacher job satisfaction. The role is that mathematics teachers with low social utility motivation to teach who empirically should have low job satisfaction can become more satisfied with their profession by enhancing their self-efficacy. This set of teachers can be supported with appropriate self-efficacy interventions. We argue that this finding is a novel contribution to the literature on the complex relationship between teacher motivation, teacher self-efficacy, and teacher job satisfaction as it concerns mathematics teaching. Therefore, policymakers and educational stakeholders now have another premise to support their argument for more investment in teacher self-efficacy interventions across secondary schools within and outside the Norwegian borders.

The second set of findings for further discussion concerns the changes in teacher job satisfaction across gender, age group, and work experience. We found that female mathematics teachers reported significantly higher job satisfaction than male mathematics teachers in Norway. That is, more Norwegian women than men agreed that the advantages of teaching mathematics outweigh its disadvantages, are contented with the profession, and have no regret in their decision to choose to teach over other professions. This finding is consistent with the results of the study by Toropova et al. (2021) who reported higher teacher job satisfaction for women than for men. More so, this finding adds more credence to not only the notion that the teaching profession has been 'feminised' in Europe with more women in the profession than men (Weiner, 2006) but able the fact that women are more satisfied with the profession than men amongst the Norwegian mathematics teachers. As rightly pointed out by Weiner (2006), this finding can be explained by the fact that teaching provides an avenue for women to convert their private domestic and caring skills into a profession that pays. However, as gender polarity in childcare is collapsing in Norway with more men getting paid parental leave, the gender difference in teacher

job satisfaction may become less. It appears that male mathematics teachers in Norway require interventions that reinforce job satisfaction more than female teachers.

As for the difference in teacher job satisfaction across age groups, we found a high-low–high changing pattern in ascending order of the teacher age groups. That is, the young Norwegian mathematics teachers are highly satisfied with the profession until after the age group, 25–29 years, when they show low satisfaction and then show improved job satisfaction once more after the age group, 40–49 years. This finding is crucial as it identifies teachers within the age group 30–49 years as most vulnerable to a decline in job satisfaction. This offers a prime opportunity to identify the age group of mathematics teachers that should be prioritised for job satisfaction interventions. In the situation of insufficient educational funding, this finding is useful for funding agencies and educational stakeholders on the research project to fund as it concerns interventions that reinforce teacher job satisfaction in Norway. The findings of this study also show a somewhat similar high-low–high changing pattern of teacher job satisfaction by the teachers' work experience. Early career teachers entered the teaching profession with relatively high job satisfaction which suffers a decline consistently until after 30 years of working as a teacher. The high job satisfaction amongst early career teachers can be explained by the natural enthusiasm that follows securing a permanent job. Then, as reality sets in they suffer attrition and pick up again after some years. By implication, we recommend deliberate attempts by the educational stakeholders to support the teachers, especially during the period they are prone to attrition in job satisfaction.

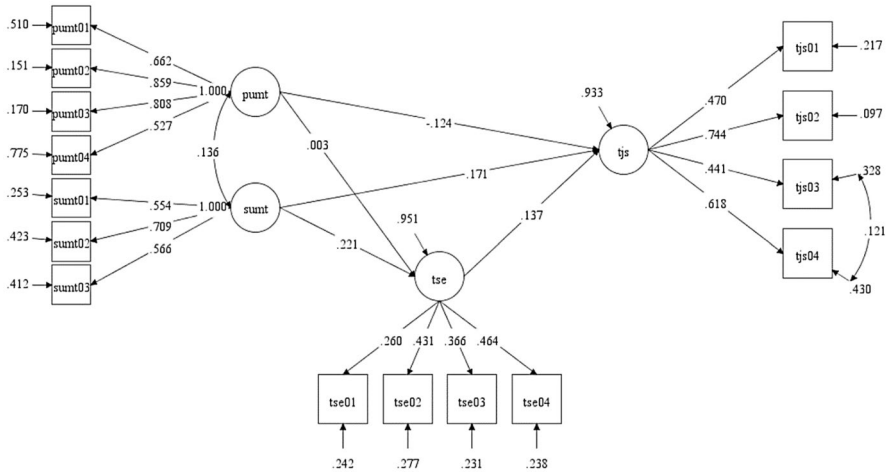
## Conclusion

Before some concluding remarks, it is necessary to highlight some limitations of the study. Arguably, some findings of this study (such as the quantification of effects between and within the research constructs as well as the patterns of changes in teacher job satisfaction across teacher age groups) constitute novel contributions to the literature. Yet, some methodological issues could limit the generalisation of the findings. For instance, we draw on a secondary dataset for the analyses in this study which limits our control over the sampling procedures of generated data. This makes it difficult to ascertain whether the data are representative of the entire population of lower secondary school mathematics teachers in Norway. For the sake of alignment with our conceptualisations of both teacher self-efficacy and teacher job satisfaction, we restricted the measures of these constructs to one dimension each. In addition to the alignment, the use of one dimension simplifies the analytical model as well as the interpretation of findings. However, since both teacher self-efficacy and teacher job satisfaction have been argued to be multi-dimensional (Ainley & Carstens, 2018; Zakariya, 2021), our use of one dimension of each construct may limit the interpretations of our findings to the dimensions used. It is crucial to remark that 93.3% of the variance in teacher job satisfaction is unexplained by the predictors (see the Appendix). This indicates that teacher motivation to teach and teacher self-efficacy explain less than 10 percent of the variance in teacher job satisfaction. This finding, on the one hand, constitutes a weakness in our structural model. On the other hand, it acknowledges the plausibility

of other predictors of teacher job satisfaction which necessitate further research. Thus, we recommended further studies of our evaluated model of relationships between and within the research constructs using the full dimensions of each construct and additional predictor variables of teacher job satisfaction.

Furthermore, the restriction of our sample to the Norwegian lower secondary school mathematics teachers could limit the generalisation of the findings. As discussed in the previous section, some peculiarities of Norwegian society such as gender equality and egalitarianism may explain some of the findings of this study. As such, we recommend replications of this study in independent samples within and outside the Norwegian borders. Despite these limitations, the findings of this study provide tentative evidence for the complex relationship between and within teacher self-efficacy, teacher motivation to teach, and teacher job satisfaction amongst Norwegian lower secondary school mathematics teachers. These findings provide some cues for educational stakeholders and policymakers on which construct to intervene for improved teacher job satisfaction as a proxy for retaining high-quality mathematics teachers within and outside the Norwegian borders. In addition, the findings of this study identify the age group as well as the gender of mathematics teachers in Norway that should be prioritised for job satisfaction intervention programmes within the confines of limited resources. Putting these together, it can be concluded that this study fits into the body of literature on reinforcing teacher job satisfaction from both the theoretical and empirical aspects of the constructs.

## Appendix. Full evaluated model of relationships between the research constructs




*Note*: pumt, personal utility motivation to teach; sumt, social utility motivation to teach; tse, teacher self-efficacy; tjs, teacher job satisfaction

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**Author contribution** Yusuf F. Zakariya conceptualised and designed the study. He carried out material preparation, data analysis, wrote the first draft of the manuscript, and supervised the publication process. Yousef Wardat revised the manuscript. Both authors revised and approved the final version of the manuscript.

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**Data availability** The data used for this study is available upon request from the corresponding author.

## Declarations

**Ethical approval** This is not applicable.

**Informed consent** All the participants voluntarily gave informed consent.



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