Study of the Motivation of Teachers in Hong Kong

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DEDICATION

To all our Teachers past and present who would do anything to make us succeed

They nurture us and watch with pride and joy as we spread our wings

The pinnacle of intrinsic motivation

ACKNOWLEDGEMENTS

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I also thank Professor Herb Marsh and Professor Dennis McInnerney for allowing me to use the Hong Kong teacher data.

Statement of authenticity

I hereby verify that this thesis, titled “Study of the Motivation of Teachers in Hong Kong” is wholly my own original work. Where materials have been drawn from other sources, they have been acknowledged.

I have not submitted this material, either in whole or in part, for a degree at this or any other institution

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Date: 17/06/2021_____

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GENERAL LIST OF ABBREVIATIONS

BHP	Broken Hill Property Limited
CFI	Comparative fit index
CFA	Confirmatory factor analysis
DIW	Desire for involvement at work
EdMAP	Education motivation attribute profile
EMAP	Employee motivation attribute profile
ESEM	Exploratory structural equation model
HESEM	Hierarchical-ESEM
IFW	Interpersonal fit at work
LASSO	Least absolute shrinkage and selection operator
MI	Modification index
PRW	Perceived recognition at work
PWBW	Psychological well-being at work
RMSEA	Root mean square error of approximation
SRMR	Standardised root mean square residual
SEM	Structural equation modelling
TAW	Thriving at work
TLI	Tucker-Lewis index

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LIST OF ABBREVIATION FOR FACTORS

Factor	Description	Abbreviation/item Code
Abstract Thinking	The level to which an individual engages with complex theoretical concepts.	ABST
Application/Energy	The level to which an individual values and maintains a high level of work activity.	APPL
Attention to Detail	The level to which an individual shows concern for details, no matter how small, in accomplishing a task.	ATD
Autonomy	The level to which an individual requires freedom from rules and structures,	AUTO
Behavioural Flexibility	The level to which an individual can modify the behavioural style to achieve a goal.	BEHA
Career Orientation /Ambition	The level to which an individual demonstrates a desire to reach personal and career goals within specific time frames.	CARI
Consultation/Group Influence	The level to which an individual seeks to consider group dynamics and their impact in reaching consensus through consultation.	CONS
Decisiveness	The level to which an individual demonstrates a readiness to make decisions, make judgements, take action and commit him/herself.	DECI
Desire for Involvement at Work	The will to involve oneself in the organisation and to contribute to its functioning and success	DIW
Emotional Control	The level to which an individual controls his/her emotions and mood changes in the workplace	EMAT
Evaluation	The level to which an individual critically evaluates and interprets information.	EVAL
Feeling of competence	The perception of possessing the essential competencies to do one's job efficiently and have mastery of the tasks to perform.	FOC
Group Sociability	The level to which an individual establishes personal friendships and social relationships within the workplace.	GROU
Innovation	The level to which an individual generates and/or requires imaginative, creative solutions in work situations.	INNO
Interpersonal Fit at Work	The perception of experiencing positive relationships with individuals interacting with oneself within the work context.	IFW
Job Satisfaction	The level to which an individual derives job satisfaction from interest in their work.	JS
Job Self-Concept	The level to which an individual feels effective, competent, and proud of the way he or she performs in the work context.	SC

Continued.

Leadership	The level to which an individual can accept responsibility of and demonstrate the ability to motivate groups of people towards task accomplishment without incurring hostility.	LEAD
People Orientation	The level to which an individual seeks to analyse and understand human behaviour.	PEOP
Perceived Recognition at Work	Perception of being appreciated within the organisation for one's work and one's personhood.	PRW
Persuasion	The level to which an individual seeks to change and influence the ideas and opinions of others and is prepared to move forward with a point of view based on his/her convictions.	PERS
Planning and Organising	The level to which an individual has a structured approach to tasks involving short and long-term aspects for self and others.	PLAN
Quantitative/Logical	The level to which an individual uses logical and quantitative approaches to obtain realistic, practical outcomes.	QUAN
Recognition and Rewards	The level to which an individual desires external recognition and tangible rewards	REWA
Routine	The level to which an individual is interested in repetitive, proceduralised routines.	ROUT
Technical Orientation	The level to which an individual is comfortable with technical processes, technology and computational sciences in the workplace	TECH
Tenacity	The level to which an individual persists until he/she has completed the task.	TENA
Thriving at Work	The perception of accomplishing a significant and interesting job that allows one to fulfil oneself as an individual.	TAW
Variety/Task Flexibility	The level to which an individual needs change and variety in work.	VARI

Note. Extracted from the EdMAP survey instrument, McInerney et al. (2014).

ABSTRACT

Study of the Motivation of Teachers in Hong Kong

No other intervention can make the difference a skilful teacher can make in learning. A teacher may account for a variation of up to 30% in student achievement. However, in most western countries, teaching is in crisis, with many studies indicating high attrition among teachers. Therefore, there is an urgent need for further research to identify the attributes that make happy, committed teachers and enable informed interventions that can reverse this trend.

Unlike western countries, the Hong Kong school context is characterised by strong inducements with high salaries, high social obligations and high academic achievement, as evidenced by its top five ranking in the Programme for International Student Assessment (PISA). Consequently, an analysis of the attributes of Hong Kong teachers as predictors of desirable workplace outcomes offers a valuable opportunity to gain new insights for use in other countries.

This thesis aimed to identify and develop a set of motivational attributes for teachers that can predict positive outcomes for job satisfaction, job self-concept and psychological well-being. These predictive attributes can guide further research, facilitate professional development, inform policymaking and guide interventions for the ongoing motivation of teachers.

The thesis consists of three interrelated studies. Study 1 established a psychometrically sound set of attributes (Education motivation attribute profile [EdMAP]). Study 2 analysed the predictive relationship between EdMAP and the outcome measurements of job satisfaction, job self-concept and personal well-being at work, thus establishing the practical value of EdMAP attributes for predicting the desired outcomes. Study 3 used latent profile analysis to unearth any identifiable, practical and theoretically relevant latent profiles or profile-based subgroups within the teacher population that can guide professional development and policymaking.

A sample of teachers from Hong Kong was administered an adapted version (for teachers) of the employee motivation attribute profile (EMAP) survey developed by Marsh et al. (1991). The instrument measured a broad range of motivation-related attributes using five items per attribute. The total useable sample was 896, with 34% males and 66% females.

Study 1 found that each of the attributes used in the investigation was a valid and robust measure of the construct being measured. The data provided an excellent fit to the hypothesised a-priori factor structure (configuration of factor loadings, variances and covariance). Confirmatory factor analysis yielded an acceptable fit. An exploratory structural equation model with all 23 factors concurrently evaluated and loaded into the non-target factors yielded a comparative fit index/Tucker-Lewis index of 0.981/0.969. The results supported a previously hypothesised set of second-order factors consisting of global-leadership, global-goal orientation, global-variety, global-abstract thinking and global-interpersonal formulated by Marsh and McInerney (1991) with varying degrees of model fit.

Study 2 found a predictive relationship between EdMAP attributes and the measured outcomes of job satisfaction, job self-concept and personal well-being at work. Considering the multicollinearity among the factors, the least absolute shrinkage and selection operator (LASSO) regression technique identified a subset of factors that best predicted the outcomes. With β coefficients ranging up to 0.45, decisiveness, leadership, application and emotional control were found to predict most outcomes.

Study 3 found that while most of the teachers were profiled based on the level of their attributes, there was a distinct group with differences in the profile. The four-class model unearthed a group that had very low values for routine and consultative behaviour and high values for variety, emotional control and career orientation. While the covariates of gender and grades taught did not have any effect on the probability of being in a specific class, the study found age-related changes in class probability. Further investigation is required to establish the significance of these changes.

In conclusion, this thesis found that the EdMAP instrument is a psychometrically sound tool, confirming that the results from the Hong Kong sample are suitable to be baselined and used for future investigations into the motivation of teachers and other professions. The results of Study 2 indicated that predictive attributes such as leadership, emotional control and sociability should be targeted in professional development. Policies and interventions to increase leadership opportunities and create environments that encourage behavioural flexibility and group sociability are predicted to lead to higher job self-concept and psychological well-being. Study 3 indicated that there were subgroups within the teacher

population that need to be targeted with specific interventions such as being change agents and early adopters.

Chapter 1. Introduction

Teachers are arguably the most important group of professionals for developing a nation's future. No other intervention can make the significant difference that a knowledgeable, skilful teacher can make during the learning process (Darling-Hammond, 1997). Significantly, a teacher may account for a variation of up to 30% of student achievement (Hattie, 2003). Guay et al. (2019) further confirmed that teachers' relatedness to students predicted the reading achievement and self-concept for kindergarten students. Teaching is a demanding job in an emerging age of diversity and sustainability (Hargreaves & Fink, 2006). Over the last 20 years, policy changes aimed at improving standards of schools have influenced the contexts in which teachers work (Day & Gu, 2007). Thus, the role of the teacher has intensified and education is in constant flux, where those who desire to survive and thrive must commit to an increased rate of and professional development and individual adaptation (Day, 2004). Consequently, teachers must be willing to overcome steep learning curves, invest personal time and energy to adapt to ongoing reforms and successfully convert ideas into effective practice, thus requiring significant personal investment (Day & Kington, 2008). To sustain their energy and commitment for the work, teachers need to maintain high personal job motivation (Day et al., 2005). Thus, it is crucial that the right individuals must be developed, motivated and retained and matched to the opportunities.

In parallel with the above developments in the work expectations of teachers, the rate of teacher attrition in the United States increased from 5.6% in 1988 to 7.7% in 2012 (National Centre for Education Statistics, 2013). Approximately one-third of new teachers plan to leave their positions within the first five years (Wilhelm et al., 2000). Similarly, the Australian Primary Principals Association found that 24% of teachers are likely to leave teaching within five years (Buchanan et al., 2013). The UK Association of Teachers and Lecturers Union (ATL), has alerted the government to an impending crisis as teachers continue to drop out of the workplace (Cassidy & Clarke, 2015). Similarly, den Brok et al. (2017) when exploring attrition in the Netherlands found that many other countries are already experiencing a shortage of trained teachers, while Lau et al. (2005) reports that in Hong Kong the teaching profession is a highly stressful one. Thus, there is an urgent need to obtain insights into teacher motivation and identify attributes that contribute to increased job satisfaction, greater

self-actualisation and a higher probability of staying within the profession to supplement improvements in teaching efficiency.

This thesis will make several contributions to the field of education by enhancing our understanding of teacher motivation by studying teachers from Hong Kong. It will validate that a set of motivational attributes found applicable to middle management is also applicable to teachers, thereby confirming the multidimensional nature of the construct of motivation (Marsh, 1990) and establish an education motivation attribute profile (EdMAP) instrument to be used in future research. It will then identify the set of attributes that predict teacher's job satisfaction and job self-concept and supplement the existing research on task-oriented assessment of motivation (e.g., Fernet et al., 2008) with personality characteristics-based analysis of motivation. The thesis will then identify the sets of attributes that allow meaningful analysis of differences in profiles. By supplementing the variable-centred approach with the person-centred approach, this thesis will offer new insights to the motivation of Hong Kong teachers. These findings can subsequently be adapted to the western context.

1.1 Theoretical Framework for the Thesis

Individuals accept and keep jobs primarily because of the ability of the job to provide what they seek in the workplace and for the satisfaction of lower- and higher-order needs, provided in return for their investment of time and talent (Cable & Edwards, 2004). The congruence of an individual's values to the workplace values leads to positive outcomes (Cable & Edwards, 2009). These workplace needs and values stem from the person's characteristics, including the individual's unique biological and psychological needs, values, goals and abilities. How well these characteristics match the intrinsic and extrinsic rewards, demands of a job or role, and the cultural expectations and characteristics of other individuals and groups in the person's work environment determines the person-work environment fit (Kristof-Brown et al., 2005). A higher degree of fit between a person's motivational attributes and the work environment results in vocational satisfaction and stability (Holland, 1997). A complementary fit occurs when the person and work environment each provide the other's requirements, whereas a supplementary fit occurs when the person and environment possess matching or similar characteristics such as values and culture (Kristof-Brown et al., 2005). The person-work environment fit can occur at many levels, with the person-vocation fit being the highest level. Other levels include the person-organisation fit, person-team fit and person-

task fit. A high person-vocation fit leads to a mutually beneficial relationship that leads to higher job satisfaction. However, Marsh (1990) proposed that using a global motivation orientation may be problematic and is prone to errors. Thus, rather than search for a single motivational construct to investigate fit, this thesis examined a set of attributes for their relevance to the work environment of teachers that can predict increased job satisfaction, job self-concept and psychological well-being (PWB).

1.1.1 Reasons for Focus on Motivational Attributes

Studies on why people choose to teach as a profession have identified diverse reasons including the desire for social mobility, following parents or extended family, a desire to work in a people-oriented profession, a desire to work with children and job-related benefits including security, holidays and pensions (Watt & Richardson, 2015). Accordingly, these diverse reasons indicate the existence of identifiable individual attributes that influence entry to the profession and the subsequent remaining in the profession. However, most researchers of teacher motivation have focused on the level or "quantity" of indicators such as job satisfaction, while treating motivation for teaching only as an outcome, rather than as a predictor, thereby creating a gap in the current research (Butler, 2012).

Early studies found that pay incentives are not always successful in increasing teacher motivation. Joseph and Green (1986) reported that teachers approach teaching as a mission or calling, attracting individuals who desire intrinsic rewards. Additionally, teacher motivation is based on higher-order needs such as freedom to try out new ideas, desired responsibility levels and intrinsic work elements (Sylvia & Hutchinson, 1985). Similarly, theories of motivation such as Rotter's social learning theory and Banduras self-efficacy theory suggest that teachers may be motivated because a) they grasp the value of their work, b) the work itself is fun and rewarding or c) because of external benefits associated with the work (Fernet et al., 2008). Notably, researchers have also found that teachers would do anything they could to help students succeed because the resultant student success provides teachers with intrinsic gratification (Perry & Hondeghem, 2008). These findings strongly suggest that intrinsic rewards play a key role in teacher motivation and is a strong driver in the search for internal attributes that predict job satisfaction, job self-concept and psychological well-being at work (PWBW).

Analysing motivation from a person-environment fit perspective, Kristof- Brown et al. (2005) proposed that positive outcomes are produced by the match between personal

characteristics including the individual's values, abilities and personality with environmental characteristics including intrinsic and extrinsic rewards. The above findings indicate a pivotal role for individual attributes in determining workplace outcomes. McInerney et al. (2018) noted that the motivational attributes of teachers can predict occupational quitting intentions.

Therefore, the primary aim of this study was to identify and develop a set of motivational attributes for teachers that are intrinsically or extrinsically rewarded by the work environment and can be used to predict positive outcomes.

1.1.2 Why Study Hong Kong Teachers

In Hong Kong, the teaching profession is a highly stressful one (Lau et al., 2005), with teachers having heavy teaching loads (Titus & Ora, 2005). Statistics support this view. The Hong Kong teacher–student ratios of 1:22 in primary schools and 1:18 in secondary schools and class sizes of 33 and 37, respectively (Education Bureau, 2018), are much higher than the Australian teacher–student ratios of 1:15 for primary and 1:12 for secondary schools and class sizes of 23 and 22, respectively (Australian Bureau of Statistics, 2016).

However, unlike the UK, the USA and Australia, teacher retention in Hong Kong is comparatively strong, with a change in the annual attrition rate of the secondary sector of only 3.9% to 5.6% for the period 2001 to 2009 (Choi & Tang, 2011).

The Programme for International Student Assessment (PISA) average achievement scores have consistently placed Hong Kong ahead of Australia and near the top of the developed world (Table 1-1). This higher ranking despite the higher student/staff ratios and adverse class sizes makes Hong Kong teachers an appropriate group to study for understanding the motivation of teachers.

Table 1-1

Programme for International Student Assessment Scores for 2018

	Reading (Score/Rank)	Math (Score)	Science (Score)
Hong Kong	524 (4)	551	517
Australia	503 (16)	491	503
OECD Average	487	489	489

Note. Extracted from PISA 2018 results in focus; http://www.oecd.org/pisa.

Thus, despite some differences, a study of the teacher motivation in Hong Kong has the potential to offer new insights that may be extended to other countries.

1.1.3 Hong Kong Education System and the Key Similarities and Differences with Other Countries

As a former British Colony coming under British rule in 1841, Hong Kong institutions, including the education system, bear many similarities to western institutions. In 1861, Frederick Stewart oversaw the integration of a modern western-style education model into the colonial Hong Kong school system (Wiltshire, 1987). Currently, the schools are overseen by the Education Bureau. In the 2016/17 school year, there were 580 primary schools and 524 secondary schools in the Hong Kong special administrative region (Education Bureau, 2018). Compulsory education consists of nine years, including six years in primary education (grades 1 to 6) and three years in secondary education (grades 7 to 9). The medium of instruction is mainly the Chinese language.

The cultural aspects of Hong Kong have several differences from other developed countries. The Hong Kong teaching profession is characterised by strong inducements to teach and significant social obligations to students (McInerney et al., 2014). In Hong Kong, the teaching profession is well regarded and a teacher's salary is comparable to other professions (e.g., Engineering–Carnoy, 2007). A Hong Kong teacher receives approximately 50% more than the average graduate, while an Australian teacher gets only 35% more than the average graduate (Table 1-2).

Table 1-2

Hong Kong Teacher Salary vs. USA and Australia

	Australia	USA	Hong Kong
Average Annual salary for a graduate	AUS$ 55,000 (US$ 38,732)	US$ 38,000	HK$ 176,220 (US$ 22,505)
Average Annual salary for Level 2.2 (4-year trained teacher with 1-year experience)	AUS$ 74,760 (US$52,647)	US$ 44,000	HK$ 261,400 (US$ 33,716)
Percentage increase from Annual salary of a graduate	+35%	+15%	+49%

Source. Australian values–www.education.edu.au/teacher-salaries, Hong Kong values–www.payscale.com/research/HK/Job=High_School_Teacher/Salary, US values–www.oecd.org.

Research shows that eastern and western cultures differ in their emphasis on social values and power distance (Hofstede, 2001). Significantly, in eastern cultures, hierarchy, interdependence and social conformity are highly valued. Additionally, eastern cultures tend to conform to societal norms and place less emphasis on the value of agency and personal choice (Markus & Kitayama, 1991) and assign a higher value on adhering to the commitment to one's obligations (Markus & Kitayama, 2010). Henceforth, these values can directly influence the perceived role of the teacher in society, define the dynamics between teachers and students and define the interaction with other stakeholders, including parents. Furthermore, in many western contexts, there is strong resistance to traditional authority figures, which has resulted in teachers being challenged by both students and parents (Maclure & Walker, 2000). Significantly, Hong Kong straddles both cultures.

Notwithstanding the above differences, the higher student achievement as evidenced by PISA scores and the relatively lower attrition rates make Hong Kong schools a good context in which to study teacher motivation.

1.2 Approach to the Thesis

Marsh and McInerney (1991) used a grass-roots approach to extensively investigate and develop a set of relevant individual's attributes for middle management at Broken Hill Property Limited (BHP), a large Australian mining organisation. The resulting survey instrument, named the employee motivation attribute profile (EMAP), was broad in scope and covered all factors considered important by the researchers and BHP's human resource department. This thesis adapted and used Marsh and McInerney's (1991) EMAP survey instrument. The development, confirmation and analysis of the EdMAP for teachers were conducted in three studies with distinct yet interrelated focus. A brief overview of each study follows.

1.2.1 Study 1: Psychometric Testing and Development of the EdMAP Instrument

The first study evaluated the applicability of the instrument to a different occupation and culture to that for which it was initially developed. While the instrument was found to be reliable and valid for middle management, the instrument has not been used in the different context of teachers. Thus, the first step was to confirm its suitability for subsequent analysis. Study 1 investigated the measurement invariance of the instrument with gender, age and

grades taught to test its generalisability. In addition, when applying the instrument to middle management, the researchers found evidence of a theoretically explainable second-order factor structure. This study investigated the applicability of the second-order factor structure to teachers.

1.2.2 Study 2: Predictive Power of the EdMAP instrument

Holland (1997) asserted that the degree of fit (congruence) between an individual's personality type and the work environment predicts several important outcomes, including job satisfaction and performance. This theory suggests that individuals possess different traits, behaviours and interests that can be used to classify them. Subsequently, the classification can be used to predict the occupation the individual will choose and enjoy. Accordingly, teaching is classified as a "social" occupation in Holland's six class RIASEC model (i.e. realistic, investigative, artistic, social, enterprising and conventional) and is predicted to attract and reward "social" individuals. Thus, Study 2 investigated the predictive relationship between a broad range of EdMAP attributes and workplace outcomes, thereby identifying the attributes that make them choose and enjoy teaching as a career.

1.2.3 Study 3: Person-Centred Analysis

Most studies on motivation have focused on the variable-centred approaches of regression analysis and factor analysis. While variable-centred analysis with a large number of variables is difficult to interpret and less suited for making inferences about individuals, the person-centred approach offers a parsimonious way to model individual heterogeneity (Merz & Roesch, 2011). Moreover, Meyer et al. (2013) proposed that there are benefits to adopting the person-centred strategy as a complement to the traditional variable-centred approach, arguing that a person-centred approach has the potential to provide new information that cannot be obtained using a variable-centred approach.

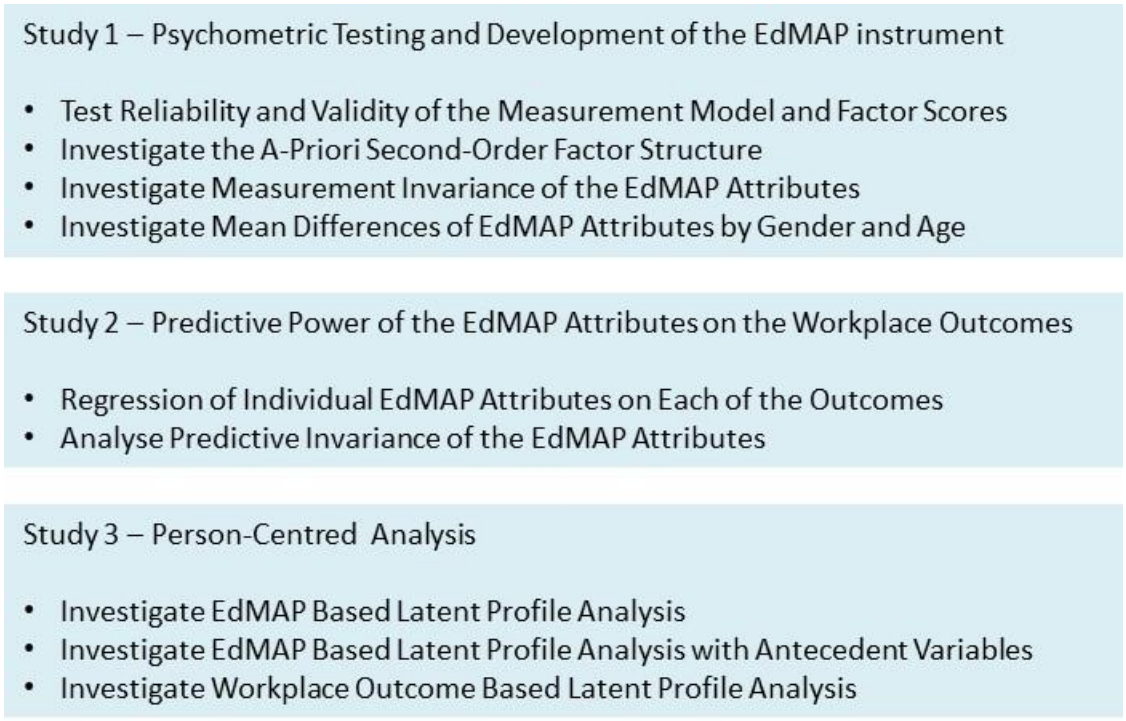
Furthermore, when calling for extended research on teacher motivation, Richardson and Watt (2010) identified a largely unexamined aspect of profiles of motivation among teachers, observing that motivational profiles from multiple motivational constructs have been relatively under-researched. Considering that the variable-centred approach focuses only on the interrelationships among variables and assumes that all individuals are from a single underlying population (Marsh & Lüdtke, 2009), this person-centred analysis has the potential to offer new insights into the multidimensional nature of motivation (Urdan, 2014).

Therefore, Study 3 used a person-centred strategy to investigate shape (qualitative) and level (quantitative) differences in the profiles of EdMAP attributes to develop new insights, and thus complement the findings of the first and second studies.

Additionally, interactions among workplace outcomes such as job satisfaction, job self-concept, and PWBW have not been typically evaluated for multiplicative effects (Merz & Roesch, 2011). Because the latent profiles are a manifestation of the interaction among the variables, in addition to examining the profiles based on motivational attributes, Study 3 filled the above gap by extending the person-centred approach to analyse profiles based on the outcome variables (Figure 1-1).

Figure 1-1

Summary of the Aims of the Three Studies



1.3 Overview of the Thesis

Chapter 1 Introduction: The present chapter provides a brief introduction of the aims, objectives and rationale for the thesis and an overview of the thesis. It argues the importance of studying teacher motivation, makes a case for the choice of the sample and rationale for focusing on motivation attributes.

Chapter 2 Literature Review: This chapter provides a summary of the literature related to the topics of the thesis. The first section reviews the general theories of motivation, followed by a review of findings that are specific to teachers and the current state of play. The wide range of theories clearly indicates that motivation is not a simple unidimensional construct, but rather a complex interplay among individual, contextual and environmental factors. The chapter also examines the rationale for choosing the attributes that were selected for further investigation.

Chapter 3 Aims, Research Questions and Hypotheses: In this chapter, I present the aims, hypotheses and research questions and the rationale for the choice of hypotheses and questions for the three studies of this thesis, which aims to establish the psychometric properties of the EdMAP instrument, examine the predictive value of the instrument and investigate the existence of theoretically meaningful profiles of teachers.

Chapter 4 Methodology: Here, I present the approach, including details of the sample population and a brief overview of the statistical tools used in this thesis. It describes the approach to confirmatory factor analysis (CFA), the emerging techniques of using an exploratory structural equation model (ESEM) and the person-centred approach of latent profile analysis (LPA).

Chapter 5 Study 1: This chapter presents the results of Study 1, which investigated the psychometric properties of the EdMAP instrument, and developed the factor scores that are used in the subsequent studies. This chapter then presents the results of the invariance analysis of the measurement model over gender, age and grades taught, examines the existence of a second-order factor structure and reviews the age and gender differences that manifest as mean differences in the latent factors.

Chapter 6 Study 2: In this chapter, I present the results of Study 2, which investigated the predictive relationship between the EdMAP instrument and the selected job outcomes of job satisfaction, job self-concept, and PWBW. The selected predictors are then tested against a test dataset to determine predictive accuracy. This chapter also reviews the invariance of the regression relationship (interaction effects) with age and gender.

Chapter 7 Study 3: This chapter presents the results of Study 3, which used a person-centred approach to investigate the existence of meaningful subpopulations based on EdMAP attributes. The identified profiles were examined against the antecedent variables of gender,

age, and grade taught. Similarly, job satisfaction, job self-concept and PWBW were examined for meaningful subpopulations.

Chapter 8 Discussion and Conclusion: The final chapter presents a summary of the key findings, the strengths and weakness of the thesis, considerations for future research and the impact of the findings on policymaking.

Chapter 2. Literature Review

The purpose of this chapter was to provide a review of the literature on motivation relevant to this thesis. This chapter begins with a brief overview of the current theories of general motivation, followed by recent research specific to teacher motivation, and a review of the theoretical findings that support the choice of specific attributes selected for this thesis.

2.1 Current Theories of Motivation Relevant to Teachers

Motivation is a central issue in the field of psychology and a cornerstone of biological, cognitive and social regulation (Ryan & Deci, 2000). Employee motivation is of interest for many reasons, including selection, promotion and retention (Marsh & McInerney, 1991). Although motivation is often treated as a singular construct, the observation of individuals in the workplace shows that people are moved to act by very different types of individual factors, which are influenced by the varied experiences of each individual. Correspondingly, individuals have not only different levels of motivation but also different types of motivation (Ryan & Deci, 2000). Consequently, Cable and Edwards (2004) reaffirmed that while the primary reason for employment is that people accept and keep jobs for the satisfaction of economic needs, researchers must consider other needs that stem from the person's characteristics, biological and psychological needs, values and goals. Thus, the many theories listed below provide evidence that motivation, its drivers and processes are diverse and complex and are centred uniquely on each individual.

2.1.1 Work Motivation as a Fit Between Personal and Career Topology

Holland's (1997) personal career theory postulates that vocational interest is an expression of an individual's personality and, therefore, individuals search for work environments that facilitate the exercise of their abilities and are aligned with their values. Moreover, the degree of fit (congruence) between an individual's personality and the work environment is the determinant of several important outcomes, including job satisfaction, stability and performance. Subsequently, Holland (1997) identified six individual topologies i.e. realistic, investigative, artistic, social, enterprising and conventional. On a more general scale, Holland (2012) added that most persons have a personal career theory, which can range in influence from weak and invalid to strong and valid. The personal career theory is the manifestation of the beliefs, ideas, knowledge and assumptions that guide individuals as they

choose occupations. Individuals use their personal career theory as they go about making career decisions. Significantly, Holland (2012) in the development of the self-directed search tool for identifying suitable careers, specified that teaching is most suited to the social type. The social type is best described as cooperative, empathic, generous, helpful, sociable, persuasive, responsible, understanding and warm (Holland, 1997). Similarly, while Holland's theory of career orientations advises individuals to select careers that are congruent with their personalities, the self-concordance theory, argues that individuals must select personal goals that match their autonomous interests and identifications (Sheldon & Holliday, et al., 2020).

This classification of job requirements for teachers adds weight to the argument that there is a relationship between the factors in the employee personal attribute profile and job success, thereby justifying the need to investigate whether attributes such as persuasion are rewarded in the teacher's work environment and whether an individual who is skilful in arguing a point of view and like to make my point of view heard is better suited to being a teacher.

2.1.2 Work Motivation as a Cognitive, Self-Determination Outcome

The self-determination theory (SDT) distinguishes between the different types of motivation based on the perceived reasons or goals that initiate action. The most basic distinction is between intrinsic motivation, which is doing a task because it is inherently interesting and enjoyable, and extrinsic motivation, which is doing a task because it leads to a separable outcome (Deci & Ryan, 1985). Individuals are intrinsically motivated by some tasks but not others, while not everyone will be intrinsically motivated by a specific task. Thus, intrinsic motivation exists in the nexus between a person and a task, suggesting that individuals have different types of motivation to perform different tasks. The theory also identifies that the level of internalisation can range in a continuum starting from the least of amotivation through varying levels of extrinsic motivation (external regulation, introjected regulation, identified regulation and integrated regulation) to intrinsic motivation, reflecting the level of internalisation. The level of internalisation determines the type of required regulation; the more internalised the motivation, the lesser the required external regulation. Social contexts can facilitate or hinder internalisation. Gagné and Deci (2005) defined autonomous motivation as consisting of well-internalized extrinsic motivation and intrinsic motivation. Well-internalized extrinsic motivation occurs when the value and regulation of

the activity have been integrated within one's self. However, well-internalized extrinsic motivation predicts somewhat different outcomes from intrinsic motivation.

SDT further asserts that the core psychological needs expected from the workplace are the innate needs of competence, autonomy and relatedness. The cognitive evaluation sub-theory of SDT (Deci & Ryan, 1985) proposes that the interpersonal events and structures (e.g. management feedback and rewards) that encourage the development of feelings of competence can facilitate intrinsic motivation because they satisfy the basic psychological need for competence. Thus, the sense of autonomy and competence associated with key tasks will be reflected in the resulting PWB. The organismic integration sub-theory of SDT (Ryan & Deci, 2000) postulates that the perception of high autonomy, competence and relatedness present in the context promotes the process that turns extrinsic motivation into intrinsic motivation. Optimally challenging activities were intrinsically motivating, and positive feedback facilitated intrinsic motivation by promoting a sense of competence when individuals felt responsible for their successful performance (Gagné & Deci, 2005).

Therefore, it is possible to hypothesise that levels of motivational attributes gravitate towards career-specific values, which reflect the specific requirements of the teaching profession and context. Subsequently, Study 3 used a person-centred approach to investigate the existence of such subpopulations of teachers with specific sets of attributes.

The above theories suggest the presence of a reciprocal relationship over time between "enjoying doing a task" and "being competent in the task". By applying the theory to an essential task such as planning (Fernet et al., 2008), it can be argued that a teacher who "likes to plan and work with schedules" will find this task interesting and enjoyable, leading to more time and energy in doing the task. Consequently, the teacher will develop competency in the task, leading to extrinsic rewards through better student performance and internalised extrinsic motivation rewards by being recognised by colleagues and superiors. Similarly, the need for teachers to learn and adopt new technologies (Day & Kington, 2008) provides intrinsic motivation to a person who "likes to learn new technologies", thereby leading to increased job satisfaction. Such a person is likely to achieve competence in technology and be provided with positive feedback, leading to higher job self-concept. Moreover, higher self-efficacy predicts many positive attitudes and behaviours of teachers, such as adopting innovative teaching strategies, resilience and persistence (Klassen & Chiu, 2011). Thus, the nexus between the person and task that manifests in the predictive relationship between the

motivational attributes and workplace outcomes such as job satisfaction will be investigated in Study 2.

2.1.3 Work Motivation as a Need to Align with the Profession's Social Identity

The social identity theory proposes that individuals classify themselves into social categories based on their profession and attached organisation. This classification has been used to answer questions of identity, social placing and existential motives (Ashforth & Mael, 1989). When the values of the organisation are not congruent with an individual's values, the individual will experience cognitive dissonance and negative job attitudes. When employees hold common values, then communication and friendships with other colleagues become easier (Cable & Edwards, 2004). Additionally, when adopting the identity of a group, the individual identity of the person is pushed to the background and the identity as a member of the desired group dominates in the foreground (Korte, 2007). Furthermore, teaching as a profession has a distinct contextual profile that contributes to both job context and identity. Day and Kington (2008) described this broad context by noting that teacher identities are constructed not only from the emotional, technical and task expectation aspects of teaching (i.e. classroom management strategies, pupil test results and so on) but also from the interaction between the individual experiences of teachers and the institutional, social and cultural context in which they function.

Thus, the social identity theory predicts that teachers whose values and motivation attributes are congruent with the needs of the profession will a) be able to identify with the occupation, while others leave the occupation, b) be better able to integrate and communicate with colleagues and supervisors, and c) adopt the professional group identity over time, leading to greater homogeneity in attributes that are relevant to the occupation. The above suggests that the quantitative differences of the profiled groups in Study 3 will become smaller as the shared professional identity is adopted and as the number of years in the profession increases.

2.1.4 Work Motivation as a Social Exchange

Cropanzano and Mitchell (2005) in the social exchange theory postulate that relationships evolve into trusting, loyal and mutual commitments. While these commitments occur primarily through reciprocity and negotiated agreements, other considerations such as

rationality, altruism, group gain and status consistency also influence the relationship. While in the work situation, money and services are the main benefits of the exchange, other factors such as love, status, information and psychological rewards are also relevant. Motivational attributes in the workplace can stem from individual traits that lead to symbolic benefits and socio-emotional needs (Foa & Foa, 1980). Thus, social exchange theory predicts that the emotional needs of an individual like the "need to be noticed" or "likes to be the centre of attention" will play a role in the evolving relationship with the employer.

2.1.5 Work Motivation as a Psychological Contract

Rousseau (1989) viewed the operation of the social exchange theory in the workplace as the development of a psychological contract between the person and the employer. These psychological contracts can be relational, transactional or balanced. Rousseau (2004) proposed that workers shape their psychological contracts depending on whether they view the context as a long-term or short-term engagement. Workers with a stepping-stone mentality tend to adopt a more transactional and economic view with the expectation of narrow duties and limited terms. Workers seeking longer-term employment tend to adopt relational contracts with expectations of loyalty, stability and open-ended commitment to the future. Contracts also depend on the personality of the individual, where highly neurotic or overly sensitive persons opt for transactional contracts, whereas conscientious workers prefer relational contracts.

This elaboration of contract development predicts that teachers with permanent employment will approach the workplace with different motivational expectations to those with temporary contracts. Thus, the strength of the expectation of the need "I desire recognition and reward", or "I expect praise for doing a good job" is likely to vary by the employment status of teachers. Similarly, the psychological contract of a full-time teacher will be constructed differently from that of a part-time teacher, indicating that the groupings of motivation profiles will be influenced by variables such as employment type, thus furthering the expectation that Study 3 will find theoretically supportable distinct profiles for teachers. In summary, the relationship between individual attributes and workplace outcomes has the potential to be influenced by factors such as the nature of the psychological contract.

2.1.6 Work Motivation and the Expectancy Value Theory

The expectancy value theory proposes that an individual's achievement-related choices at school, work and social endeavours are shaped by their ability beliefs, expectancies for success, and by the value attached to the task (Eccles, 2009). As a whole, ability beliefs are conceived as broad beliefs about competence in the domain of interest and not the expectation of success on a specific task. Consequently, in real-life situations, competence in a domain and the expectation of success are highly related and empirically indistinguishable. Importantly, the value attached to a task consists of the intrinsic value (how much a person enjoys the task), utility value (whether the task is seen to be useful), attainment value (perceived contribution to achieving a person's goals), opportunity cost (what an individual must forego in undertaking a task and expending the effort to succeed) and the entailing negative effects such as financial loss, adverse psychological experiences and time sacrifice (Perez et al., 2014). Furthermore, the choices are assumed to be influenced by both positive and negative task characteristics. Because one choice often eliminates other options, all choices have opportunity costs associated with them; therefore, the relative value and probability of success of the available options influence the choice.

However, considering motivation and effort from a different perspective, Marsh et al. (2016) found that effort and student self-concept was a double-edged sword, where the effort of trying hard could undermine academic self-concept. This might also apply to teachers, especially where socially or economically disadvantaged and poorly motivated students can thwart the best effort of teachers, thus complicating the study of the nexus between individual attributes and workplace outcomes by introducing additional contextual variables.

2.2 **Specific Findings on Teacher Motivation**

The study of teacher motivation is not in itself new. Even though 30% of student achievement can be attributed to teachers (Hattie, 2003), it is only in the last few decades that researchers have focused on teacher motivation with a similar intensity as on student motivation. However, most researchers have focused on external factors such as pay and work conditions, with only a few leveraging current motivation studies systematically to develop psychometrically strong and theoretically grounded models (Richardson & Watt, 2015). Similarly, while there have been extensive studies on management and student motivation, these findings have not been adequately extrapolated and analysed in the work environment of teachers (Butler, 2007). Han and Yin (2016) notes that together with teaching

strategies, the teachers' orientation towards autonomy were factors to determine the classroom environment.

2.2.1 Work Tasks Motivation Scale for Teachers (WTMST)

Most studies of the self-determined motivation of teachers have only approached motivation through a global motivational orientation at work (Pelletier et al., 2002). Subsequently, following up from Marsh's (1990) observation of the inappropriateness of a global measure of motivation and the need to look at the tasks and personality characteristics, Fernet et al. (2008) developed the WTMST, which has been used to assess five self-determination motivational constructs toward six work tasks. The six work tasks are class preparation, class teaching, evaluation of students, classroom management, administrative tasks and complementary tasks. Additionally, Fernet et al. (2008) investigated amotivation, extrinsic motivation and intrinsic motivation within each task and observed a pattern of correlations among the motivational components that were consistent with the self-determination continuum. As an example, autonomous teacher motivation is associated with autonomy-supportive teaching practices that encourage choice and provide relevance to students (Fernet et al., 2012). Furthermore, self-determined types of motivation (e.g. intrinsic, identified regulation) were more domain-specific than external regulation and amotivation. The correlation among the motivational factors and teachers' perceptions of self-efficacy, desire to change careers, burnout, and the controlling style of the school principal was found to agree with the self-determination continuum.

2.2.2 Teachers and Self-efficacy

Klassen et al. (2011) reported that higher self-efficacy predicts teacher behaviours, including innovative teaching strategies, resilience, task persistence, well-being and student achievement. Butler (2007) argued that the classroom is the achievement arena for both teachers and students, and used the goal orientations for teaching scale to identify four different orientations for teachers, i.e. mastery-orientation (competence as a teaching professional), ability-approach orientation (demonstrating superior teaching capability), ability-avoidance orientation (avoiding displaying inferior teaching skills) and work avoidance orientation (minimal effort). Since then, Butler (2012) enhanced the list of orientations by adding the new relational orientation to create caring relationships with students. Thus, there are important links among the teachers' achievement goals, the resulting

perception of self-efficacy and student achievement, with these goal types determining the teachers' behaviour in the classroom and their patterns of communication.

Similarly, Guo et al. (2015) found that the perception of self-efficacy and the dimensional comparison process played a significant role in the coursework aspirations of students. By extending this finding to teacher behaviour, it can be anticipated that the perceptions of self-efficacy will influence specific factors such as leadership aspirations and the dimensional comparison process will be used to determine outcomes such as the desire for additional involvement at work.

2.3 Differences in a Teacher's Environment to Other Professions

Alexander et al. (1994) documented themes for choosing to teach as a career, which included working with children and young adults, being of service, continued involvement with education, material benefits and security, flexibility for young parents, the need for an absorbing career, the ability to influence others and the desire for authority. While some of the above factors have since changed with variations in the teacher's social context, the aspiration to work with children has remained a central theme in many recent studies in the UK, US and Europe (Richardson et al., 2014).

While the general workplace dynamics of motivation apply to teachers, their workplace has some unique aspects that must be considered when investigating teacher motivation. These are examined in the section below.

2.3.1 Reciprocity Between Teacher Motivation and Student Abilities

Caprara et al. (2006) found evidence of a reciprocal effect between a teacher's perceived self-efficacy and a student's achievement, highlighting an unusual aspect of the teaching profession. A teacher's self-efficacy is framed by their capacity to affect student learning and engagement (van der Want et al., 2018); therefore, self-efficacy is influenced by student success. Thus, teachers of talented and well-disciplined students are perceived as being more successful and develop a robust sense of efficacy compared to those teachers of students with learning or disciplinary problems. Consequently, a strong sense of teacher's self-efficacy promotes a high commitment to continuing in the profession and to building collaborative relationships with colleagues and parents and increases the propensity for innovation in the classroom. Thus, a teacher of talented students is more likely to use classroom management approaches and methods that encourage student autonomy, leading to higher student

achievement and subsequent teacher job satisfaction. Thus, the above findings suggest that the school environment and student performance will have an impact on teachers' job self-concept, where the teachers of gifted or high performing students have a higher level of job self-concept.

2.3.2 Teacher Motivation and Professional Life Phases

Day et al. (2005) found that a teacher's work life spans several generic professional life phases, namely a) commitment phase, b) identity and efficacy in classroom phase, c) managing changes in role and identity phase, d) work-life tensions phase and e) challenges to sustaining motivation phase. These phases are differentiated by varying levels of challenge to maintaining motivation as teachers interactively balance the changing levels of competence, self-esteem and demands of life outside the classroom. Thus, professional life phases will influence career orientation and the response to questions such as "I want to keep progressing my career". Viewed from an SDT perspective, this suggests a professional life-phase based increase in intrinsic generic motivation during phases b and c, followed by an overall decrease during phase e. Similarly, viewing a teacher from a career perceptive, Reeves and Lowenhaupt (2016) identified the career life cycle phases of a teacher as progressing from novice, apprentice, professional, expert and emeritus.

2.3.3 Teachers and Goal Theory

In applying the goal theory to teachers, Butler (2007) observed that teachers might differ in the way they define their job and in the way they define success. Mastery-oriented teachers focus on the task at hand and mobilise motivation drawn from the potential for individual development that emerges from engaging in a task. Performance-oriented teachers prefer to focus their sustained attention to the task at hand rather than to the contribution that the task has for self and self-worth (Maehr, 2001).

Butler (2012) further found that when teachers started the year with the primary goal of creating personal and caring relationships with their students, they were more likely to care for students with problems and take the time to listen to them. Thus, when mastery and relational goal orientations were modelled simultaneously, the teacher's relational goals rather than mastery goals emerged as the main predictor of motivation.

2.3.4 Teacher and Goal Orientation

Ali and McInerney (2004) proposed a multidimensional hierarchy of goal orientations, i.e. task involvement, effort-striving, competitiveness, group leadership, affiliation, social concern and praise. While the focus of the above study was on students, it can be argued that these processes can be extended to adulthood, and will also be reflected in a teacher's motivational attributes. A teacher who is high on effort-striving will consider themselves as hard-working and place a high value on hard work. Similarly, a teacher with high group leadership goals is expected to score high on "I like to have leadership responsibilities".

Dowson and McInerney (2001) investigated social and work avoidance goals of students and found that students were motivated in the classroom context by multiple goals such as work avoidances, social affiliation, social responsibility and social concern. By contending that the above findings and behaviours of students will manifest in adulthood, it is likely that the above behaviours will apply to teachers and to other professions. Thus, it can be argued that teachers would be motivated by multiple goals such as "I desire recognition and reward" and "I like to have leadership responsibility".

Furthermore, Ali and McInerney (2004) found that for students these goals are not entirely independent, suggesting the existence of a second-order goal structure. Thus, the goal structure translating into the presence of a similar second-order attribute structure for teachers will be investigated.

2.3.5 Teachers and Quadric-Polar Model of Need Achievement

Protection and promotion of one's self-worth is a driver of behaviour leading to two key strategies of success-orientation and failure-avoidance (Covington, 1992). The quadric-polar model identifies four behaviour patterns based on the above strategies as a) *success-approach*, with high success-orientation and low failure-avoidance, b) *over-striving,* with high success-orientation and high failure-avoidance, c) *self-protecting*, with low success-orientation and high failure-avoidance and d) *failure-accepting,* with low success-orientation and low failure-avoidance (Covington & Muller, 2001). Subsequently, Parker et al. (2012) reported that teachers with a success-approach were more resilient and viewed failure as a form of feedback. Conversely, over-striving teachers experienced more anxiety and self-doubt while self-protecting individuals were more likely to engage in withdrawing effort or

creating excuses that in the long-term led to the very same failure they were trying to avoid. Thus, these patterns determine the adaptive and maladaptive behaviours of teachers.

Martin (2007) recognised the multidimensional nature of motivation and developed the wheel of motivation and engagement, distinguishing between behaviour and cognition. Martin (2010) applied the resulting constructs to teaching, interpreting a) *self-efficacy,* as a teacher's judgement of their ability to achieve good results, b) *valuing,* as a teacher's perceptions of the importance of their work, and c) *mastery,* as a teacher's goal orientation towards developing competence in teaching skills. He found that the wheel of motivation and engagement was appropriate for investigating motivation among teachers. Relating the topologies of the quadric-polar model to teacher behaviour, Parker et al. (2012) reported that there are established links between the wheel of motivation topologies and work-related well-being. Collie and Martin (2017) further examined these links and concluded that these links hold for teachers.

2.4 Summary of Reviewed Research on Motivation

In summary, the above literature review on motivation support Marsh's (1990) view that a global measure of motivation is not appropriate. There are multiple individual goals and individual-specific characteristics and many different dynamics involved in connecting motivation at work to individuals. These theories strongly indicate that motivational orientation is better determined by investigating personality characteristics, thus lending strong support for this thesis to investigate a set of motivational attributes that can be built into a useful EdMAP. The identification and validation of such an EdMAP profile encompassing the wide range of attributes suggested by the above theories will enable the consolidation of the practical implications of the above theories. It will provide a framework for the holistic examination of the influence of practical interventions (through their effect on individual attributes) on workplace outcomes.

Furthermore, the focus on motivational attributes was further reinforced by the findings of Fernet et al. (2008) on the dominance of intrinsic motivation in the teacher's self-determination continuum, aptly summarised by the observation that teachers would do anything they could to help students succeed. Subsequently, the above suggests that the focus must be on attributes that are relevant to the teacher tasks that influence student achievement and in the long-term lead to improved workplace outcomes for teachers.

2.5 Key Theories That Guide the Search for Motivation Attributes for Teachers.

The SDT (Ryan & Deci, 2000) with specific emphasis on intrinsic motivation and the personal career theory (Holland, 1997) are the two dominant theories that have guided the selection of the attributes, the development of the survey and the general direction of this thesis.

Ryan and Deci (2020) defined intrinsic motivation as the inherent tendency to seek out new experiences and challenges, to extend, test and use one's capacities, to explore, and to learn, and doing so expand their competencies. This inherent capability is visible in many organisms, especially mammals and is significant to humans. However, social-contextual events such as feedback, communications and rewards that can enhance feelings of competence during action can subsequently elicit/sustain or subdue/diminish intrinsic motivation for specific tasks. Ryan and Deci (2017) noted that the sense of autonomy and internal perceived locus of causality played a role in relating external events to intrinsic motivation.

A behaviour is externally regulated if it is dependent on external reward or punishment. However, Ryan and Deci (2017) proposes that through the process of internalisation, individuals assimilate and carry out behaviours on their own in the absence of immediate reward or punishment, by getting behaviours established in each individuals mind and motives. Internalisation is a humanisation process promoting individual growth as well as coherence and growth of social groups, as individuals tend to internalise extrinsic motivations that are endorsed by others. Introjection regulated behaviour stems from only partially or incompletely assimilated motives and values. They may be powered by feelings of worth. Regulation through identification occurs when the individual sees the behaviour as something personally important to themselves. Integrated regulation, which is considered the fullest type of internalisation occurs when there is a wholehearted endorsement of the behaviour, with no conflict with other values or attitudes. Deci and Ryan (2005) further suggests that internalisation is a natural process that operates to serve the individuals need for relatedness, competence, and autonomy.

Experiencing one's behaviour as self-determined increases one's intrinsic motivation. Thus, some of the attributes detailed below (e.g. variety, autonomy, behavioural flexibility

and leadership) were chosen based on their possible contribution to the perceived causality for successful workplace outcomes.

My personal experience is that "teachers would do anything they could to help students succeed" and the pride they take in the students' subsequent success confirm the dominance of autonomous (well-internalised) motivation in the teaching profession. Findings by other researchers such as Bieg et al. (2011) that intrinsically motivated teachers provided a positive instructional setting that increased student motivation provides further credence. Therefore, the present study will focus on the internal attributes with the potential to relate to intrinsic motivation and feelings of competence for teaching tasks.

Holland's (1959) theory of vocational choice provided a mechanism for linking an individual's characteristics with the characteristics of the environment. The core idea that most individuals resemble a combination of Holland's six topologies of realistic, investigative, artistic, social, enterprising and conventional (RIASEC) have been extensively investigated and maintained validity across gender and cultural groups (Nauta, 2010). As briefly discussed before, the environment can also be classified by a similar topology. Holland (1997) asserted that teaching is most suited to the social type. This thesis will indirectly test Holland's (1997) assertion that individuals select and thrive in work environments that are congruent with their personality types, enabling them to exercise their values, and address agreeable problems and roles, against the backdrop of teaching being a social type. Holland (1997) further defined the three evaluative constructs of *consistency*–as a measure of the coherence of the type represented by greater proximity on Holland's hexagon, *differentiation*–where the person or environment reflects specific types and excludes others and *identity*–where the work environment has clear and stable goals, tasks, and rewards. Therefore, this thesis is predicated on the school environment demonstrating both consistency and stability in the environment and the expectation that social-attributes will figure prominently as predictors of job satisfaction, job self-concept and PWBW.

Holland considered teaching as a career for a social individual who likes to do things to help people and generally avoids using machines, tools, or animals to achieve a goal. While a good teacher would predominantly be a social individual who like to do things to help people, the teachers tasks identified by Fernet et al. (2008) indicates that a successful teacher needs abilities or attributes from other classifications, such as the need to be enterprising to lead students, parents and other stakeholders both inside and outside the classroom, needs to be

investigative in solving math or science problems, and need to be conventional in being good at working with written records and seeing self as orderly following a set plan. Thus, the EDMAP instrument that covers a broad range of attributes was considered for this thesis.

2.6 Choice of Personality Attributes for the EdMAP

The identification of attributes of individuals that correlate to motivation and work outcomes has been the aim of many industrial and management researchers, underpinned by the belief that job characteristics influence employee attitudes and behaviours and that there is an optimal nexus between what a job offers and what the employee desires.

Techniques used for investigating what the employee desires include ability tests, personality tests, personal history, interest inventories, projective techniques, simulations and work motivation inventories. Furthermore, Ryan and Sackett (1987) found a range of diverse dimensions (up to 70 attributes) used by organisations in screening applicants based on the prior experiences of the personnel selection officers.

The following sections will review some of the frequently quoted instruments, followed by a summary of the research justifying the attributes selected for use in this thesis.

Attributes Used in Frequently Quoted Instruments

A review of the current literature identified many discrete factors affecting job performance and subsequent job satisfaction. The dimensions measured in some of the frequently quoted instruments are summarised in Table 2-1.

Table 2-1

Frequently Quoted Instruments of Job-Related Attributes

Author	Attributes Studied	
Gagné et al. (1997) - Job Diagnostic Survey	Job autonomy Feedback from the job Feedback from agents Autonomy Competence	Empowerment scale Impact Meaningfulness Motivation at work scale Intrinsic motivation
Hackman and Oldham (1975)	Skill variety Task identity Task significance Autonomy Feedback	
Strong (1943) - Vocational Interests of Men and Women	4 × personal style scales Work style, learning environment, leadership style, risk-taking	25 × basic interest scales (some examples below) Teaching, social service, science etc. 6 × general occupational themes Realistic, enterprising investigative, artistic, social

Marsh et al. (1991) noted that there is considerable overlap in the constructs and even within the particular items used in a specific instrument, further noting that there are a plethora of instruments whose psychometric properties have not been rigorously evaluated and that many of the psychometrically sound research instruments measure such a narrow range of constructs that their value to the practitioner is limited. While there has been significant research on leadership and student motivation, the progress on teacher motivation has been slower.

2.6.1 Individual Attributes Selected for This Thesis

Marsh and McInerney (1991) combined the attributes identified in the literature and the attributes used by BHP for its middle management to produce the EMAP. The development of the instrument was a collaborative exercise involving an ongoing interplay between applied practitioners (BHP personnel staff) and measurement experts (research staff). The theories examined above indicate widely different dynamics and point to the relevance of a broad range of motivational attributes. Thus, creating a holistic profile requires the consideration of a wide range of attributes. Therefore, task-oriented attributes such as planning and routine that relate to teaching as a process and person-oriented attributes such as consultation and group sociability that relate to the teacher as a person were considered. Identifying the attributes that correlate to workplace will increase our understanding of motivation.

The attributes listed in Table 2-2 were examined for their relevance to teachers and were chosen for this study. The selected attributes, a brief definition, a sample question and the prior research that supported the inclusion of the factors in the survey are presented in Table 2-2. All 23 attributes from the original EMAP instrument were used to facilitate future use of the EDMAP as a standard established instrument.

Table 2-2

Employee Motivation Attribute Profile (Marsh & McInerney, 1991)

Variety	The level to which an individual needs change and variety in work. e.g. I enjoy the chance to do different things.
Hackman and Oldham (1974) in their work on job design proposed that the extent to which a variety of skills are needed for a job increased its meaningfulness and, in turn, lead to high internal motivation and satisfaction. Because teaching requires a variety of tasks (Fernet et al., 2008), it is possible to hypothesise that the level to which an individual needs change and variety in work will influence their job satisfaction. Thus, variety is a candidate attribute for this study.	
Autonomy	The level to which an individual requires freedom from rules and structures. e.g. I like to have the freedom to act in my area.
Hackman and Oldham (1974) noted that job autonomy increases the experienced responsibility for outcomes of work. However, Day et al. (2005) pointed out the bureaucratically driven pressures are chipping away at teachers' autonomy. Thus, the level to which an individual requires freedom from rules and structures was selected as a motivational attribute relevant to the current school climate. Significantly, Zimmermann et al. (2018) studying the predictors of burnout found favourable effects of competence support, autonomy support and social relatedness on the core burnout dimensions and satisfaction in teachers.	
Innovation	The level to which an individual generates or requires imaginative and creative solutions in work situations. e.g. I think creatively and imaginatively.
Hattie (2003) identified the ability to innovate and improvise as required by the situation as a critical difference between experienced teachers and expert teachers. The classroom is a dynamic workplace and the level to which an individual competently generates or requires imaginative and creative solutions is a pre-determinant of classroom success; thus, innovation	

is a candidate attribute.	
Behavioural Flexibility	The level to which an individual can modify the behavioural style to achieve a goal. e.g. I cope with frequent changes to situations.
Day and Kington (2008) identified the need for resilience and behavioural flexibility in classroom contexts. Additionally, Pierce & Morrison (2011) noted the importance of behavioural flexibility during early career stages when teachers transition from the ideal to the practical. In the dynamic classroom environment and a profession that is in flux, behavioural flexibility is a candidate attribute for investigation.	
Attention to Detail	The level to which an individual shows concern for even minute details, in accomplishing a task. e.g. I prefer to engage with considerable attention to detail.
Lesson preparation is a crucial task for a teacher (Fernet et al., 2008). Consequently, attention to detail provides many benefits in lesson preparation and the overall effectiveness of a teacher by a) improving student's comprehension of a lesson, b) avoiding confusion for students and c) enabling the teacher to anticipate the questions that will be asked after a lesson (Jensen et al., 2014). Thus, attention to detail can be considered an important attribute to be a successful teacher.	
Abstract Thinking	The level to which an individual engages with complex theoretical concepts. e.g. I prefer working with complex theoretical questions.
The ability to engage in abstract thinking improves teaching success, by a) enabling a teacher to understand abstract concepts to assess and better manage classroom situations (Hattie, 2003), b) allowing students to learn and adopt the teacher's approach (Diezmann et al., 2002) and c) providing students with authentic opportunities for abstract thinking and reasoning in the classroom.	
Technical Orientation	The level to which an individual is comfortable with technical processes, technology and computational sciences in the workplace. e.g. I enjoy mastering new equipment and techniques.

Teachers are increasingly expected to incorporate new technology into their classroom practice. Day et al. (2005) views the introduction of exciting innovations and technology into teaching as a professional success factor. Additionally, a teacher with a technical orientation can build a better relationship with students with a similar orientation or with students studying subjects that require a technical orientation. Thus, the level to which an individual is comfortable with technical processes, technology and computational sciences is an attribute to be studied.	
Planning	The level to which an individual has a structured approach to tasks involving short-term and long-term aspects for self and others. e.g. I like to plan and work with schedules.
The level of planning influences the lesson focus, learning opportunities, the organisation of students and teacher-student interaction (Day & Kington, 2008). Hattie (2003) found that expert teachers extensively plan classroom interaction and strategies. The level to which an individual has a structured approach to tasks involving short- and long-term aspects for self and others will be a crucial determinant of work outcomes, and thus is a relevant attribute.	
Evaluation	The level to which an individual critically evaluates and interprets information. e.g. I am not prepared to accept things at face value.
Housner and Griffey (1985, cited in Hattie, 2003) found that expert teachers investigate and evaluate the abilities, experience and background of students and use this information to determine teaching strategies. Thus, the level to which an individual can critically evaluate and interpret information to feed into their decision making and choice of teaching strategies will play a key role in a teacher's success and job outcomes.	
Quantitative	The level to which an individual uses logical and quantitative approaches to obtain realistic, practical outcomes. e.g. I enjoy quantitative analysis.
Many fields of study require a logical and quantitative approach for analysis and problem solving. The teacher is the role model for the student and imparts the skills. Thus, a teacher's	

skills will be reflected in student success and ensuing teacher self-concept.	
Decisiveness	The level to which an individual demonstrates a readiness to make decisions, render judgements, take action and commit themselves. e.g. I readily make decisions.
Expert teachers are more decisive and better decision-makers (Hattie, 2003). They are skilful in keeping the lesson focus and accomplishing the teaching objectives. Moreover, decisive teachers encourage students' questions and comments as springboards for discussion. They achieve a balance between content-centred and student-centred instruction. Therefore, the ability and readiness to make decisions, render judgements and take actions that have an impact on the dynamics of classroom management is a candidate attribute for this study.	
Application	The level to which an individual values and maintains a high level of work activity. e.g. I can handle a lot of work.
There is strong, consistent evidence to suggest that when a teacher exhibits greater enthusiasm, students are also more likely to be energetic and excited about learning (Patrick et al., 2000). Thus, in addition to the direct impact on teacher performance, the level to which an individual values and maintains a high level of work activity will be indirectly reflected in student performance.	
Tenacity	The level to which an individual persists until he/she has completed the task. e.g. I finish what I start.
Tenacity, which involves sustaining goal-directed action and energy when faced with obstacles, has been associated with leadership, resilience and achievement (Baum & Locke, 2004). Thus, the extent to which an individual persists until they have completed the task can be considered a motivational attribute for teachers.	
Career Orientation	The level to which an individual demonstrates a desire to reach personal and career goals within specific time frames. e.g. I have a well-defined set of personal career goals.

Judge (1994) found that ambitious individuals set high goals for their career attainment and high goals lead to higher levels of motivation and performance. Since teaching demands significant personal investment (Day & Kington, 2008), it can be argued that the level to which an individual demonstrates a desire to reach personal and career goals will be related to their performance and job satisfaction.	
Persuasion	The level to which an individual seeks to change and influence the ideas and opinions of others and is prepared to move forward with a point of view based on their convictions. e.g. I can convince others with my argument.
The teachers play a key role in facilitating group processes and in managing the classroom environment (Galajda, 2012). In addition, changes in the educational system demand greater participation in school and parent-school relationship (Day et al., 2005). Subsequently, the level to which an individual seeks to influence and change the ideas and opinions of others and is prepared to move forward with a point of view based on their convictions will impact the relationship, is likely to increase the internalized extrinsic motivation.	
Leadership	The level to which an individual can accept responsibility and demonstrate the ability to motivate groups of people towards task accomplishment without incurring hostility. e.g. I can keep a group working together as a team.
Teachers can lead in a variety of ways, including leadership at school and community levels. Harris and Spillane (2008) found that the availability of opportunities to demonstrate leadership had positive impacts on morale, self-esteem and self-efficacy. Thus, the attribute of leadership measuring the level to which an individual can accept responsibility and demonstrate the ability to motivate groups of people can be hypothesised to impact performance, satisfaction and job self-concept.	
Group Sociability	The level to which an individual establishes personal friendships and social relationships within the workplace. e.g. I establish personal friendships and social relationships.
Vandenberghe et al. (1999) noted that a good teacher needs to develop the social aspect of	

classroom life and make parents active partners in the teaching process. Thus, the level to which an individual can establish personal friendships and social relationships with parents, students and other teachers will influence success in the school environment. Liem and Chong (2017) investigating international best practices noted the strong influence of the teacher-student relationship in student achievement. Thus, developing and maintaining positive relationships with students, parents and colleagues is a difficult aspect of the teacher's work, especially in schools with challenging circumstances (Johnson & Birkeland, 2003). This challenge is more prominent in western cultures, where there is resistance to traditional authority figures (Maclure & Walker, 2000).	
Consultation	The level to which an individual seeks to consider group dynamics and their impact in reaching consensus through consultation. e.g. I support and encourage the contribution of others.
Galadja (2012) noted that the classroom climate is determined by the learning group dynamics and development. The teacher is the de-facto group leader and the role of the teacher in facilitating group processes is of primary importance. The level to which an individual seeks to consider group dynamics and their impact in reaching consensus through consultation is a key element in managing the classroom and success potentially leading to increased internalisation of extrinsic motivation via feedback.	
People Orientation	The level to which an individual seeks to analyse and understand human behaviour. e.g. I am interested in understanding people's behaviours.
Emerson et al. (2012) stated that school-family and school-community partnerships are re-defining the location, functions and boundaries of education. These partnerships enhance parental and community capacity to create conditions in which children are encouraged to learn more effectively and take education beyond the school gate. Thus, the level to which a teacher seeks to analyse and understand student, parent and colleague behaviours is an important facet of teacher performance and it is possible to hypothesise that the level of people orientation will be reflected in job performance.	
Recognition	The level to which an individual desires external recognition and tangible rewards.

	e.g. I seek recognition from superiors in words or actions.
Recognition by supervisors and rewards for performance play a vital role in determining job satisfaction. Lawler (2003) noted that the factors that determine the attractiveness of a reward are a) the amount of the reward and b) the weight an individual assigns to the reward. Thus, the level to which an individual desires external recognition and tangible rewards will be positively associated with motivation and job satisfaction.	
Emotional Control	The level to which an individual controls his/her emotions and mood changes in the workplace. e.g. I am unflappable regardless of the situation.
It is now recognised that emotions are a powerful vehicle for inhibiting or enhancing learning (Fried, 2011). Furthermore, the teacher's emotions and emotion regulation influences and are influenced by the emotional climate of the school in a reciprocal relationship. Moreover, the level to which a teacher controls their emotions in the classroom will impact the teacher, the students and school climate, and contributes to teaching performance. Similarly, King and Cheng (2019) reported several studies that show that teachers' emotions play a crucial role in teacher success.	
Routine	The level to which an individual is interested in repetitive, proceduralised routines. e.g. I am comfortable with routine work.
A teacher is required to perform many routine tasks such as marking tests. Mccarthy (2009) reported many studies that found that turnover is positively associated with task repetitiveness, suggesting that increases in routinisation decrease job satisfaction. The level to which an individual is interested in repetitive, proceduralised routines will determine the intrinsic motivation of the task and the variety offered by the tasks.	
Attention Seeking	The level to which an individual is seeking attention to themselves. e.g. "I like to be the centre of attention"

The above attributes constitute the basis for the present study and will be referred to collectively as the EdMAP and will be modelled as the input variables used to predict the selected outcomes that are described in the following section.

2.7 Choice of Workplace Outcomes Selected for Investigation

The interaction between the employee and the workplace produces many outcomes relevant to the employer and employee. For this study, job satisfaction, job self-concept and PWBW were chosen as the outcomes to be studied and are described below.

2.7.1 Job Satisfaction

Job satisfaction is one of the most fundamental, yet elusive, constructs used in the study of industrial relations (Macdonald & Maclntyre, 1997). Job satisfaction is referred to as a person's general attitude towards their job and has been extensively used as a predictor of a) absenteeism, b) turnover and c) productivity (Judge et al., 2002). Jin and Lee (2012) found that job satisfaction was related to the improved health and well-being of workers. Significantly, teachers report that job satisfaction accrues from the context of day-to-day classroom activities including working with children, seeing students make progress and the general school climate of working with supportive peers (Cockburn & Haydn, 2004). Klassen and Chiu (2010) found that job satisfaction is a decisive element influencing an teacher's attitudes and performance. Thus, job satisfaction is an outcome of significant interest.

2.7.1.1 Measuring Job Satisfaction

Macdonald and Maclntyre, (1997) listed the two main approaches to measuring job satisfaction as a) the factor/facet approach, where individual facets such as pay, supervision and work conditions are evaluated and b) the general level of satisfaction approach. The authors further elaborated that some studies suggest that facets are merely components of a larger, more general factor, concluding that the general approach better examines the overall level of satisfaction. In contrast, the facets approach better examines the structure of satisfaction. The present study used the former approach with survey questions designed to evaluate the general level of satisfaction (Table 2-3).

Table 2-3

Measuring Job Satisfaction

Job Satisfaction	The level to which an individual derives job satisfaction from an interest in their work. e.g. I am very satisfied with the kind of work that I do.

2.7.2 Job Self-Concept

Job self-concept is another important construct in the study of motivation, being an important outcome and a predictor of subsequent behaviour (Zeleke, 2004). Marsh and Perry (2005) defined self-concept as a person's self-perception that is formed through experience and interpretation of one's environment. There is compelling evidence that individuals who feel good about themselves in a social context and are confident of their abilities are likely to be more motivated and effective than individuals with low self-concept (Craven & Marsh, 2008). While self-concept is multidimensional (Shavelson et al., 1976), the expectancy value model predicts direct and indirect relationships between the dimensions of self-concept and the individual's plans and choices (Born-holt & Piccolo, 2005).

In students, academic self-concept shares a mutually reinforcing relationship with academic achievement (Marsh & Craven, 2006). A similar dynamic can be expected from teachers. Further strengthening the argument for selecting job self-concept, Shamir (1991) observed that the existing theories of motivation offer an inadequate explanation of work motivation and should be supplemented by a self-concept-based explanation of work motivation. Thus, this pivotal construct of job self-concept was chosen as an outcome to be measured.

Craven and Marsh (2008) postulated that the most powerful effects of the multidimensional self-concept are based on specific components of self-concept as opposed to self-esteem or general self-concept. Thus, this study will focus on job self-concept.

2.7.2.1 Measuring Job Self-Concept

Korthagen (2004) stated that while the concept of self is crucial to a proper understanding of how individual teachers function, there are several challenges in using self-concept. There are many facets of self, such as actual self, the true self, the essential self and the ideal self. This study recognises the distinction between the *personal self* and the *professional self* and will investigate the professional self through the use of questions such as "I feel competent in

my job" and "I am competent in the work that I do" that focus on the actual professional self (Table 2-4).

Table 2-4

Measuring Job Self-Concept

Job Self-Concept	The level to which an individual feels effective, competent, and proud of the way they perform in the work context. e.g. I am good at doing what is expected of me in my job.

2.7.3 Psychological Well-Being at Work

PWB is a topic of interest to politicians, philosophers and the medical profession and has been guided by two primary conceptions of positive functioning. One formulation distinguishes between positive and negative affect and defines PWB as the balance between the two. The other formulation emphasises life satisfaction as the key indicator of well-being (Dagenais-Desmarais & Savoie, 2012). Research on PWB has evolved along two lines of a) the hedonic approach defining PWB in terms of happiness and life satisfaction, and operationalised based on indicators of positive affect, negative affect and general satisfaction with life and b) the eudemonic approach defining PWB in terms of optimal functioning, meaning and self-actualisation. Ryff (1989) described PWB as consisting of six dimensions of purpose in life, environmental mastery, autonomy, positive relations with others, personal growth and self-acceptance.

Most teachers spend more than half of their waking hours at work, making this life domain a primary focus for study (Morin, 2004) and a key contributor to both general well-being and life satisfaction. Psychological health at work is one of the evolving issues and critical responsibility for managers, and contextually distinct from PWB. PWBW has not been unambiguously defined or well operationalised. Thus, Dagenais-Desmarais and Savoie (2012) after extensive statistical analysis proposed a five-factor model of PWBW consisting of the facets of *interpersonal fit at work*, *thriving at work*, *perceived recognition at work*, *feeling of competence* at work, and *desire for involvement at work*. This thesis will use the Dagenais-Desmarais and Savoie (2012) definition and facets of PWBW (Table 2-5).

Table 2-5

Measuring the Facets of Psychological Well-Being at Work (Dagenais-Desmarais & Savoie. 2012)

Interpersonal fit at work	Perception of experiencing positive relationships with individuals interacting with oneself within the work context. e.g. I value the people I work with.
Thriving at work	Perception of accomplishing a significant and interesting job that allows one to fulfil oneself as an individual. e.g. I find my job exciting. Thriving individuals grow and develop. They are energised rather than feel stagnating or depleted. Thriving is characterised by a display of vitality and increased learning at work.
Feeling of competence	Perception of possessing the essential competencies to do one's job efficiently and have mastery of the tasks to perform. e.g. I know I am capable of doing my job. Gagné et al. (1997) defined the feeling of competence as the belief in one's ability to perform a job successfully and recognised the feeling of competence as one of the four psychological dimensions of empowerment. It is important to note that job self-concept is a broad view of the individual in the workplace with feeling of effectiveness, competence and pride in the work. The feeling of competence in the PWBW context, can be considered the task oriented component of the job self-concept, focusing on the specific tasks at hand and the mastery of the tasks. Furthermore, Marsh et al. (2019) in reference to the murky distinction between math self-efficacy vs. self-concept and the jingle-jangle fallacies, reports that generalized math self-efficacy and math

	outcome expectancies were indistinguishable from math self-concept but were distinct from test-related and functional measures of self-efficacy. This observation may have implications on when the same constructs are evaluated in the workplace.
Perceived recognition at work	Perception of being appreciated within the organisation for one's work and one's personhood. Beer et al. (1984) postulated that recognition is one of the motivations of employees, and thus how well one's effort is recognised is a personal reward. e.g. I feel that my work is recognised.
Desire for involvement at work	The will to involve oneself in the organisation and to contribute to its functioning and success beyond the allocated tasks. e.g. I want to take initiative in my work.

Note. Questions for measuring PWBW are extracted from the EdMAP (McInerney et al., 2014).

These definitions by Dagenais-Desmarais and Savoie (2012) support and agree with some of the earlier definitions such as those identified by Ryff (1989) listed above, the affective states and cognitive evaluations of satisfaction with one's life (Diener, 1984) and with Masse et al.'s (1998) concepts of control of self and events.

When evaluating PWBW, it is necessary to acknowledge the three major competing hypotheses regarding the impact of generic well-being across all life domains on PWBW, i.e., *spill-over*–hypothesising that one domain spills over other domains of life experiences, *segmentation*–hypothesising that individual's life domains do not interact with one another and *compensation*–hypothesising that individuals seek to compensate one dissatisfying life domain by investing in another one (Judge & Klinger, 2008). The balance points are specific to each individual. In self-reporting, there is the possibility that other domains may contaminate PWBW.

In summary, this thesis is based on a set of attributes that are supported by the existing literature and by extensive statistical analysis and results of the first application of the EMAP to an Australian mining organisation. It encompasses a wide range of attributes covering

leadership, career orientation, technology orientation and interpersonal orientation of teachers in its effort to create a comprehensive profile. It also engages three dominant and multiple outcomes of job satisfaction, job self-concept and PWBW to validate the usefulness of the EdMAP instrument. After having reviewed the current literature, the following chapter describes the key hypothesis and research questions addressed in the thesis.

Chapter 3 Aims, Research Questions and Hypotheses

The research undertaken in this thesis has the potential to change the way teachers are trained and motivated. The findings will improve the understanding of the individual attributes that lead to teachers with greater job satisfaction, higher job self-concept and better PWB. This understanding will help in identifying and retaining motivated teachers and offer insights for further research, policy and interventions aimed at alleviating the western world's emerging teacher crisis.

A feature of this thesis is the focus on the internal attributes of the individual teacher rather than the external conditions, such as pay and work hours. The thesis consists of three interrelated studies. The primary purpose of Study 1 was to establish a psychometrically sound set of attributes, that is an EdMAP that was valid and suitable for further analysis. The primary purpose of Study 2 was to identify the predictive relationship between the EdMAP and the outcomes of job satisfaction, job self-concept and PWBW. The primary purpose of Study 3 was to use the techniques of LPA to investigate theoretically relevant latent profiles of EdMAP attribute-based subgroups within the teacher population.

This chapter presents the overall aims, hypothesis, research questions and their rationale in detail for each of the three studies. Predictions are hypothesised based on previous research and theory presented in Chapter 2. Where there is insufficient prior research or theory to support a hypothesis, the aspect under investigation is presented as a research question. The hypotheses and questions are numbered based on study, type (hypothesis/research question) and a sequence number for ease of reference, e.g. Study 1 Research Question 1 → S1-RQ-1.

3.1. Study 1: Psychometric Testing and Development of the EdMAP Questionnaire

Aim of Study 1

The aim of Study 1 was to confirm that the EdMAP instrument for teachers possesses acceptable psychometric properties demonstrated by:

a) The reliability and validity of the measurement model and the suitability of the collected data for further analysis.

b) The generalisability of the EdMAP instrument by confirming invariance of the measurement model across gender, age and grades taught.

The instrument was then analysed for the existence of a theoretically relevant second-order factor structure, followed by an investigation into the mean differences of the factors by age and gender.

Approach to Study 1

The results of Study 1 are presented in four sections:

- Section 1 demonstrates that each of the attributes used is a valid and robust measure of the construct being measured by examining the a-priori hypothesised factor structure (e.g. configuration of factor loadings, variances and covariance).
- Section 2 investigates whether the results for teachers confirm the existence of a second-order factor structure like the one found for middle management (Marsh, 1991).
- Section 3 investigates and evaluates whether the factor structure is invariant across males and females, different age groups and primary and secondary teachers.
- Section 4 investigates the mean difference of the EdMAP factors by gender and age.

This study used both CFA and ESEM to identify and confirm the EdMAP profile.

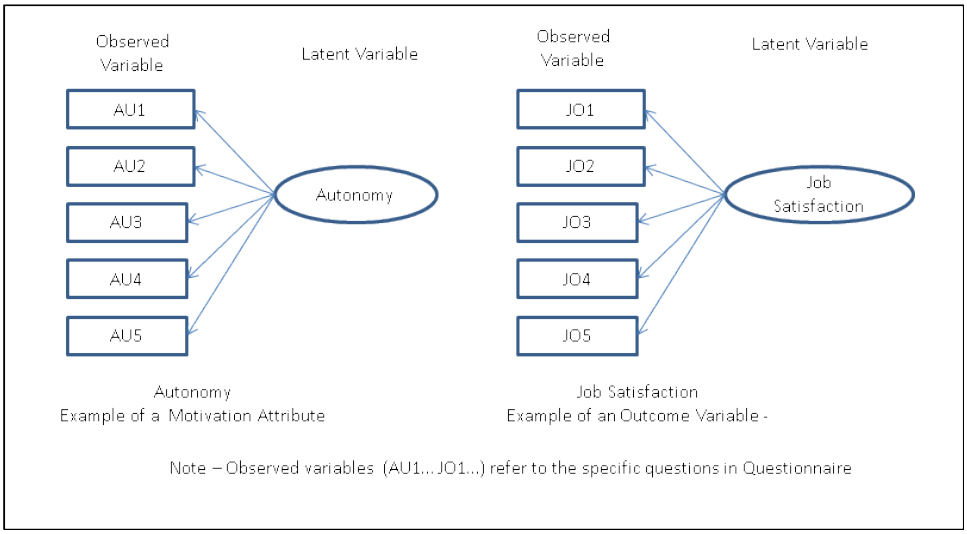
The following presents the hypotheses and research questions that are examined in each section.

2.7.4 Confirm the Reliability and Validity of the Measurement Model

The EdMAP individual attributes profile and its predecessor (EMAP) have not been used before in an international context or within the teaching profession. Therefore, this study began with a validation of the instrument and measuring model as an integrated whole for the Hong Kong teacher sample. Figure 3-1 shows two examples of the EdMAP measurement model.

Figure 3-1

Examples of the Measurement Model



Note. AU1-AU5, JO1-JO5 are examples of the survey items, and autonomy and job satisfaction are examples of the hypothesised factors.

3.1.1. Goodness of Fit of Individual Items of the EdMAP Instrument

Hypothesis S1-HY-1: Tests of reliability and goodness of fit will find an acceptable fit for the one-factor congeneric measurement model for each of the a-priori EdMAP factors.

Rationale

A one-factor congeneric measurement model is a simple model within which a single latent variable is measured by several observed items and is used to assess item reliability and scale reliability. In considering the appropriate number of items per factor, Marsh et al. (1994) expressed several concerns with two-item factors, considered three items as the acceptable minimum for a congeneric model, and recommended four to five items per factor. The present study initially used all five items per factor and evaluated whether the number of factors could be reduced while providing evidence of a better fit. While it is possible to estimate congeneric models with three items, Marsh (1998) observed that more is never too much, about the number of items used. Thus, the CFA tuning was limited to reducing to four items per factor.

Reliability was measured using single-factor omega, which is a better measure than the popular Cronbach's alpha, which assumes tau (item loading) equivalence (Trizano-Hermosilla & Alvarado, 2016).

3.1.2. Multifactor Congeneric Model with 23 Factors and Five Items

Hypothesis S1-HY-2: The tests of reliability and goodness of fit will demonstrate acceptable fit when all the attributes of the EdMAP instrument are evaluated together as a multifactor congeneric CFA with all 23 factors and five items per factor.

Rationale

This hypothesis intended to validate that the factorial integrity of the individual factors was maintained when they were placed together as a single complete instrument. In the congeneric model, each item was associated with only one factor and all covariation between items was assumed to be a consequence of the relationship between items and factors.

3.1.3. Tuning the Multifactor Congeneric Model

Research Question S1-RQ-1: Can the multifactor congeneric model of EdMAP with 23 factors be improved by removing the item with the lowest loading on the designated factor or by removing the item with the highest modification index?

Rationale

A factor may not load into its theorised item because of a vague wording of the item, or ambiguity of the item, or because the item response can be a result of multiple factors. Thus, it was necessary to investigate whether the overall model could be improved by eliminating the lowest loading items. Matsunaga (2011) noted that on a liberal-conservative continuum, a loading of 0.4 is acceptable, while a conservative approach will require a loading of 0.6. The item with the lowest loading is identified for dropping because it least contributes to the construct being measured. The results of this simple analysis were used to form the baseline against which the more sophisticated MI-based tuning could be evaluated. However, Marsh et al. (2010) in investigating short-form questionnaires argued that reducing the number of items may change the scope of the factor. Thus, it is necessary to make a practical trade-off.

Modification indices are estimates of the expected reduction in the overall model fit chi-square value when each relevant parameter is freed. Thus, removing the items whose

parameters lead to the highest modification index (MI) is expected to reduce the chi-square value. Some authors argue against changing the model in this manner, as such model refinement amounts to changing the model to empirically fit the data and changing the scope of the factor (Marsh et al., 2010). Others note that only items that have a strong loading into one component and small or zero loadings on all others should be retained, supporting the view that low loading items, as well as those with high loadings on other factors, should be dropped (Matsunaga, 2011). However, this approach must be considered in the light that the two factors themselves may be correlated or refer to the same construct. Because the MPLUS package used in this thesis provides the MI by the parameter and provides the values if the loading is constrained or the correlation is constrained, the contribution of both the parameter loading and correlation to the model fit can be evaluated; therefore, this thesis used the combined MPLUS output.

3.1.4. Exploratory Structural Equation Model

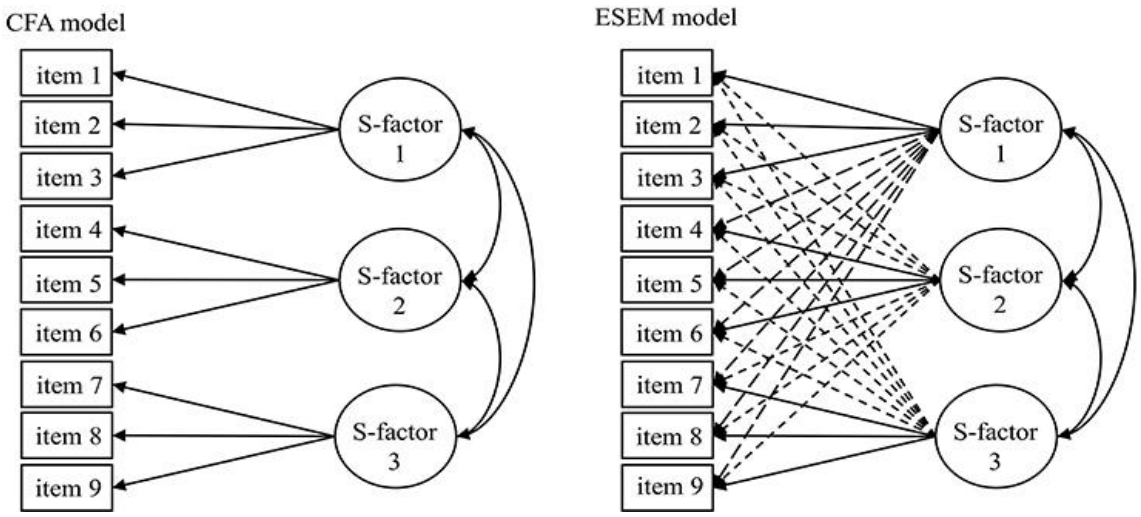
Hypothesis S1-HY-3: Using an ESEM will provide a better fit than the corresponding CFA model and a better overall model with improved factor discrimination.

Rationale

Despite the extensive use of CFA, Marsh et al. (2014) proposed that the typical independent cluster model (ICM)-CFA structure is sometimes inappropriate because the factor structures are not often consistent with the highly restrictive ICM, where each item loads on one factor and all non-target loadings are constrained to be zero. Thus, ICM-CFA usually leads to distorted factors with overestimated factor correlations. Marsh et al. (2014) proposed ESEM as a suitable approach. As elaborated in Chapter 4, items are allowed to load to multiple factors, thereby removing the artificial constraint of the ICM approach as shown in Fig 3.2

Figure 3-2

CFA Model vs. ESEM



Note. The dotted line represents non-target loadings with the initial value set to zero.

The low loading on the non-target factors is achieved by setting the initial value of the loading to zero. By allowing cross-loadings, the model is hypothesised to provide better distinction between factors and less biased estimates.

3.1.5. Investigation of the A-Priori Second-Order Factor Structure

In observing that, in an interacting, unsegregated world most influences will tend to show some correlation, Cattell (1965) predicted a correlation among psychological attributes and the possible existence of a higher-order factor structure among observed attributes. Hierarchical factor structures have been found in many psychological constructs, such as self-concept (Marsh & Hocevar, 1985). Furthermore, Marsh and McInerney (1991), using the EMAP instrument, reported a second-order factor structure in the EMAP attributes for managers.

Thus, the 23 individual attributes that have been measured for EdMAP were evaluated for the existence of a theoretically coherent, second-order factor structure. The following section describes the hypothesis related to the existence of a higher-order factor structure.

3.1.6. The A-Priori Second-Order Factor Structure

Research Question S1-RQ-2: Does the Hong Kong teacher data provide evidence for the existence of a second-order factor structure that closely reflects the factor structure hypothesised in Table 3-1?

Table 3-1

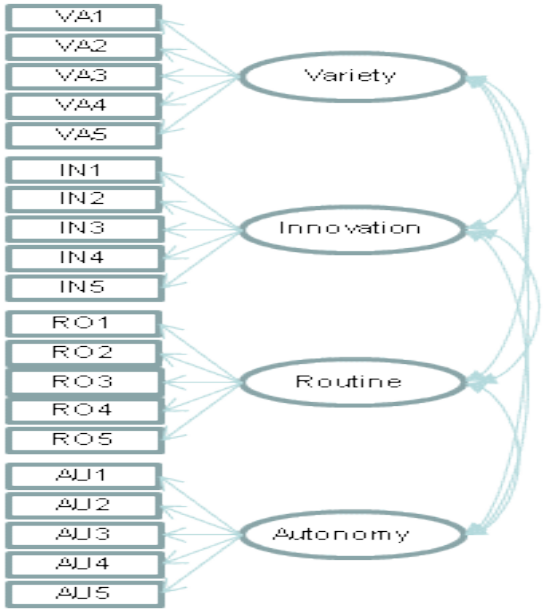
A-Priori Second-Order Structure by Marsh and McInerney (1991)

EdMAP attribute	Proposed Second-Order Factor
Abstract Thinking	Global-Abstract Thinking
Technical orientation	Global-Abstract Thinking
Quantitative	Global-Abstract Thinking
Attention to Detail	Global-Application
Planning	Global-Application
Application	Global-Application
Tenacity	Global-Application
Career Orientation	Global-Goal Orientation
Attention Seeking	Global-Goal Orientation
Recognition	Global-Goal Orientation
Behavioural Flexibility	Global-Interpersonal
Group Sociability	Global-Interpersonal
Consultation	Global-Interpersonal
People Orientation	Global-Interpersonal
Evaluation	Global-Leadership
Decisiveness	Global-Leadership
Persuasion	Global-Leadership
Leadership	Global-Leadership
Emotional Control	Global-Leadership
Autonomy	Global-Variety
Innovation	Global-Variety
Variety	Global-Variety
Routine	Global-Variety

The second-order factors have been named with the suffix “global” to distinguish them from the primary factors. Figure 3-3 depicts an example of the model used to evaluate the global-variety second-order factor.

Figure 3-3

Example of the Hypothesised Model for Second-Order Factor – Global-Variety



Note. VA1–AU5. The set of items to measure each first-order factor.

Rationale

Marsh and McInerney (1991), using the EMAP set of motivational attributes of managers, examined several different solutions of second-order factors. They found the above second-order factor model was the most interpretable.

The following research findings (Table 3-2) on a teacher's role provided theoretical support to extend the above second-order factor model from management to teachers.

Table 3-2
Research Findings on the Second-Order Factors and the Teaching Profession

Global-Leadership	Lieberman and Miller (2005) found that teachers are assuming expanded roles as researchers, mentors, scholars and developers, and thereby expanding what it means to be a teacher. They are thought leaders and active intellectuals who can make a difference in their schools and profession. Thus, the global-leadership capability will be a candidate success criterion in the expanded role of teachers.
Global-Goal Orientation	Dresel et al. (2013) found that teacher's goal orientations directly affect their instructional practices and, subsequently, students' goal orientations. It can be argued that global-goal orientation will impact job satisfaction and job self-concept of teachers.
Global-Variety	Hackman and Lawler (1971) found that individuals obtain personal satisfaction when they perform well on jobs that they perceive as high on variety, autonomy, task identity and feedback. With expanding tasks inside and outside the classroom (Day et al., 2005), a teacher with a high need for global-variety can be expected to experience intrinsic satisfaction in the school environment.
Global-Abstract Thinking	Freebody and Freiburg (2011) portray the teacher as researcher, knower and thinker, who is tasked with generating theories grounded in practice. Thus, a teacher high on the abilities as a global-abstract thinker will be able to achieve better performance and positive outcomes such as high job satisfaction and a sense of competence.
Global-Interpersonal	den Brok et al. (2005) found that teacher interpersonal behaviour has a high relationship with the student's subject-specific motivation. Additionally, teachers need to build partnerships with other teachers and parents (Day et al., 2005). Thus, the teacher's interpersonal capabilities are relevant to the success inside and outside the classroom.

Considering the expanded role that a teacher plays inside and outside the classroom, and the variety of tasks teachers are called upon to perform, it is plausible that the Hong Kong teacher data will fit the proposed second-order factor model.

3.1.7. Measurement Invariance

Overview of Invariance Hypothesis and Research Questions

The analysis of the model fit considers the teacher sample as one uniform population. However, context variables such as gender, age and grades taught can lead to differences in the behaviour of individuals that may manifest in structural equation models as differences in a) measurement model parameters, i.e. intercepts/thresholds of the factor indicators, factor loadings and residual variances of the factor indicators implying measurement non-invariance and b) structural model parameters such as factor means, variances, covariance and regression coefficients implying population heterogeneity (Muthén & Muthén, 2012). Additionally, the differences in behaviour may manifest itself as predictable variations in a) average values of substantive variables (mean effects), b) relationships between two variables (slope effects) and c) both slope and mean variation (mean and slope effects) (Wang & Wang, 2012).

Marsh et al. (2014) asserted that if grouping variables vary substantially for different items, in a manner unrelated to the true levels on the latent construct, then the observed differences might be idiosyncratic. In providing a concrete example of extraversion from the big five traits, Marsh et al. (2010) noted that if the level of gender differences varies substantially from item to item, then the analysis of gender differences in the corresponding latent construct is misleading. Thus, confirming measurement invariance is a fundamental prerequisite for the evaluation of construct validity and generalisability.

Traditionally measurement invariance is evaluated using the following nested structure of increasingly restrictive invariance models of a) c*onfigural invariance*–using the same items, b) w*eak invariance*–using the same items and equivalent factor loading, c) *strong invariance*–using the same items, intercepts and factor loading and d) *strict invariance*–using the same items, uniqueness, item intercepts and factor loading (Marsh et al.2010). This thesis will examine the above levels of invariance.

The following section summarises the research questions of the invariance of the measurement parameters for the EdMAP instrument. Mean differences of the latent factors and slope differences of the relationship between predictors and outcomes will be analysed in subsequent sections.

3.1.8. Measurement Invariance Across Gender

Research Question S1-RQ-3: Is the measurement model invariant across gender?

Rationale

Measurement invariance relates to the factor structure and the relationship between factors and the measured items. Marsh et al. (2010) used new statistical tools to revisit the big five-factor model and found that there is strong evidence that item intercepts are not completely invariant with gender. In some instances, gender differences at the level of item means cannot be fully explained by factor means; thus, suggesting a differential item functioning between the two genders. Marsh (2010) further asserted that there is considerable study-to-study variation in reported gender differences that may be due to interactions with age, nationality and the particular instrument. Therefore, the EdMAP attributes that measure similar constructs to the big five factors that form part of a teachers personality, are hypothesised to demonstrate a similar gender influence on the invariance of the measurement model.

3.1.9. Measurement Invariance Across Age Groups

Research Question S1-RQ-4: Is the measurement model invariant across age groups?

Rationale

Studies concerning life span changes in the big five-factor model show that in general people become more conscientious, dominant and agreeable with age. Caspi et al. (2005) described this phenomenon as the maturity principle. A similar phenomenon named the “la dolce vita” effect was reported by Marsh et al. (2010) that showed mean differences with age. While these findings mostly focus on mean differences, Marsh et al. (2010) used a 13 model taxonomy of invariance over six age-gender groups (young, middle and old) and gender (male and female) and found support for partial strict measurement invariance. These authors noted that if responses to individual items differ systematically with age for different respondents or over time, then the findings based on comparisons of item scores might be invalid, as this implies that differences in the factor do not generalise to the items of the factor.

However, there is likely to be a linear relationship between age and years in career and the difficulty in separating one effect from the other. From an interpretation perspective, a

late start in the teaching career can be due to more learning or switching from another career, with each cause having a different influence on the development of the individual, and thus contaminates the conclusions. In a parallel development, early career teachers experience a dissonance/misalignment between idealism and reality (Abbott-Chapman, 2005). This dissonance leads to the struggle that teachers must confront at this stage of their professional lifecycle when they are in the phase of moving between 'communities of practice' (Wenger, 1998). Thus, there is a theoretical expectation that motivation attributes will vary through career phases, contaminating the item-age relationship.

3.1.10. Measurement Invariance Across Grades Taught

Research Question S1-RQ-5: Is the measurement model invariant across primary and secondary teachers?

Rationale

In investigating differences between the needs of a primary school and a secondary school, Cortis (1973) found differences in approach to teaching practice, noting that secondary school teachers are more sensitive, while primary teachers hold their students to lesser standards. Additionally, secondary teachers must deal with increased issues of behavioural management (Eccles & Midgley, 1989). Ball (2000) found that secondary teachers expect students to analyse what they are doing and saying, and provide objective comments about performance, whereas primary teachers are more likely to have different expectations and relate differently with both words and body language. While women in teaching have always outnumbered men, this difference is more prominent at the primary school level. Moreover, primary teachers have comparatively more practical and professional training than secondary teachers, where secondary teachers are considered to be more subject matter experts (Ball, 2000). The above differences are accentuated by the two-tier training structures for teachers in Hong Kong where upper secondary teachers have typically completed a postgraduate diploma after finishing university education (National Centre on Education and the Economy, 2015). Similarly, Klassen and Chiu (2010) found that there is a relationship between professional experience and self-efficacy. These authors hypothesised that demographics such as gender and grade taught influence the level of stress, self-efficacy and teaching strategies. These findings support those of Wolters and Daugherty (2007) who found an inverse relationship between teaching level and self-efficacy with those teachers in

higher grade levels reporting lower self-efficacy. The above findings suggest the need to investigate the differences between primary and secondary teachers.

Summary on Measurement Invariance

Supporting all three above hypotheses regarding invariance, Klassen and Chiu (2010) identified three domains of self-efficacy for teachers, namely instructional strategies, classroom management and student engagement, and two types of stress namely workload stress and classroom stress. The authors reported nonlinear relationships with all three self-efficacy factors between early-, mid- and late-career teachers, and differences depending on gender and grades taught. Furthermore, teachers with higher instructional strategy self-efficacy or higher classroom management self-efficacy had higher job satisfaction, thus adding weight to the need to confirm that the EdMAP attributes will be invariant across gender, age and grades taught.

3.1.11. Mean Differences in Gender and Age

The previous section looked at measurement invariance. The following investigates differences in the structural model that manifest as mean differences.

Research Question S1-RQ-6: Are there differences in teacher attributes by gender and age that manifest as mean differences in the sample population?

Rationale

As discussed in the previous sections, gender and age have been extensively studied in relation to the psychological makeup of individuals and it is well-established that males have a different psychological makeup to females and that both males and females show different age-related changes (Bleidorn et al., 2015). Costa et al. (2001) reported that women had higher scores across all items of agreeableness and neuroticism, while gender differences were small for conscientiousness. Gender differences were found to be less consistent for items of openness and extraversion where at least two items favoured women and at least two favoured men. Thus, it is necessary to investigate whether gender and age differences in the psychological makeup that manifest as differences in personality can also manifest in motivational attributes.

3.2. Study 2: Predictive Power of the EdMAP Instrument

The practical value of this thesis is in confirming that the EdMAP instrument can be used for predicting desirable workplace outcomes, thus enabling and informing the formulation of suitable interventions in training, motivation and retention of teachers.

Aim of Study 2

The aim of Study 2 was to examine the predictive power of the EdMAP attributes on the key outcome variables of job satisfaction, job self-concept and PWBW, and to confirm a set of attributes that can be used for predicting and evaluating future interventions.

Hypotheses and Research Questions for Study 2

The following presents the detailed research questions that are examined in each section

3.2.1. Predicting Job Satisfaction

Research Question S2-RQ-1: Is there a nexus between the EdMAP attributes and the workplace outcome of job satisfaction?

Rationale

As outlined in the SDT, job satisfaction can occur because a) doing something is inherently interesting or enjoyable or b) leads to a desirable separable outcome (Deci & Ryan, 1985). Thus, the many daily tasks expected of a teacher contribute to job satisfaction via both types of motivation. For example, the task of developing the social aspect of school life by creating friendships with students, colleagues and parents will offer intrinsic motivation for an individual who “likes to develop close friendships”. Similarly, teachers are required to make in-flight decisions with little time for reflection (Stern & Shavelson, 1983). Thus, the decision-making power of a teacher who can “make up my mind quickly on major issues” is likely to contribute to teaching success and extrinsic rewards, leading to higher job satisfaction. The above observations support the theoretical expectation that both group sociability and decisiveness have a close nexus to job satisfaction for teachers. As discussed in the section on attribute selection, other attributes are hypothesised to contribute to workplace outcomes as they were chosen based on the nexus documented in the literature survey in Chapter 2.

3.2.2. Predicting Self-Concept

Research Question S2-RQ-2: Is there a nexus between the EdMAP attributes and the workplace outcome of job self-concept?

Rationale

Marsh and Shavelson (1985) identified self-concept as a person's perception of oneself, which is shaped by the evaluations of significant others, reinforcements and attribution for one's behaviour. Consequently, a teacher's self-concept is defined as a teacher's self-perception of their teaching effectiveness. Thus, any attribute of the person that is either evaluated or reinforced by direct or indirect rewards in the working environment can be hypothesised to lead to higher self-concept. Significantly, an individual's self-concept and value perceptions can influence their behaviour. Moreover, a teacher's competence beliefs are a significant predictor of behaviour and performance and influences teaching practices (Yeung et al., 2014). Thus, not only is a positive teaching self-concept a key goal in itself but is also a significant contributing factor that can influence other desirable outcomes (Roche & Marsh, 2000).

3.2.3. Predicting Psychological Well-Being at Work (PWBW)

Research Question S2-RQ-3: Is there a nexus between the EdMAP attributes and the workplace outcome of PWBW?

Rationale

PWBW provides a conceptual framework for examining the contribution of the outcomes at the workplace into the broader construct of overall PWB. Malka and Chatman (2003) found that intrinsic and extrinsic motivation interacts in a complex relationship with PWBW. Ryan and Deci (2000) observed that some conditions at work could elicit, sustain and enhance a specific type of motivation, while others subdue or diminish motivation. Applying these findings to the five facets of job-related PWBW identified by Dagenais-Desmarais and Savoie (2012), it is possible to argue that EdMAP attributes are practically related to one or more PWBW dimensions and the relationship is influenced by the work context. For example, teachers who have a high need for autonomy or variety/task flexibility will have a high feeling of thriving at work and feeling of competence at work because teaching consists of a variety of tasks and teachers are allowed autonomy to choose their teaching strategies.

Similarly, an individual with a high level of behavioural flexibility is likely to feel a higher level of interpersonal fit at work.

The theories examined in the literature review suggest the application of a complex dynamic in the workplace. Thus, all attributes do not contribute equally to the resulting workplace outcomes. At a more granular level, each attribute is hypothesised to have a unique relationship with each workplace outcome.

3.2.4. Predictive Invariance Across Gender, Age and Grades Taught

In addition to mean differences in latent variables, the impact of population heterogeneity may lead to predictable differences in a) relationships between latent constructs (latent slope effects) and b) both slope and mean variation (latent mean and slope effects). The following section documents the research questions that will be examined in investigating whether population heterogeneity stemming from gender, age and grades taught will cause differences in the relationship (regression coefficients) between the EdMAP attributes and workplace outcomes.

3.2.5. Gender Invariance of Regression of the EdMAP on Workplace Outcomes

Research Question S2-RQ-4: Are there differences in the predictive relationship between EdMAP attributes and the workplace outcomes between males and females?

Rationale

Marsh et al. (1985), using the EMAP profile, found that the percentage of variance attributed to gender is substantially smaller than the percentage attributed to other group variables. However, other studies have not only found differences in personality traits and attributes among the genders but also evidence of differences in self-reporting. As an example, McCrae and Terracciano (2005) found gender differences and biases in rating styles. More significantly, Marsh et al. (1985) found gender differences in self-concept and in the dynamic processes that individuals use to evaluate job satisfaction and job self-concept, thereby, suggesting similar differences in the relationship between EdMAP attributes and job satisfaction and job self-concept.

3.2.6. Age Invariance for Regression of the EdMAP on Outcomes

Research Question S2-RQ-5: Are there differences in the predictive relationship between EdMAP attributes and the workplace outcomes between different age groups?

Rationale

Costa et al. (1999) proposed that personality traits appear to be mostly fixed after the age of 30, a theory Srivastava et al. (2003) referred to as the plaster hypothesis. However, Roberts et al. (2006) in a meta-analysis of existing research found evidence contradictory to the notion that personality traits stop changing at a certain age and reported evidence of change from middle age onwards for four of the six trait categories studied. More specifically, Roberts et al. (2006) found increases in openness during adolescence and no decline until old age. In contrast, conscientiousness had the highest scores for middle-aged participants in the 40–50-year age group indicating change after the age of 30. Similarly, Caspi et al. (2005) proposed the maturity principle, arguing that most people become more dominant and emotionally stable as they age, indicating increasing psychological maturity. Additionally, Marsh et al. (2012) used the ESEM to re-evaluate the big five-factors and proposed the "la dolce vita" effect in old age, noting that individuals become happier, more self-content, more laid back and more satisfied with what they have.

The above findings indicate a reducing role for attributes such as career orientation and leadership in overall job satisfaction and implies a change in the regression relationship between the EdMAP attributes and job satisfaction with age.

3.2.7. Grade Taught Invariance of Regression of the EdMAP on the Workplace Outcomes

Research Question S2-RQ-6: Does grade taught have interaction effects on the relationship between the EdMAP attributes and the outcomes of job satisfaction and job self-concept?

Rationale

As discussed in section 3.1, teaching in primary school requires a different set of classroom strategies and attributes compared to those required for teaching in secondary school. Furthermore, the grade taught influences key perceptions such as self-efficacy. Thus, it is foreseeable that the grade taught can influence the relationship between EdMAP attributes and workplace outcomes.

3.2.8. Summary of Study 2

The ability to successfully use EdMAP to predict workplace outcomes will establish the EdMAP as a valuable tool. However, the design of the study is based on the relationship at a point in time and does not infer causality. Thus, a close regression relationship does not imply causal attribution.

3.3. Study 3: Person-Centred Analysis

Most psychological studies use factor analysis, where covariance is analysed to identify relationships among variables. A high correlation coefficient is interpreted to indicate that two variables share a common cause. However, a high correlation may also reflect the presence of discrete groups in the population, each characterised by different mean levels on the observed variables. LPA applies this latter perspective to cross-sectional data in which individuals who are like each other based on overt measures are grouped into classes. The classes can be validated against demographics such as age and gender (Morin & Marsh, 2015) and subsequently used to compare the outcomes of interest (Gellatly et al., 2014). While neither person-centred nor variable-centred approach is superior (Bauer & Curran, 2004), Muthén and Muthén (2000) proposed that they are complementary and offer different perspectives and information.

The profiles may differ in level or shape. Quantitative/level differences exist when the relative strength of all factors within a system differs similarly across groups (i.e. a person is high, medium or low across all factors). Qualitative/shape differences exist when the hierarchical ordering of the groups using one set of factors is different for some groups than it is for another set of factors (i.e. a person has a mix of high, medium or low factors).

The basic tenant of psychology that every person is like every other person, like some other persons and like no other person, points to the existence of groupings and benefits of classification. Thus, the wide breadth of attributes covered by the EdMAP and the absence of high correlation between some of the factors lead to the expectation of shape differences.

By asserting that the positive development of an individual cannot be studied independently from the environment in which they live as an active part of an integrated person-environment system, Magnusson and Mahoney (2003) predicted the formation of subgroups based on environmental factors. Thus, some of the covariates may offer the basis

(clues) to the identification of the subgroups. The above is especially true for teachers who in addition to the general education undergo specific teacher training as part of their development.

3.3.1. EdMAP-Based Latent Profile Analysis

Research Question: S3-RQ-1: Are there distinct profiles of teachers based on the EdMAP set of attributes where individuals can be accurately categorised into qualitatively and quantitatively distinct profiles?

Rationale

Van den Berghe et al. (2014) noted that although the variable-centred approach can yield valuable insights into the motivation of the teacher's functioning, a person-centred approach offers the possibility to identify naturally occurring groups of teachers with specific profiles of attributes. Thus, these within-teacher combinations indicate the existence of different motivational profiles. Examining how antecedents relate to these profiles may address important questions about the combined influence of the types of motivation on behaviour.

The first stage of investigating the existence of groups of teachers with distinct profiles is exploratory in scope. These extracted profiles then need to be validated by associating the groups to multiple predictor variables (Morin et al., 2010). This study used previously identified predictors of age and gender to validate the identified profiles.

3.3.2. EdMAP-Based Latent Profile Analysis with Antecedent Covariates

Research Question S3-RQ-2: Do the antecedent covariates of gender, age and grade taught predict the class into which an individual belongs?

Rationale

Gender and age are antecedent variables found to induce heterogeneity in populations. Therefore, can they be used to predict the latent classes?

Marsh et al. (2009) discussed the inclusion of covariates in models and identified many alternate models for accommodating covariates. Covariates such as gender can either be included in the classification as a known-class or be treated as an auxiliary variable that is not included in the classification algorithm (Muthén & Muthén, 1998-2012). The study evaluated both approaches.

3.3.3. Workplace Outcome-Based Latent Profile Analysis

Research Question S3-RQ-3: Will LPA find meaningful profiles of teachers based on the workplace outcomes of job satisfaction, job self-concept and PWBW?

Rationale

Workplace outcomes are the result of the fit between the individual and the workplace (Holland,1997). Furthermore, Magnusson and Mahoney (2001) predict the formation of subgroups based on environmental factors. Therefore, the above research question examines the presence of latent profiles based on workplace outcomes.

3.3.4. Summary of Study 3

As the analysis moves beyond a focus on individual components of motivation to examine motivation profiles, we can gain additional insights and an understanding of the mindsets accompanying these profiles. As discussed before, Holland (2012) proposed that teaching requires the social type, suggesting that factors such as interpersonal fit at work provide a more significant contribution to job satisfaction and job self-concept than perceived recognition at work. Thus, interpreting and providing plausible theoretical analysis for the expected profiles would challenge the thesis.

Chapter 4. Methodology

4.1 Introduction

The previous chapter described the aims, research questions and hypotheses of the three studies that constitute this thesis. This chapter describes the methodology used and provides the rationale and background to the selection of the sample and a brief introduction to the statistical tools used in this thesis.

The next section describes the participants and the details of the instrument and its adaptation for the current environment.

4.2 Participants

This study used data collected by McInerney et al. (2014) from 1018 teachers from 15 primary schools and 15 secondary schools from a cross-section of educational regions in Hong Kong, to yield 876 useable records. Of these participants, the majority of 582 (65.2%) were females and 294 (34.3%) were males, while 4 (0.4%) did not indicate their gender. The mean age was 41 years (SD = 9.08) with the average age of males being 41 years and the average age of females being 39 years. The average teaching experience was 15.14 years, with a range of 1–40 years (Table 4-1).

There were 13.50% whose monthly family income ranged in HKD 15,000 to 29,999, 35.97% in HKD 30,000 to 49,999, 47.26% in HKD 50,000 to 79,999 and 3.27% did not indicate their family income. Of the sample population, 47.26% received a monthly family income over HKD 50,000, which compares favourably with a senior IT manager's income of HKD 45,000 to 60,000 and falls within the top 10% income group in Hong Kong. The lowest 5% had an average salary of HKD 15,000, which compared favourably with the median monthly income of 11,000 HKD for graduates (Census & Statistics Department, 2015).

Of the participants, 2.40% had completed a diploma or associate degree, 51.20% had attained college degrees, 44.46% had attained master's degrees, 0.6% had attained doctoral degrees and 1.8% did not indicate their highest education attained.

Table 4-1

Teachers by Age and Gender

Age group (years)	Male	Female
20–29	25 (29%)	62 (71%)
30–34	52 (30%)	121 (70%)
35–39	57 (31%)	129 (69%)
40–44	44 (37%)	75 (63%)
45–49	43 (41%)	61 (59%)
50–55	33 (41%)	47 (59%)
>55	29 (42%)	40 (58%)

Note. The percentage is for the age group.

When analysed by age and gender (Table 4-2), only 29% of the teachers under 30 were male. The male/female ratio improved with age. However, from the percentage of teachers who participated in the survey, female teachers outnumbered male teachers. Comparing this ratio to the global percentage of female primary teachers of 77.5% (UNESCO Institute for Statistics, 2017) and the Hong Kong percentage of female primary teachers of 77% (https://data.worldbank.org/indicator/SE.SEC.TCHR.FE.ZS) there was no evidence of gender bias in the percentage of teachers who responded to the survey .

Table 4-2

Number and Percentage of Teachers by Grade Taught and Gender

	Survey Respondents		HK National Ratio	
	Male	Female	Male	Female
Primary	96 (23%)	316 (77%)	22%	78%
Secondary	198 (43%)	266 (57%)	44%	56%

Note. The percentage is for grade taught,

National data— https://data.worldbank.org/indicator/SE.SEC.TCHR.FE.ZS

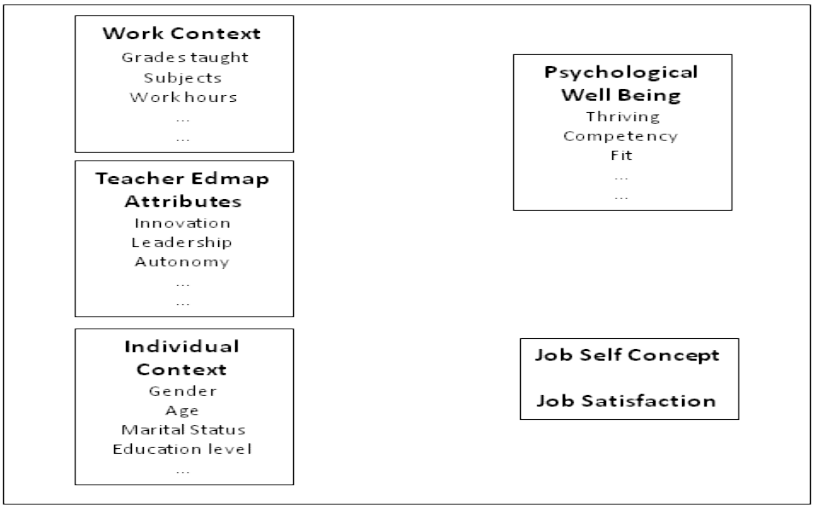
The analysis of collected data indicated that there were more female teachers in the lower grades, a finding supported by statistics indicating that “Male and female kindergarten teachers are 41 and 8,737, respectively, for year 2001/2002” (Hong Kong Legislative Council, 2002).

4.3 **Instrument Description–Education Motivation Attribute Profile**

The specific items for measuring the attributes of the EdMAP were chosen as a subset of the EMAP questionnaire developed by Marsh et al. (1991) and adapted for use with Hong Kong teachers by McInerney et al. (2014). The selection of the EdMAP variables was guided by the existing literature presented in Chapter 2. Figure 4-1 indicates the structure of the survey.

Figure 4-1

Overview of the Survey Data for Each Teacher



3.1.1 Employee Motivation Attribute Profile (EMAP) – A History

The original EMAP questionnaire was developed to support the needs of the largest Australian mining company (BHP). At that time, the EMAP broke new ground in Australia, as it was explicitly designed for a management level workforce and embodied a taxonomy of values that were considered important to the organisation's human resource initiatives. It was also one of the first studies that attempted to identify an individual's motivational profile. Combining the findings from academic research and factors used by the organisation's human resources department, the questionnaire included a wide range of attributes ranging from leadership to group sociability, which past research has identified as relevant to a workplace. The BHP staff involved in the design included staff with strong applied skills, practical knowledge and intuition about the human resource process under consideration.

The pilot study involving 468 BHP employees found the questionnaire to be psychometrically robust with 25 discrete scales. The initial survey used 15 items per

construct, which were then reduced to 10 items per construct via extensive statistical analysis, including reliability analysis, exploratory factor analysis (EFA) and CFA. Subsequent use confirmed the 25 well-defined distinct scales that comprise the EMAP instrument with Marsh et al. (1987) confirming that the instrument has been rigorously tested and psychometrically validated. This instrument was adapted as the EdMAP for use with the teaching profession.

4.3.1 Development of the EdMAP Instrument

The EMAP survey was customised for teachers and the school environment by adding the word ‘school’ or ‘teaching profession’ to the stems of the questions. This survey used only five of the 10 original items for each construct, which still amounted to a total of 115 EdMAP questions. The Chinese version was developed and validated against the English version using forwards and backwards translation procedures (McInerney et al., 2014). The teachers had the choice to answer the surveys in either language. However, all teachers responded to the Chinese version. Teachers participating in this study were given the option to complete a hard copy version of the survey. A total of 253 completed the survey online while 764 completed the hard copy version. A seven-point Likert-type scale was used, with the scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*, where a higher score indicated a higher degree of endorsement.

4.3.2 Workplace Outcomes

The workplace outcomes included job satisfaction, job self-concept and the five facets of PWB (i.e. interpersonal fit at work, thriving at work, perceived recognition at work, feeling of competence at work and desire for involvement at work). Each of the workplace outcomes was probed using five questions for a total of 35 items.

4.3.3 Contextual Data

In addition to the EdMAP items, the survey captured a wide range of input data, including work context (e.g. grades taught, work hours) and demographic variables (e.g. age, gender, marital status).

4.4 **Data Analysis**

The following section presents an overview of the statistical methods used in this study, including a brief overview and rationale for each choice and the relevance to the thesis.

4.4.1 Statistical Software

This study used MPLUS version 7 extensively for ESEM, regression analysis and LPA (Muthén & Muthén, 1998-2012). The MPLUS results were supplemented by additional analysis using the relevant statistical packages implemented in the R ecosystem (R Core Team, 2013), especially those for linear regression analysis (lm package) and LPA (Mclust package) (Maechler et al., 2012).

4.4.2 Missing Data

Missing data is an inevitable issue with surveys. The EdMAP items had minimal missing data (approximately 1%). Of the relevant attributes, age had the most missing values with 47 respondents not answering the question (Table 4-3).

Table 4-3

Top Five Missing Data Items

Attribute/Item	Number of Missing records
Age	47
Grade Taught (Q16)	15
Gender (Q1)	8
Innovation – Item 1	7
Leadership – Item 1	7

Traditionally, researchers have simply deleted participants with missing data from their analyses. However, this can skew the conclusions, especially where a random sample is used to draw conclusions about the entire population. While deleting a few participants may not significantly influence the conclusions, it can skew the data if participants refrained from filling the item due to some perceived reason. Other common practices include list-wise deletion, mean substitution or regression imputation (conditional mean imputation). However, Marsh and Balla (1994) warn that list-wise deletion reduces the statistical power and risk non-convergent solutions. Subsequently, the APA task force on Statistical Inferences

(1999) confirmed this view, stating that list-wise and pair-wise deletion of missing values are among the worst methods available for practical applications.

Rubin (1976) identified three different scenarios under which data can be missing and proposed a framework for evaluation and remedy. The scenarios are *missing completely at random* (MCAR), *missing at random* (MAR) and *missing not at random* (MNAR). In the MCAR scenario, a wide range of analyses derived from observed data can be unbiased. If in the MAR scenario, the missingness is associated with other variables in the data, then analysis based only on the observed data can be biased. The MNAR scenario can produce biased results. However, if auxiliary variables related to the missing mechanism are included in the analysis, it is possible to transform data from MNAR to MAR. Schafer and Graham (2002) recommend new approaches to preserve the integrity of the data by using statistical techniques of multiple imputations and full information maximum likelihood to fill probable values for missing information, enabling researchers to make a more accurate analysis of the population under study. Imputation examines the range of plausible values for a specific variable and randomly calculates many values. ML consolidates into a single analysis missing data analysis and the data analysis technique a researcher wants to use. However, through mathematical derivation and empirical simulation, Graham and Olchowski (2007) have found that full information maximum likelihood is asymptotically equivalent to ML.

The MPLUS package has an inbuilt capability to accommodate missingness. MPLUS provides ML estimation under MCAR, MAR and MNAR. However, MPLUS does not allow missingness for the observed covariates. Subsequently, the MPLUS model is estimated conditional on the covariates and no distributional assumptions are made about the covariates (MPLUS User Guide, 1998-2012). While the LIST-WISE option of the DATA command is available to delete all observations from the model that have missing values on one or more of the analysis variables, it was not used. The MPLUS default is to estimate the model under missing data theory using all available data.

During early data analysis and preparation for this thesis, the impact of the missing data was examined using the Amelia package (a program for estimating missing data) in the R ecosystem. The statistical properties of the raw dataset were compared to the imputed data. Due to the very low percentage of missing data (1%–2%) for the items measuring the EdMAP attributes, there were no significant differences in the key parameters for the

variables. Thus, MPLUS's inbuilt default capability for addressing missing data was used for the ongoing analysis.

4.4.3 Improving Reliability

A key challenge in refining a measurement model is to identify the items to be excluded from subsequent analysis. A multitude of factors, including inadequate wording and loading into multiple factors, may cause an item to be unsuited for subsequent analysis. Raubenheimer (2004) suggested a sequential approach of improving internal consistency, followed by improving convergent and discriminant validity analysis to refine data. In the first step, a subscale's reliability is optimised by removing the least reliable item, as indicated by the resultant increase (if any) in alpha for the subscale. Ideally, this process is repeated until the various subscales are maximised. Subsequently, in step two, the discriminant validity is assessed and improved by identifying and removing, one by one, the items that load significantly on more than one factor. This approach was indirectly applied in this thesis via the use of the MI as implemented in MPLUS, which used a similar concept. Marsh et al. (2010) in investigating the precarious endeavour of developing short-form instruments, noted that removing items may cause the scope of factors to become narrower. Thus, the tuning exercise was limited to removing only one item per factor, thereby leaving four items per factor.

4.5 **Confirmatory Factor Analysis (CFA)**

CFA is a flexible and powerful statistical technique from the group of techniques known as SEM. CFA is based on the theoretical foundations of common factor model (van der Linden, 2013) which postulates that each observed indicator is a linear function of one or more common factors. Subsequently, the model was expanded by Jöreskog (1969) noting that any number of parameters can be specified in advance and the remaining ones can be estimated by the ML method. The analytical technique partitions the variance of an indicator into the components of common variance indicating the proportion of variance attributable to the latent variable, unique variance attributed to a combination of random error variance and variance that is specific to a particular item (Gallagher & Brown, 2013). The relationships among latent variables are modelled as covariances/correlations rather than as structural relationships (i.e. regressions). Thus, in CFA, the researcher specifies the relations between the observed measures and the underlying a-priori factors and then statistically tests the

hypothesised structure (Byrne, 2005). Conversely, the above must be seen in contrast to the EFA, where the goal is to discover a set of as-yet-unknown or unverified factors based on the data.

Typically, CFA is used to evaluate a measurement model and specifies the relationship between the observed indicator variables and the relevant latent variables/factors they are used to measure and then evaluates them against the data to 'confirm' the specified factorial structure (van der Linden, 2013).

The results of a CFA include estimates of factor variances and covariances, factor loadings and measurement error for each indicator. A good model is indicated if all indicators specified to measure a common factor have relatively high standardised factor loading (> .70) indicating a good convergent validity and estimated correlations between the factors are not excessively high (< .90 in absolute value) indicating discriminant validity (Byrne, 1998).

For model identification of a one-factor CFA model, a minimum of three indicators is required. However, if errors are not correlated, a one-factor CFA model with three indicators is considered as just identified (Byrne, 1998). However, for assessing model fit, the model must be over-identified. Thus, if error covariances are not specified, a one-factor CFA model needs at least four indicators to be considered as over-identified. However, Bollen (1989) argued that a factor with only two indicators might be acceptable if the factor is hypothesised to be correlated with at least one additional factor in a CFA model and the error-terms are not correlated with each other. This thesis used four or more items per factor in both single-factor and multifactor models.

4.5.1 Disadvantages of CFA

Marsh (2007) observed that the ICM-CFA requirement that all items have zero factor loadings on all factors excluding the ones they are designated to measure was restrictive. CFA fails to provide clear support for instruments that had been well-established in EFA research. Furthermore, most real-world items, including clinical symptoms of psychological disorders, can be associated with multiple diagnostic categories. Thus, when challenged for counterexamples of acceptable fit for 'good' multifactor rating instruments when analyses are performed at the item level, there were no counterexamples produced (Marsh et al., 2009). Requiring non-target loadings to be zero can lead to inflated factor correlations that subsequently lead to biased estimates in structural equation models (Asparouhov & Muthén,

2009). This bias undermines support for the multidimensional perspective inherent in many psychometric instruments, the discriminant validity of the factors and the predictive validity of the factors due to multicollinearity, thus endangering the diagnostic usefulness. In a one-factor model, ESEM and CFA become essentially the same.

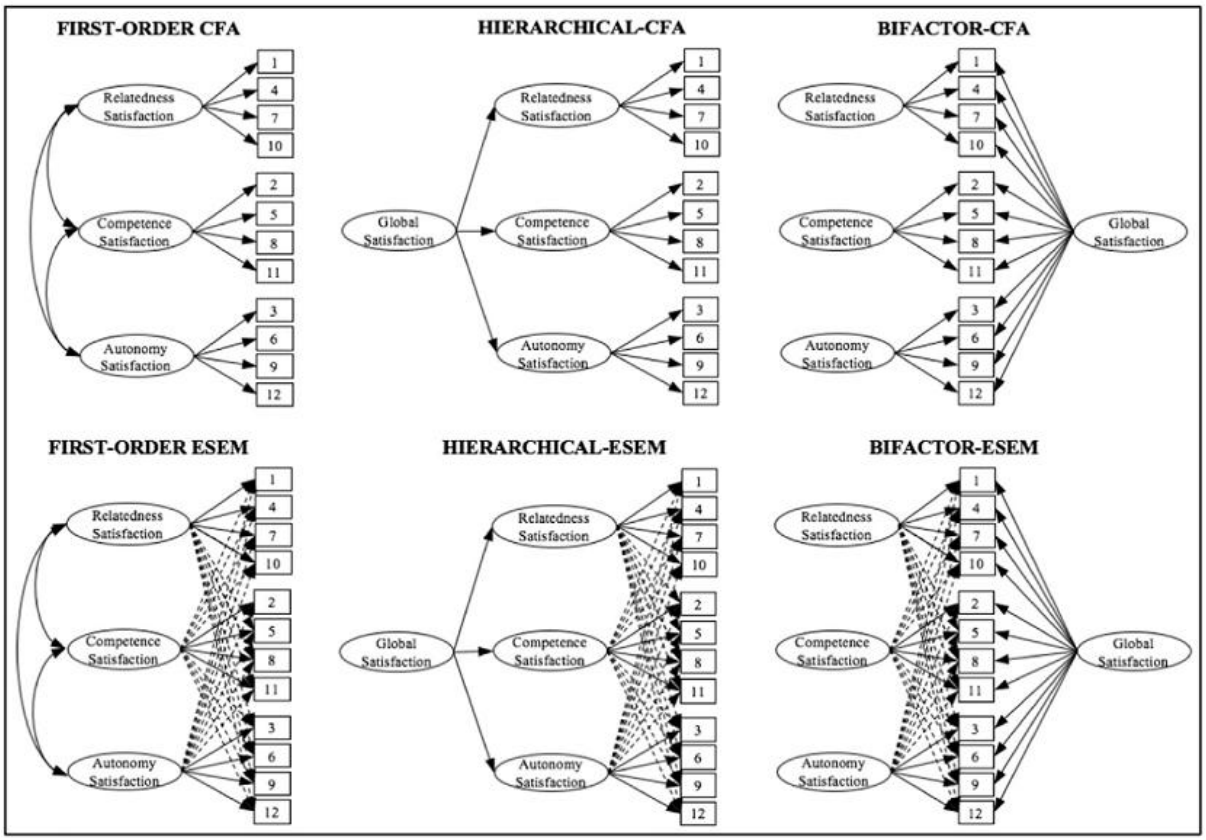
4.6 Exploratory Structural Equation Model (ESEM)

To overcome the above limitations of CFA, Asparouhov and Muthén (2009) proposed the EFA-SEM (ESEM) approach, where in addition to a traditional CFA measurement model, an EFA measurement model with rotations is used in a structural equation model. ESEM is an integration of EFA, CFA and SEM that has the potential to resolve the dilemma of constraint on loadings and has broad applicability. Marsh et al. (2011) reviewing an 11-factor motivation and engagement scale, demonstrated that ESEM provides a better fit to the data and results in more differentiated factors than CFA models. These authors further demonstrated that ESEM could be applied to other areas of analysis such as invariance of factor loadings, item intercepts, item uniqueness and factor variances-covariances. They concluded that ESEM can be extended and has broad applicability to areas of research that cannot be addressed with either EFA or CFA and proposed ESEM as a standard tool for use in psychometric tests.

ESEM has been extended to other facets of analysis such as multi-level factor structures and evaluation of invariance. Extracted from Morin et al. (2017), the diagram in Figure 4-2 demonstrates a set of models that use both CFA and ESEM as a single layer, hierarchical and bifactor models that allow the analysis of alternative approaches. In the basic CFA model, a single-factor loads only on one item whereas the basic ESEM allows loading on multiple items. The two hierarchical models assume the existence of a two-layer structure, where the second-order factor loads only through the first-order factors. The more flexible bifactor model ESEM allows all items to load to the specific construct and the global construct.

Figure 4-2

ESEM and CFA Models (Morin et al., 2016)



Note. The dotted line represents non-target loadings with the initial value set to zero.

The first-order models were used for the generation of factor scores and the hierarchical and bifactor models were used to analyse the second-order factor structure. ESEM, as implemented in the MPLUS package, provides access to the typical SEM parameters of residual correlations, regression of factors on covariates, and regression among factors. It also enables multiple-group analysis with intercept and mean-structures (MPLUS user guide ver. 7; Muthén & Muthén, 1998).

4.6.1 Advantages of ESEM

ESEM provides a synergy that is the best of both worlds and can adequately account for complex measurement models. The main advantage of the ESEM is its seamless incorporation of the EFA and SEM. ESEM can enforce better model testing sequences, i.e. starting with an EFA measurement specification with only the hypothesised number of factors, theory-driven CFA restrictions can be added to the measurement model. Therefore,

for many applications, the ESEM can replace the more restrictive SEM model. Additionally, the ESEM framework supports the incorporation of substantive information in the model. Another advantage of the ESEM framework is that it easily accommodates EFA simulation studies.

Furthermore, the EFA analysis is usually followed by a CFA measurement specification. However, the ESEM achieves this task in a one-step model by estimating the measurement and structural model parts simultaneously (Asparouhov & Muthén (2009). Consequently, the ESEM approach is more accurate as it avoids the challenging EFA to CFA conversion, such as is required when covariates are added to the model. Considering all the above advantages, the superiority of ESEM is now well-established (Marsh et al., 2013).

4.6.2 Limitations of ESEM

A key limitation of the ESEM framework is the modelling constraint that any structural path between an exploratory factor and another exploratory factor can be included in the model only if such a path is specified for all factors specified in the same block. Elaborating the above, Asparouhov and Muthén (2009) noted that where a factor in an exploratory block is regressed on a covariate, then all remaining factors in that block must be regressed on the same covariate. Similarly, if a variable in the model is correlated with an exploratory factor, the variable must be correlated to all other variables in that exploratory block implying that the covariance parameters are either all zero or are simultaneously free and unconstrained.

Marsh et al. (2014) proposed EwC (ESEM within CFA) to accommodate some specific model requirements such as partial factor loading invariance that is currently not available in ESEM.

4.6.3 Suitable scenarios for ESEM

Marsh et al. (2013) proposed that the assignment of items is usually determined based on a-priori theoretical expectations and practical considerations. While ESEM is most appropriate when it fits the data better than the corresponding CFA model, CFA is more parsimonious, even though researchers have found that ICM-CFA models do not provide an acceptable fit for many psychological instruments.

This thesis supplemented CFA with ESEM to identify the optimal measurement model and to develop the factor scores that were used in Study 2 and Study 3.

4.7 **Reliability, Validity and Goodness of Fit**

The evaluation of a model consists of a) checking technical aspects such as out-of-range parameters and negative estimates, b) checking consistency with a-priori theoretical estimates and c) evaluating tests of statistical fit and indices of fit.

4.7.1 Reliability and Validity

Reliability refers to the consistency of a set of measurements or measuring instruments and validity indicates how well a tool measures what it is supposed to measure. The latter requires multiple indicators of the same construct to be substantially correlated (convergent validity) to each other and less correlated to indicators of different constructs (discriminant validity) (Marsh, 1991). The internal consistency of the subscales and the factor structure of the EdMAP instrument was investigated using CFA. The above requires that the observed items load well on the underpinning factor (range 0.40–0.80) and that the single construct explains a substantial percentage (20%–60%) of the observed variability in each item. Cronbach's alpha underestimates reliability unless there is Tau equivalence (Deng & Chan, 2017). Thus, one-factor omega was used as the reliability indicator and was calculated as:

Omega = Σ (factor loading)^2 / (Σ (uniqueness) + Σ (factor loading)^2)

4.7.2 Goodness of Fit

A model fit can be evaluated via indicators of absolute-fit, which determine how well an a-priori model fits the sample data (McDonald & Ho, 2002), or via indicators of comparative fit, which determine how well the model fits the data compared to no model at all (Jöreskog & Sörbom, 1993). Indices of absolute-fit include the chi-squared test, root mean square error of approximation (RMSEA), goodness of fit index, root mean square residual and standardised root mean square residual. In contrast, comparative fit (relative fit) indices do not directly use the chi-square in its raw form but compare the calculated chi-square value to a baseline model. The baselined null hypothesis for these models is that all variables are uncorrelated (McDonald & Ho, 2002). Two frequently used comparative fit indices are the Tucker-Lewis index (TLI), which analyses the discrepancy between the chi-square value of the hypothesised model and the chi-square value of the null model, and the comparative fit index (CFI), which analyses the model fit by examining the discrepancy between the data and the hypothesised model.

4.7.3 Sample Size Requirements

Marsh and Hau (1999) examined the influence of sample size on different indicators and found that many were dependent on sample size. The RMSEA, TLI and CFI are relatively independent of sample size. Notably, the TLI also penalised model complexity, so that adding new parameters did not necessarily improve the fit. The sample size effect was found to be weaker but still statistically significant for the larger sample sizes of 400 and up. Marsh et al. (2004) further extended the analysis of the impact of model complexity and sample size on the goodness of fit indicators and proposed that when comparing the relative fit of different models, it would be useful to formulate a set of nested or partially nested models specifically designed to evaluate the aspects of interest. Jackson et al. (2009), in a review of the current practices, discussed the fit indices and put forth many recommendations, including reporting multiple plausible models and reporting all relevant parameter estimates.

This study reported primarily on TLI, CFI, RMSEA and the chi-square test. TLI and CFI vary from 0 to 1. Values of TLI/CLI above 0.90 and above 0.95 are considered acceptable and excellent fit, respectively. RMSEA of less than 0.05 and 0.08 are considered close and reasonable fit, respectively. When comparing nested models, a CFI/TLI reduction of less than 0.01 or RMSEA increase of less than 0.015 for the more parsimonious model is considered as sufficient support for the model (Marsh et al., 2011).

4.8 **Invariance Analysis**

Measurement invariance is of significant substantive importance for clinical research as mean-level differences across multiple groups (e.g. gender, treatment versus control groups) have significant implications. Tests of whether the underlying factor structure is the same for different groups or time points have often been overlooked in clinical research. As a consequence, these mean comparisons assume the invariance of item intercepts and factor loadings, thus overlooking the problems associated with differential item functioning. Marsh et al. (2009) specified that measurement invariance is fundamental to the evaluation of construct validity and generalisability, emphasising that unless the underlying factors are measuring the same construct in the same way, mean differences and other comparisons are potentially invalid. Moreover, Vandenberg and Lance (2000) specified that the confirmation of measurement invariance across groups is a logical prerequisite to cross-group comparisons and involves the confirmation that there are no gender, demographic or other individual

differences that preclude responding to instruments in similar ways. Therefore, it is essential to evaluate the full measurement invariance of the EdMAP instrument.

4.8.1 Invariance Framework

Marsh et al. (2015) in developing a 13-model framework for invariance analysis, lists four levels of increasingly stronger invariance measurements as the critical models. They are a) *configural invariance*–with the same items used across the groups and no invariance constraints imposed, b) *metric or weak factorial invariance*–with factor loadings held invariant, c) *scalar or strong invariance*–with factor loadings and item intercepts held invariant, and d) *strict invariance*–with factor loadings, item intercepts and item uniqueness held invariant.

Marsh et al. (2009) noted that tests of the invariance of factor loadings, i.e. weak measurement invariance, is particularly important as all models except the configural invariance model assume the invariance of factor loadings. Therefore, unless the factor loadings are reasonably invariant across groups, any comparisons can be rendered invalid. However, the authors noted that if there is a sufficient number of items, partial invariance might be warranted, if invariance of factor loadings is supported for the majority of items for each factor. Additionally, the invariance test may be used as the basis of selecting items to be retained.

4.9 **Regression and Multicollinearity**

Multicollinearity is a well-known pervasive problem that seriously threatens valid interpretations in SEMs (Marsh et al., 2004). It is of particular importance in investigating psychological constructs because many of the constructs are interrelated either by the nature of the neural processes or the experiences that influence the evolution of such constructs. This effect will be even more prominent in the case of a selected sub-population such as teachers who would have been chosen for possessing such attributes. As an example, a person with leadership aspiration will possess strong persuasive skills or will develop them. Thus, multicollinearity poses both a philosophical challenge in attempting the meaningful interpretation of the unique impact of variables and a statistical challenge in attempting to predict the unique effects when individual predictors are estimated. One approach to resolving this issue is described below.

4.9.1 Least Absolute Shrinkage and Selection Operator (LASSO)

The recent development of alternative techniques for analysing data for machine learning has provided the opportunity to address the effects of multicollinearity. A set of techniques are used to "regularise" the coefficients, i.e. controlling how large the coefficient estimates can grow. Ridge regression (Hoerl & Kennard, 1970) implements the minimisation of the usual least-squares criterion plus a penalty term and thus uses shrinkage, i.e. shrink the estimator towards a zero vector. The LASSO with tuning parameter $\lambda \geq 0$ is one such penalised shrinkage approach and shrinks some coefficients while setting others to exactly zero. Thus, LASSO enjoys the useful features of both subset selection and ridge regression. LASSO-type estimators are often suggested to handle the problem of multicollinearity in a regression model (Oyeyemi et al., 2015). Therefore, Study 2 used LASSO as implemented in the R ecosystem to address multicollinearity.

4.9.2 Predictive Accuracy

Ideally, a model should not only be evaluated by how well it fits the current data, but also how well it will fit a new dataset. This confirmation can be achieved by extracting a test dataset from the available sample and using the test data to validate the trained model. While the multiple R-squared (percentage of the response variable variation that is explained by a linear model) offers a good indication of model fit to the dataset, the predictive accuracy of the data can be assessed by applying the data to a test set from the same population. The predicted values can be compared with the actuals. Study 2 used the classification and regression training (caret) package (R Core Team, 2013) to evaluate the predictive models from the previous section.

The key indicators used to evaluate the models were:

- RMSE–The average deviation of the predictions from the observations. The smaller the RMSE, the better the model fit.
- R-Square–Indicator for the "goodness of fit" measure for the predictions. The R-squared value shows a good fit for the data when the value is very close to 1.
- MAE–The measure of the difference between two continuous variables. MAE is the average vertical distance between each point and the identity line.

4.9.3 Predictive Invariance

Millsap (1998) investigated the relationship between invariance in measurement and invariance in prediction and concluded that one form could exist without the other. Further investigating predictive invariance, Olivera-Aguilar and Millsap (2013) noted that many empirical studies of differential prediction have concluded that intercept invariance does not hold even though regression slopes are invariant or nearly so. When dealing with multiple predictors, this study focused on the slopes (β coefficients). Predictive invariance can be assessed using a series of multiple regression models where the outcome is regressed on the group variable, predictor scores, and a group × predictor interaction effects (Olivera-Aguilar and Millsap, 2013)). Thus, Study 2 focused primarily on interaction effects.

4.10 Latent Profile Analysis (LPA)

The first two studies of this thesis used the techniques of factor analysis to identify unobserved attributes and their relationships. As discussed in section 3.3, LPA investigates the perspective that the correlation among variables may reflect the presence of discrete groups in the population, each characterised by different mean levels on the observed variables (Gellatly et al., 2014). From a statistical perspective, Bauer and Curran (2004) summarised the difference between factor analysis and LPA approaches, stating that factor analysis decomposes the covariances to evaluate relationships among the variables, whereas LPA decomposes the covariances to evaluate relationships among individuals. However, Bauer and Curran (2004) conceded that each model could equivalently reproduce the covariances, and thus it could be argued that neither model is superior to the other. Similarly, from a substantive perspective, person-centred and variable-centred strategies are complementary and offer unique perspectives and information (Muthén & Muthén, 2000). Meyer et al. (2013) elaborated the above by stating that those variable-centred approaches provide information about how the variance in one variable can be explained by one or more of the other variables. In contrast, the person-centred approaches provide information about the operation of systems of variables within individuals. Additionally, Magnusson (1990) argued that the positive development of an individual cannot be evaluated separately from their environment. Thus, research on human attributes must centre on a person who adapts, develops and functions as an active part of an integrated person-environment system. Subsequently, subgroups of individuals with distinct profiles of biological, psychological, motivational and other relevant characteristics pertinent to the phenomenon of interest can be

identified early in the developmental process and observed through longitudinal studies. Magnusson (1990) classified the variable-centred approach as a nomothetic approach, whereas the person-centred approach is the idiographic approach. Study 3 investigated whether there were latent profiles of individuals based on the EdMAP factors that will provide additional insight into the predictive relationships.

One of the main challenges of effective LPA is to determine the number of groups that should be used to represent the population. The two key criteria used in this decision are the substantive relevance and theoretical conformity of the extracted profiles (Marsh et al., 2009) and the statistical adequacy of the solution. Morin and Maïano (2011) suggested looking at the observed pattern of change in the goodness of fit and other information criteria to find a point where the decrease in value with additional profiles reach a plateau. Marsh et al. (2014) concluded that while there are diverse opinions and no golden rule on how to choose the correct number of groups, the appropriate approach is to explore solutions with a varying number of groups and choose the one that makes sense with theory, previous research, the nature of the groups and the fit indices.

The other main challenge in using LPA is to represent the covariates in a way to supplement the grouping variables. Lubke and Muthén (2007) suggested that the inclusion of covariates in the model can improve classification accuracy. On the other hand, if the assumption is that the covariates do not affect the latent class probabilities, then the failure to include covariates should not result in a misspecified model or a different class configuration. Thus, the authors caution that assigning a participant to a class is model dependent and not an innate quality of the participant. Marsh et al. (2014) accepted the caution but clarified that the treatment of covariate should be based on the purpose of the study and that researchers must recognise the extent to which the inclusion of the covariates alters the groups. The covariates should be antecedent variables and should not be concurrent or distal outcomes influenced by the grouping variables. The above represents a challenge to modelling where there is a likelihood of a reciprocal relationship between the latent variables and the covariates. Marsh and Craven (2006) in the study of academic self-concept (ASC) and achievement found evidence of reciprocal causal ordering with prior ASC influencing subsequent achievement and prior achievement influencing subsequent ASC. In this scenario, Marsh et al. (2014) proposed that it is appropriate to consider the correlates as auxiliary variables. Thus, they can be used to validate the latent classes by examining the class-specific means and variances for

the correlates without directly including them in the model. Thus, Study 3 evaluated the antecedents.

Marsh et al. (2009) emphasised that LPA groups are formed to maximise the distinctiveness of the groups, leading to the loss of some of the variance in the scores that make up those groups, especially when a small number of LPA groups is based on many distinct indicators, and cautioned that there is a need to trade-off the parsimony gained from considering only a small number of groups with this corresponding loss of information.

While accepting that LPA is a developing field, this study applied the currently available techniques to the Hong Kong teacher dataset.

When evaluating and interpreting profiles, one must take into consideration substantiative issues to ensure that qualitative (shape) differences between the extracted profiles are supported by practical relevance. Ordered profiles, showing only quantitative level differences (where each profile simply presents a higher level than the other on all variables) would generally be better represented by variable-centred analysis and would thus have no additional analytical value (Morin & Marsh, 2015).

4.11 Chapter Summary

This chapter described the key statistical techniques and the considerations used in evaluating the hypotheses that are examined in the subsequent chapters. Both ESEM and LPA are emerging techniques that have started to gather traction recently. Some aspects will be further elaborated during the discussion of the results, where the context will offer better relevance.

Chapter 5 Study 1: Psychometric Testing and Development of the EdMAP Instrument

5.1 Introduction

This chapter reports the results of Study 1, which aimed to examine and evaluate the psychometric properties of the EdMAP. It follows the theoretical background for the EdMAP attributes, as presented in Chapter 2, and the operationalisation of the constructs, as presented in Chapter 3, to generate the latent factor scores to be used in subsequent studies.

Nearly all psychological constructs are hypothetical constructs requiring validation using a construct validation approach. Marsh et al. (2005) proposed that while these approaches can be broadly classified as within-network or between-network validations, in practice they form a continuum starting from item reliability and factor analysis, to stability and factor structure generalisability. From a construct validation perspective, theory, measurement, empirical research and practice are tightly coupled. Thus, the exclusive focus on one will imperil the others. Consequently, validation is a multistep cyclical process in which theory and practice are used to enhance a measure. The empirical research is then used to validate the theory and the measure, and subsequently inform and drive the improvement of both the theory and the measure, then followed by new research.

The results of Study 1 are presented in the following order:

- Section 5.2 presents the findings on the reliability and validity of the EdMAP instrument through the evaluation of a set of models consisting of a) a congeneric single-factor at a time CFA model, b) a congeneric multifactor CFA model and c) a comparable ESEM.
- Section 5.3 presents the findings on the support for an a-priori second-order factor structure using hierarchical and bifactor models, using both CFA and ESEM to refine the model.
- Section 5.4 presents the findings on measurement invariance of EdMAP across gender, age and the grades taught to establish the stability and generalisability of the instrument.
- Section 5.5 presents the mean differences in EdMAP attributes by age and gender using analysis of variance (ANOVA) to investigate the presence of statistically significant differences and smoothed-plots to identify trends.

While the EDMAP instrument contains 23 factors with 115 Items, most of the following analysis include only 22 factors as Tenacity was removed due to model convergence issues.

5.2 **Reliability and Validity of the Measurement Model and Factor Scores**

Table 5-1 summarises the hypothesis and research questions examined through the CFA model and ESEM as detailed in Chapter 3 for ease of comparison.

Table 5-1

List of Hypothesis and Research Questions on Reliability and Validity of the EdMAP Instrument

Number	Hypothesis and Research Questions
S1-HY-1: Individual Factors	Tests of reliability and goodness of fit will find an acceptable fit for the one-factor congeneric measurement model for each of the a-priori EdMAP factors.
S1-HY-2: Multifactor Congeneric Model with all five items	The tests of reliability and goodness of fit will demonstrate acceptable fit when all the attributes of the EdMAP instrument are evaluated together as a multifactor congeneric CFA with all 23 factors and five items per factor.
S1-RQ-1: Tuning the Multifactor Congeneric Model	Can a multifactor congeneric CFA model with 23 factors be improved by a) removing the item with the lowest loading on the designated factor or b) removing the item with the highest MI?
S1-HY-3 – Exploratory Structural Equation Model (ESEM)	Using an ESEM will provide a better fit than the corresponding CFA model and a better overall model with improved factor discrimination.

5.2.1 Hypothesis S1-HY-1: Goodness of Fit of Individual EdMAP Attributes

Overview

Hypothesis S1-HY-1 predicted that the tests of reliability/goodness of fit would demonstrate good outcomes with acceptable fit indices when each of the a-priori EdMAP factors were considered individually. A good fit confirms the internal consistency of the EdMAP instrument to the extent that the response to all the items hypothesised to measure a construct reflects the same construct.

Each factor was investigated using all five of its designated items. The model was fitted using the ESTIMATOR = WLSMV (weighted least square mean and variance adjusted) option

of the MPLUS package Version 7. WLSMV uses a diagonal weight matrix with standard errors and a mean and variance adjusted chi-square test statistic that uses a full weight matrix. The WLSMV is a robust estimator that does not assume normally distributed variables and provides the best option for modelling categorical and ordered data (Brown, 2006).

Results

Table 5-2 presents the results when each factor is considered individually with the five measured items that pertain to the factor.

Table 5-2

Reliability and Goodness of Fit Indicators for Individual EdMAP Factors

Factor	Code	Omega	Chi square	p-value	Baseline chisq	CFI	TLI	RMSEA
Autonomy	AUTO	0.73	27.12	0.00	841.75	0.93	0.91	0.07
Variety	VARI	0.86	30.49	0.00	2166.19	0.93	0.88	0.08
Innovation	INNO	0.85	13.87	0.00	1966.36	0.95	0.92	0.12
Behaviour Flexibility	BEHA	0.83	4.95	0.42	1570.34	0.98	0.97	0.14
Attention to Detail	DETA	0.84	3.64	0.60	2307.98	0.97	0.95	0.13
Abstract Thinking	ABST	0.85	6.55	0.26	1954.41	0.98	0.96	0.02
Technology Orientation	TECH	0.87	3.64	0.60	2124.55	0.99	0.97	0.00
Planning	PLAN	0.81	13.76	0.02	1171.11	0.96	0.92	0.10
Evaluative	EVAL	0.81	13.82	0.02	1247.22	0.97	0.94	0.04
Quantitative Thinking	QUAN	0.89	9.82	0.08	2185.38	0.95	0.91	0.16
Decisiveness	DECI	0.84	3.09	0.69	2123.58	0.96	0.93	0.12
Application	APPL	0.82	3.94	0.56	1194.49	0.97	0.94	0.00
Tenacity	TENA	0.85	5.14	0.40	1596.62	0.91	0.86	0.01
Career Orientation	CARI	0.88	3.83	0.57	2018.12	0.98	0.96	0.01
Persuasiveness	PERS	0.81	1.28	0.94	1752.45	0.96	0.94	0.01
Leadership	LEAD	0.87	13.62	0.02	2277.10	0.96	0.92	0.04
Attention Seeking	ATTN	0.84	26.58	0.00	1683.75	0.96	0.92	0.02
Group Sociability	GROU	0.83	2.57	0.77	1878.40	0.99	0.98	0.01
Consultation	CONS	0.81	18.38	0.00	1156.55	0..93	0.91	0.04
People Orientation	PEOP	0.88	8.91	0.11	1916.30	0.96	0.91	0.03
Reward Orientation	REWA	0.84	11.77	0.04	1481.33	0.93	0.91	0.04
Emotional Control	EMOT	0.91	19.02	0.00	2402.29	0.96	0.92	0.06
Routine	ROUT	0.67	40.12	0.00	623.04	0.89	0.84	0.06

Outcomes								
Job Satisfaction	JO	0.83	2.98	0.96	1733.45	0.97	0.93	0.03
Job Self-Concept	SC	0.88	2.65	0.35	1895.83	0.99	0.96	0.01
Interpersonal Fit at Work	IPW	0.91	4.47	0.40	1127.23	0.97	0.94	0.30
Thriving at Work	TAW	0.88	13.27	0.59	1468.58	0.98	0.95	0.05
Feeling of Competence	FOC	0.87	3.86	0.32	1257.86	0.97	0.93	0.04
Perceived Recognition at Work	PRW	0.89	8.29	0.02	1379.44	0.98	0.98	0.03
Desire for Involvement at Work	DIW	0.86	6.04	0.37	1654.89	0.96	0.95	0.80

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, RMSEA–root mean square error of approximation. The code (e.g. EVAL) refers to the item number prefix.

Reliability

Except for the factors of routine (ω= 0.67) and autonomy (ω= 0.73), the other factors had one-factor omega coefficient values over 0.80, which is well above the rule of thumb 0.70 cut-off for reliability indicating high reliability in the measurement of the individual factors.

Goodness of Fit

Sixteen of the 23 factors had a TLI of >0.95, indicating an excellent fit and five factors had a TLI value between 0.90 and 0.95, indicating an acceptable fit. Only the factors of routine and tenacity had low CFI/TLI scores (<0.90). The results indicate the good/excellent fit of the measurement model and support for this aspect of construct validity. Except for a few factors, the chi-square value was relatively small compared to the degrees of freedom, with factors routine, variety and autonomy providing a high chi-square and low CFI/ TLI.

Factor Loadings

The complete list of factor loadings for the individual EDMAP attributes is shown in Appendix C in the column titled “Single factor at a time”. The factor loadings range from the lowest of 0.34 (EVAL1 for factor evaluate) to the highest of 0.90 (ATTN3 for factor attention seeking). Only one item (EVAL1) was below the rule of thumb cut-off of 0.4 for factor loadings (Velicer & Fava, 1998).

Conclusion

All factors except routine and tenacity had CFI/TLI over 0.90, indicating a good/excellent fit. The internal consistency and congeneric factor structure of these scales were psychometrically sound with each item loading into the hypothesised factor, high reliability and an acceptable to excellent model fit. Thus, the hypothesis S1-HY-1 was well supported.

5.2.2 Hypothesis S1-HY-2: Multifactor Congeneric Model with Five Items

Overview

Hypothesis S1-HY-2 predicted that the tests of reliability and goodness of fit will demonstrate acceptable fit when all the attributes of the EdMAP instrument are evaluated together as a multifactor congeneric CFA with all 23 factors and five items per factor.

This hypothesis predicted that the EdMAP maintained the factor integrity as a consolidated multifactor instrument with 22 factors.

Note: The factor tenacity was excluded from this analysis due to model resolution issues when included with the other 22 factors.

Results

The goodness of fit indicators for the multifactor congeneric model with 22 factors and five items are shown in Table 5-3.

Table 5-3

Goodness of Fit for the Multifactor Congeneric Model With 22 Factors and Five Items

Indicator	Value
Number of Free Parameters	1054
Chi-Square Test of Model Fit	
Value	21521.00
Degrees of Freedom	6744
P-Value	0.0000
RMSEA	
Estimate	0.049
90 Percent C.I.	0.049- 0.050
Probability RMSEA <= .05	0.899
CFI	0.891
TLI	0.885
WRMR	2.130

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, RMSEA–Root mean square error of approximation, WRMR– Weighted root mean square residual

When all factors were evaluated in a multifactor CFA, the goodness of fit (CFI/TLI) for the EdMAP instrument dropped below the acceptable 0.90. The RMSEA of 0.049 is better than the 0.5 considered the requirement for an excellent fit (Hu & Bentler, 1999). The chi-square to degrees of freedom ratio was21521.00/6744.

Factor Loading

The complete list of factor loadings for the individual EDMAP attributes is shown in Appendix C in the set of columns titled “Congeneric - All factors together”. A sample of factor loadings for the multifactor congeneric model is shown in Table 5-4 alongside the corresponding one factor at a time loading.

Table 5-4

Example of Standardised Factor Loading–One Factor at a Time vs. All Factors

Factor/ Item	Description	One factor	All factors
Evaluation			
EVAL1	I am not prepared to accept things at face value.	0.33	0.39
EVAL2	I like to question the validity of the assumption.	0.63	0.61
EVAL3	I look for flaws in arguments.	0.72	0.73
EVAL4	I review information critically.	0.78	0.76
EVAL5	I critically evaluate and interpret data.	0.79	0.78
Decisiveness			
DECI1	I can readily take decisions.	0.69	0.63
DECII	I am able to make decisions easily.	0.78	0.74
DECI3	I assess situations quickly and decisively.	0.81	0.84
DECI4	I make up my mind quickly on major issues.	0.79	0.70
DECI5	I like making decisions with high impact	0.67	0.81
Persuasion			
PERS1	I can convince others with my argument	0.72	0.67
PERS2	I can argue persuasively for my point of view	0.76	0.77
PERS3	I am skillful arguing a point of view	0.82	0.76
PERS4	I can express an argument convincingly	0.78	0.77
PERS5	I like to make my point of view heard	0.55	0.66
Leadership			
LEAD1	I can keep a group working together as a team	0.70	0.72
LEAD2	I am seen as an effective leader	0.68	0.65
LEAD3	I am confident in directing the activities of others	0.80	0.80
LEAD4	I like to have leadership responsibility	0.78	0.81
Emotional Control			
EMOT1	I remain calm when emergencies occur	0.75	0.83
EMOT2	I stay calm under pressure	0.76	0.82
EMOT3	I control my emotions in all circumstances	0.83	0.74
EMOT4	I am firmly in control of my emotion	0.86	0.78
EMOT5	I am unflappable regardless of the situation	0.88	0.87
Career Orientation			
CARE1	I want to achieve career goals	0.85	0.79
CARE2	I am ambitious about my career	0.68	0.73
CARE3	I have a vision for my career	0.82	0.83
CARE4	I want to keep progressing in my career	0.79	0.75
CARE5	I have a well-defined set of personal career goals	0.78	0.83

Note. One factor–One factor at a time, All factors–All 22 factors in a single congeneric model.

Except for a few items, the standardised factor loadings for the multifactor congeneric model ranged from 0.6 to 0.9, indicating that the items measured the construct they were meant to measure and were internally consistent.

Factor Correlation

A high correlation among factors indicates a lack of discriminant validity (Marsh & Hocevar, 1988). While there are no universally accepted criteria to establish discriminant validity in CFA, as a rule of thumb correlation between two factors with an absolute value close to one (e.g. >|0.90|) is considered to indicate poor discriminant validity.

Table 5-5 lists the factor correlation between the generated factor scores for the multifactor congeneric model (22 factors, five items).

While most correlation values fell within the acceptable range indicating sufficient discriminant validity, there were a few factor correlations greater than 0.90, indicating a lack of discrimination between the specific factors. There were high correlation values between specific groups (e.g., *evaluation, decisiveness, leadership*), which is further investigated through the analysis of a second-order factor structure.

Table 5-5

Correlation of Factor Scores for Multifactor Congeneric Model

	Evaluative	Decisiveness	Persuasiveness	Leadership	Emotional Control	Career Orientation	Attention Seeking	Reward Orientation	Planning	Application	Attention to Detail	Variety	Innovation	Routine	Autonomy	Abstract thinking	Technology Orientation	Quantitative thinking	Behavioral Flexibility	Consultation	People Orientation
Evaluate	1.00																				
Decisiveness	0.83																				
Persuasiveness	0.91	0.88																			
Leadership	0.75	0.91	0.91																		
Emotional Control	0.66	0.79	0.7	0.69																	
Career Orientation	0.65	0.68	0.72	0.77	0.54																
Attention Seeking	0.52	0.62	0.68	0.7	0.36	0.53															
Reward Orientation	0.45	0.41	0.62	0.58	0.31	0.65	0.7														
Planning	0.78	0.84	0.85	0.87	0.67	0.8	0.49	0.56													
Application	0.68	0.75	0.78	0.82	0.71	0.84	0.43	0.61	0.92												
Attention to Detail	0.58	0.56	0.62	0.66	0.48	0.63	0.47	0.57	0.79	0.75											
Variety	0.71	0.8	0.74	0.77	0.61	0.67	0.62	0.49	0.67	0.69	0.55										
Innovation	0.79	0.81	0.81	0.75	0.57	0.68	0.6	0.49	0.69	0.64	0.52	0.81									
Routine	0.72	0.81	0.77	0.81	0.69	0.79	0.64	0.59	0.84	0.83	0.78	0.71	0.65								
Autonomy	0.81	0.79	0.84	0.76	0.63	0.79	0.46	0.56	0.89	0.86	0.69	0.72	0.84	0.8							
Abstract thinking	0.88	0.75	0.79	0.71	0.56	0.59	0.58	0.45	0.67	0.6	0.57	0.73	0.74	0.7	0.67						
Technology Orientation	0.75	0.72	0.68	0.66	0.58	0.66	0.49	0.49	0.7	0.66	0.6	0.76	0.72	0.7	0.69	0.76					

	Evaluative	Decisiveness	Persuasiveness	Leadership	Emotional Control	Career Orientation	Attention Seeking	Reward Orientation	Planning	Application	Attention to Detail	Variety	Innovation	Routine	Autonomy	Abstract thinking	Technology Orientation	Quantitative thinking	Behaviour Flexibility	Consultation	People Orientation
Quantitative thinking	0.83	0.71	0.75	0.69	0.59	0.59	0.58	0.49	0.72	0.6	0.58	0.57	0.58	0.75	0.61	0.84	0.74				
Behaviour Flexibility	0.77	0.87	0.85	0.84	0.83	0.75	0.53	0.53	0.84	0.86	0.61	0.79	0.75	0.82	0.84	0.68	0.72	0.67			
Consultation	0.72	0.65	0.78	0.72	0.62	0.76	0.46	0.68	0.78	0.86	0.66	0.68	0.65	0.78	0.82	0.62	0.66	0.66	0.83		
People Orientation	0.77	0.63	0.74	0.58	0.5	0.52	0.41	0.45	0.63	0.55	0.51	0.63	0.68	0.53	0.7	0.64	0.57	0.49	0.67	0.64	
Group Sociability	0.47	0.54	0.62	0.59	0.55	0.55	0.49	0.53	0.56	0.6	0.42	0.54	0.52	0.61	0.55	0.42	0.53	0.5	0.69	0.72	0.47

Note. The correlation values range from 0.31 to 0.92. Tenacity was removed due to issues with convergence

Conclusion

The multifactor congeneric model with 23 factors and five items per factor indicated a poor fit with a CFI/TLI of 0.891/0.885. When compared with the model using one factor at a time, the loading of some items increased (e.g. *Evaluate*-EVAL1 increased from 0.334 to 0.390) whereas others reduced (e.g. *Autonomy*-AUTO1 decreased from 0.441 to 0.228). With a few exceptions, the ordered pattern in which items loaded into a factor remained the same (i.e. the highest loading item in the one-factor model remained as the highest loading item in the multifactor model) indicating that there was no significant change in the factor structure. The instrument did not display acceptable goodness of fit, and thus did not support the research hypothesis S1-HY-2.

However, the closeness of CFI/TLI to the cut-off of 0.90, the consistent factor loadings and the presence of only a few low loading items in the range of 0.3–0.5 such as a*ttention seeking* (ATTE1) suggest an opportunity for tuning and improvement.

5.2.3 Research Question S1-RQ-1: Can Tuning Improve the Congeneric Model?

Overview

S1-RQ-1: Can the multifactor congeneric model of EdMAP with 23 factors be improved by removing the item with the lowest loading on the designated factor or by removing the item with the highest modification index?

Tuning Using the Lowest Loading Item

Velicer and Fava (1998) suggested that if an item has a loading of < 0.40, then it may a) not be related to the other items of the factor or b) indicate the presence of an additional factor that should be explored. While superseded by a more advanced approach using the MI, dropping the lowest loading was used here to gain a basic insight into the data and as a baseline for the more sophisticated MI approach that followed.

The following items were removed as the lowest loading items:

autonomy-1, innovation-1, variety-1, behaviour flexibility-1, abstract thinking-5, technical orientation-2, planning-3, evaluation-1, quantitative-2, application-1, tenacity-1, career orientation-2, persivasiveness-5, leadership-1, attention to detail-1, group sociability-

3, consultation-3, people orientation-3, reward-3, emotional control, routine-3 and ecisiveness-5.

Tuning Using the Modification Index

One of the common methods of identifying localised misfit is the MI (Sorbom, 1989). The MI specifies the change in the chi-square value when a new parameter is introduced, or a constrained parameter is freed. The modification indexes for both the factor loading (MPLUS BY statement) and correlation (MPLUS WITH statement) were evaluated to identify items with the highest contribution.

The MI indicated that the following items should be removed:

planning-1, attention to detail-1, autonomy-5, decisiveness-5, persivierence-5, reward-2, routine1, routine-2, routine-3 and routine-4.

Note. The factor routine was removed from the model as four of its items indicated high MI values.

Results

Table 5-6 provides the goodness of fit for the four-item model after removing the lowest loading item and the fit after tuning using modification indexes.

Table 5-6

Goodness of Fit for the Multifactor Congeneric Models With 23 Factors and Four Items

	Item with the lowest loading removed	Item with the highest MI removed	All five items
Number of Free Parameters	892	867	1054
Chi-Square Test of Model Fit			
Value	14851.04	13474.01	21521.00
Degrees of Freedom	4024	3917	6744
P-Value	0.00	0.00	0.00
RMSEA			
Estimate	0.055	0.053	0.049
90 Percent C.I.	0.054 - 0.056	0.053 - 0.056	0.049 -0.050
Probability RMSEA <= .05	0.000	0.00	0.000
CFI	0.910	0.917	0.891
TLI	0.902	0.916	0.885
WRMR (Weighted Root Mean Square Residual)	2.056	2.048	2.130

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, RMSEA–Root mean square error of approximation, WRMR–Weighted root mean square residual. The corresponding five-item model is presented for comparison.

Tuning Using the Lowest Loading Item and Modification Index

By eliminating the lowest loading item from each factor, the CFI/TLI changed from a poor fit of 0.891/885 to an acceptable fit of 0.910/0.902, which was an improvement of ΔCFI/TLI of 0.019/0.017. The chi-square remained low compared to the degrees of freedom (14851.04/4024) and the RMSEA (0.055) was within the range for a good fit. The factor loadings, a sample of which is shown in Table 5-7 did not change substantially.

By tuning using the MI, the CFI/TLI improved from a poor fit of 0.891/885 to an acceptable fit of 0.917/0.916, which was an improvement of ΔCFI/TLI of 0.026/0.031. The chi-square remained low compared to the degrees of freedom (13474.01/4017) and the RMSEA (0.055) was still within the range for acceptable fit.

Factor Loadings

A sample of the factor loadings is shown in Table 5-7.

Table 5-7

Comparison of a Sample of Factor Loadings of Alternative Multifactor Congeneric Models

Items	Description	One factor at a time	5-items together	lowest loading items removed	highest MI item removed
	EVALUATION				
EVAL1	I am not prepared to accept things at face value.	0.33	0.39		0.38
EVAL2	I like to question the validity of the assumption.	0.63	0.60	0.61	
EVAL3	I look for flaws in arguments.	0.71	0.72	0.73	0.71
EVAL4	I review information critically.	0.77	0.75	0.77	0.75
EVAL5	I critically evaluate and interpret data.	0.79	0.78	0.79	0.77
	DECISIVENESS				
DECI1	I can readily take decisions.	0.69	0.62		0.66
DECI2	I am able to make decisions easily.	0.78	0.73	0.72	0.77
DECI3	I assess situations quickly and decisively.	0.81	0.84	0.83	0.89
DECI4	I make up my mind quickly on major issues.	0.79	0.69	0.68	0.73
DECI5	I like making decisions with high impact	0.66	0.80	0.79	
	LEADERSHIP				
LEAD1	I can keep a group working together as a team	0.69	0.71	0.71	0.71
LEAD2	I am an effective leader	0.67	0.65		
LEAD3	I am confident directing the activities of others	0.79	0.79	0.79	0.79
LEAD4	I like to have leadership responsibility	0.77	0.80	0.79	0.79
LEAD5	I confidently approach leadership tasks	0.84	0.81	0.81	0.81
	EMOTIONAL CONTROL				
EMOT1	I remain calm when emergencies occur	0.74	0.83	0.82	0.81
EMOT2	I stay calm under pressure	0.76	0.82	0.80	0.79
EMOT3	I control my emotions in all circumstances	0.82	0.74		0.72
EMOT4	I am firmly in control of my emotion	0.85	0.77	0.76	
EMOT5	I am unflappable regardless of the situation	0.87	0.87	0.85	0.85
	CAREER ORIENTATION				
CARE1	I want to achieve career goal	0.85	0.78	0.80	0.77
CARE2	I am ambitious about my career	0.67	0.72		0.71
CARE3	I have a vision for my career	0.82	0.82	0.83	0.81
CARE4	I want to keep progressing in my career	0.79	0.74	0.76	
CARE5	I have a well-defined set of personal career goals	0.77	0.83	0.84	0.82

Note. The above is a sample of factor loadings. EVAL1-5 are the items for measuring Evaluation, DECI1-5 for Decisiveness, CARE1-5 for Career Orientation etc.

The pattern of factor loadings did not change substantially. As seen from the above sample, the highest loading factor remained as the highest loading in the tuned models.

Conclusion

CFA after removing the lowest loading item produced a CFI/TLI of 0.910/0.902 to provide an acceptable fit. CFA after removing the items with the highest MI produced CFI/TLI of 0.917/0.916 to provide an acceptable fit.

The tuned models provide acceptable values for the fit indicators including CFI, TLI, chi-square/degrees of freedom ratio and the RMSEA. The fit was marginally better when the multifactor congeneric model was tuned using the MI than when tuned by removing the lowest loading item.

Because the values for the fit indices were in the lower end of the range for an acceptable fit, the following investigates the supplementary approach of ESEM to improve the fit.

5.2.4 Hypothesis S1-HY-3: Exploratory Structural Equation Model

Overview

Hypothesis S1-HY-3 stated that using an ESEM will improve the fit over the corresponding CFA model, and thus provide better factor values.

Compared to a restrictive CFA model, in an ESEM the items are free to load to non-target factors. The initial values for the non-target items were set to zero and the target items were set to one.

The variables scored on a 7-point Likert scale were treated as categorical. ESEM analysis was performed using the ESTIMATOR = WLSMV and ROTATION = TARGET options of the MPLUS package version 7. All factors were considered as a single cluster (block).

Note. The factor *routine* was dropped from the model and some items were dropped for tuning, leaving 22 factors and 101 items in the optimal model.

Results

Table 5-8 lists the goodness of fit comparison between the CFA model and ESEM when all 22 factors were concurrently evaluated.

Table 5-8

Model Fit for Single Cluster ESEM With All 22 Factors and Corresponding CFA

	Single cluster ESEM	Multifactor CFA
Number of Free Parameters	2632	1054
Chi-Square Test of Model Fit		
	5753.69	21521.00
Degrees of Freedom	3218	6744
P-Value	0.0000	0.0000
RMSEA (Root mean square error of approximation)		
Estimate	0.030	0.049
90 Percent C.I.	0.028 - 0.031	0.049 - 0.050
Probability RMSEA <= .05	1.000	0.899
CFI	0.981	0.891
TLI	0.969	0.885
WRMR (Weighted Root Mean Square Residual)	0.573	2.130

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, RMSEA–Root mean square error of approximation, WRMR–Weighted root mean square residual. The CFA model values are shown for comparison.

The single cluster ESEM, where all items can load into all factors, provided a better fit than CFA. The number of estimated parameters (parsimony) changed from 1052 to 2632. The CFI/TLI improved from 0.891/0.885 to 0.981/0.969. The RMSEA changed from 0.049 to 0.030, indicating an improved fit. These values were consistent with similar findings from Marsh et al.'s (2010) study of CFI/TLI improvement from 0.685/0.672 to 0.851/0.821 when the big five factors were revisited using ESEM.

Factor Loading

Table 5-9 contains the factor loadings for the ESEM.

Table 5-9

Factor Loadings for Single Cluster ESEM

	Autonomy	Innovation	Variety	Behavioural flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
AUTO1	**0.62**	0.23	-0.09	-0.01	-0.01	0.13	-0.13	0.12	0.02	-0.15	0.23	0.01	-0.16	0.04	-0.01	-0.06	-0.07	-0.15	0.18	-0.09	0.16	-0.02
AUTO2	**0.83**	0.11	0.01	0.11	0.07	0.02	-0.15	-0.01	0.04	0.05	0.17	-0.01	0.00	-0.05	-0.05	-0.15	-0.01	0.01	-0.02	-0.01	0.00	-0.03
AUTO3	**0.66**	0.22	-0.01	0.05	0.02	-0.11	-0.09	-0.07	0.00	0.13	0.24	0.01	0.00	0.09	-0.05	-0.18	-0.07	0.06	0.00	0.00	0.04	-0.02
AUTO4	**0.33**	0.08	-0.07	0.11	0.14	-0.03	-0.02	0.22	0.09	0.10	-0.05	-0.05	0.16	0.16	-0.05	0.08	0.15	-0.10	0.00	0.13	-0.10	-0.05
INNO1	0.14	**0.75**	-0.17	-0.07	0.03	0.23	0.08	0.15	-0.08	-0.14	0.10	0.03	-0.10	0.01	0.01	-0.06	0.01	-0.02	-0.03	0.01	-0.02	0.07
INNO2	0.11	**0.80**	0.11	-0.09	-0.05	-0.10	0.05	0.08	-0.08	-0.02	-0.07	-0.12	0.02	0.11	0.12	0.12	0.12	-0.07	-0.01	-0.06	-0.05	0.03
INNO3	0.17	**0.72**	0.02	0.02	0.04	0.11	0.10	-0.01	0.04	-0.01	-0.08	-0.04	0.05	-0.05	0.09	0.04	-0.13	0.06	-0.06	-0.14	0.02	0.04
INNO4	0.17	**0.72**	0.16	0.12	0.00	-0.03	-0.01	-0.04	-0.03	-0.05	-0.04	-0.05	-0.02	-0.16	-0.03	-0.14	0.13	0.04	0.05	0.01	-0.03	-0.11
VARI1	0.01	-0.06	**0.78**	0.02	0.04	-0.10	0.08	0.08	-0.03	-0.01	-0.12	0.15	-0.09	0.07	0.17	0.00	0.03	-0.06	-0.06	0.08	-0.09	0.03
VARI2	0.09	0.01	**0.68**	0.04	0.00	0.07	0.05	-0.03	-0.15	0.02	-0.04	-0.06	-0.03	-0.02	0.05	-0.04	0.06	-0.01	-0.06	0.05	0.02	0.03
VARI3	-0.12	-0.01	**0.83**	0.09	-0.02	0.12	-0.06	-0.05	0.05	-0.05	0.11	-0.17	0.11	-0.18	-0.10	0.04	-0.01	-0.01	0.01	0.01	0.13	-0.05
VARI4	-0.06	0.10	**0.76**	-0.02	0.08	0.05	0.06	-0.05	0.12	-0.15	-0.02	-0.01	0.01	0.08	0.08	0.09	-0.04	0.04	-0.03	-0.13	-0.02	0.02
VARI5	-0.11	0.09	**0.77**	0.04	-0.01	0.11	0.00	-0.01	0.15	-0.13	0.13	-0.05	0.09	-0.13	-0.24	0.08	-0.03	-0.06	0.21	-0.08	-0.01	0.00
BEHA1	-0.03	0.11	0.10	**0.27**	-0.07	-0.11	0.19	0.04	0.08	-0.08	0.25	0.17	-0.05	-0.08	0.02	0.13	0.06	0.08	0.05	0.05	-0.05	0.08
BEHA2	0.24	-0.10	0.01	**0.55**	-0.06	-0.14	0.09	0.05	-0.05	0.03	0.07	0.04	-0.05	-0.04	0.14	-0.15	-0.03	0.00	0.11	0.09	-0.03	0.11
BEHA3	-0.09	0.08	0.06	**0.82**	-0.12	0.01	-0.02	0.03	-0.13	0.06	0.05	0.05	0.02	0.11	0.04	0.04	-0.01	-0.09	0.02	-0.08	-0.03	-0.07
BEHA4	0.02	-0.05	-0.02	**0.88**	-0.02	-0.04	-0.04	0.01	0.02	-0.06	-0.08	0.12	-0.07	-0.04	-0.01	-0.03	-0.11	0.01	0.06	0.02	0.03	0.14
BEHA5	0.09	-0.04	0.01	**0.88**	-0.07	-0.05	-0.02	0.19	0.06	0.01	-0.01	-0.04	0.01	-0.06	-0.10	0.02	0.12	0.08	-0.01	0.00	-0.10	-0.06

	Autonomy	Innovation	Variety	Behaviour Flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
DETA1	0.06	-0.03	0.00	-0.10	0.91	-0.04	0.11	0.13	0.03	-0.01	0.02	0.14	-0.11	-0.13	-0.04	0.01	0.05	-0.03	0.06	-0.05	-0.09	-0.07
DETA2	0.06	0.09	0.07	-0.14	0.59	-0.03	-0.04	0.17	0.01	0.07	-0.04	0.04	0.06	0.02	0.03	0.08	-0.06	0.07	-0.11	0.05	0.10	0.07
DETA3	0.08	0.04	-0.12	-0.04	0.87	-0.13	0.10	0.01	0.08	0.01	-0.16	0.22	0.03	-0.13	0.08	0.08	0.08	-0.02	0.01	0.05	-0.13	0.03
DETA4	0.03	-0.03	0.18	0.00	0.79	-0.02	0.02	0.09	0.13	-0.11	-0.08	0.00	-0.02	0.01	0.02	-0.01	-0.09	0.08	-0.13	0.00	0.03	0.08
ABST1	-0.06	0.14	0.10	-0.17	0.03	**0.66**	-0.01	0.02	0.02	0.06	0.14	0.07	-0.10	0.09	-0.13	-0.09	0.00	0.01	-0.05	0.13	-0.05	-0.04
ABST2	0.04	-0.08	-0.06	-0.02	-0.12	**0.77**	-0.01	0.06	0.11	0.12	0.03	0.13	0.04	-0.09	0.03	-0.04	0.02	0.00	-0.06	0.03	0.06	-0.01
ABST3	0.05	-0.03	0.06	-0.09	-0.04	**0.86**	-0.01	-0.07	0.05	0.17	-0.14	0.10	0.04	0.03	0.07	0.08	-0.07	0.03	-0.09	-0.01	-0.03	-0.02
ABST4	0.06	0.06	0.07	-0.02	-0.08	**0.81**	0.05	-0.06	0.10	0.17	-0.23	0.06	0.05	0.01	0.07	0.02	-0.14	-0.01	-0.05	0.00	-0.01	-0.02
ABST5	-0.11	0.12	0.08	-0.04	-0.11	**0.66**	0.00	-0.16	0.11	-0.01	-0.02	0.02	-0.02	-0.03	-0.07	-0.13	0.15	-0.04	-0.05	0.12	-0.02	-0.03
TECH1	-0.04	-0.01	0.00	0.03	-0.03	-0.04	**0.97**	0.12	-0.05	-0.03	0.01	-0.10	-0.06	0.05	-0.06	-0.07	0.06	-0.02	0.07	0.04	-0.04	-0.05
TECH2	-0.10	0.03	0.01	0.14	0.07	0.06	**0.84**	-0.06	-0.12	0.14	0.12	-0.14	0.04	0.00	-0.14	-0.05	-0.04	-0.10	-0.07	-0.05	0.01	0.03
TECH3	-0.13	0.15	0.22	-0.06	0.07	0.07	**0.76**	-0.03	-0.06	0.01	-0.04	0.10	-0.03	0.03	-0.10	-0.04	-0.11	0.08	0.00	-0.02	-0.05	-0.05
TECH4	-0.14	0.08	-0.09	0.07	0.02	-0.06	**0.94**	0.05	0.09	0.01	0.08	-0.06	-0.02	-0.06	-0.10	-0.07	-0.04	0.05	-0.10	-0.02	0.21	0.01
TECH5	-0.04	-0.03	-0.02	0.01	-0.01	-0.02	**0.68**	-0.12	0.16	0.21	0.14	-0.01	0.02	0.07	-0.07	-0.07	0.03	-0.06	0.10	-0.02	-0.11	0.00
PLAN1	0.12	0.07	0.23	-0.05	0.19	-0.01	-0.12	**0.43**	-0.13	0.16	0.01	-0.07	-0.10	0.09	0.01	0.34	-0.05	-0.12	0.10	0.08	-0.06	-0.05
PLAN2	0.15	-0.09	-0.04	0.03	0.09	0.01	0.18	**0.40**	-0.06	0.15	0.18	0.02	0.27	-0.13	0.19	0.06	-0.05	0.03	-0.14	0.03	0.08	0.02
PLAN3	-0.04	0.12	-0.13	0.28	0.12	-0.02	0.03	**0.13**	0.14	0.16	0.16	0.19	0.03	-0.01	0.09	0.11	0.00	-0.03	-0.11	0.15	0.04	-0.10
PLAN5	0.14	0.07	-0.04	0.12	0.08	-0.10	0.00	**0.51**	-0.04	0.19	-0.05	0.01	0.21	0.15	0.03	0.23	-0.06	0.13	0.02	-0.03	-0.04	-0.11
EVAL2	0.17	-0.05	0.06	0.00	0.02	0.23	0.01	-0.08	**0.37**	0.04	0.07	-0.05	0.00	-0.05	0.15	-0.08	0.13	-0.07	-0.04	0.21	-0.01	-0.05
EVAL3	0.05	0.02	-0.07	-0.03	0.17	0.17	0.09	-0.23	**0.42**	0.06	0.02	0.03	0.00	-0.03	0.23	0.11	0.11	-0.08	0.05	0.12	-0.10	-0.01
EVAL4	-0.04	0.01	0.10	0.05	0.03	0.09	-0.01	0.12	**0.79**	0.05	0.04	0.08	-0.08	0.03	0.36	-0.20	-0.03	-0.08	0.02	-0.03	0.03	0.04
EVAL5	0.00	-0.02	0.10	0.00	0.04	-0.06	0.02	0.11	**0.65**	0.35	0.09	-0.09	-0.02	0.13	0.30	-0.24	-0.06	-0.04	0.10	0.04	-0.06	0.04

Continued

	Autonomy	Innovation	Variety	Behavioural flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
QUAN1	0.00	-0.11	-0.05	-0.14	-0.05	0.33	0.07	0.17	0.01	0.64	-0.01	-0.08	-0.04	-0.07	0.05	0.18	-0.03	0.17	-0.08	-0.06	-0.01	0.01
QUAN2	0.16	-0.10	-0.08	-0.09	0.02	0.16	0.09	0.15	0.28	0.55	-0.04	-0.01	-0.08	-0.02	0.12	0.13	0.02	0.08	-0.02	-0.12	-0.02	0.03
QUAN3	-0.12	-0.01	-0.02	0.12	0.05	-0.03	0.05	0.18	0.06	0.81	-0.07	-0.08	0.00	0.03	-0.01	-0.12	0.09	-0.08	0.13	-0.13	0.02	0.06
QUAN4	0.14	0.07	-0.10	0.06	-0.08	0.10	0.17	0.00	0.00	0.61	-0.05	-0.03	-0.03	0.01	0.01	0.01	-0.03	-0.03	0.09	-0.05	0.00	-0.04
QUAN5	-0.06	-0.03	-0.04	0.04	0.00	-0.02	0.02	0.20	0.09	0.94	-0.02	-0.10	0.00	-0.02	-0.06	-0.05	0.03	-0.03	0.16	-0.03	-0.02	0.05
DECI1	0.18	-0.03	0.04	0.08	-0.02	0.03	0.14	0.13	0.02	-0.17	**0.57**	-0.01	0.02	-0.11	0.11	0.18	0.07	-0.04	0.19	-0.10	-0.09	-0.05
DECI2	0.22	-0.11	0.16	0.22	-0.09	0.01	0.07	-0.03	-0.07	0.00	**0.51**	-0.07	-0.09	-0.04	0.08	0.10	0.04	0.02	-0.05	-0.03	-0.03	0.16
DECI3	-0.04	0.09	-0.07	0.16	-0.04	-0.02	0.10	0.11	0.19	0.03	**0.43**	0.04	0.17	0.02	0.06	0.18	-0.02	0.03	-0.10	0.12	-0.01	0.07
DECI4	0.21	0.08	0.03	-0.07	-0.05	-0.10	0.07	0.07	0.07	0.01	**0.60**	-0.15	0.05	0.04	-0.06	0.10	0.01	0.01	-0.03	0.12	0.04	0.16
APPL2	0.01	0.11	-0.10	-0.03	0.10	0.09	0.02	0.13	-0.15	-0.03	-0.09	**0.51**	0.20	0.13	-0.03	0.08	-0.10	0.12	-0.01	-0.02	0.14	0.07
APPL3	0.09	-0.17	0.03	0.01	0.15	0.08	-0.11	-0.20	0.10	-0.04	-0.01	**0.37**	0.10	0.14	-0.02	0.06	0.05	-0.02	0.28	0.00	0.01	0.01
APPL4	-0.05	-0.02	-0.01	0.23	0.14	0.13	-0.06	0.08	-0.04	-0.10	0.01	**0.50**	0.13	-0.01	-0.08	0.14	-0.01	-0.02	0.10	-0.03	-0.02	0.16
APPL5	-0.01	-0.04	0.01	0.16	0.04	0.10	0.06	0.03	0.07	-0.09	-0.10	**0.49**	-0.08	0.18	-0.12	0.12	-0.09	-0.03	0.16	0.05	0.01	-0.08
TENA1	0.09	-0.11	-0.07	-0.01	-0.08	0.02	0.18	0.28	0.04	-0.17	0.16	0.00	**0.30**	0.05	0.26	-0.10	0.05	-0.04	0.19	0.05	0.07	0.07
TENA2	0.00	0.06	0.11	0.15	0.05	-0.02	-0.02	0.19	-0.05	-0.07	-0.06	0.30	**0.43**	0.11	0.13	-0.18	0.09	-0.01	0.03	0.02	0.02	0.04
TENA3	0.04	0.01	0.07	0.03	0.02	0.02	0.08	0.20	-0.07	-0.08	-0.03	0.36	**0.33**	0.09	0.00	-0.02	0.01	0.03	0.13	0.01	0.04	0.08
TENA5	0.01	-0.04	0.06	-0.08	0.00	0.02	0.01	0.23	0.04	0.05	0.19	0.23	**0.49**	0.11	-0.09	0.01	0.07	0.06	-0.02	-0.01	0.04	0.12
CARE1	0.11	0.02	0.00	-0.09	-0.09	-0.08	0.03	-0.04	-0.01	0.06	-0.03	0.03	-0.01	**0.91**	-0.04	0.02	0.05	-0.03	-0.03	0.07	0.04	0.01
CARE3	-0.01	-0.02	-0.07	0.02	0.01	0.08	0.10	-0.01	0.08	-0.05	0.01	0.17	-0.07	**0.75**	0.05	0.02	0.01	0.04	-0.10	-0.04	0.07	-0.08

Continued.

	Autonomy	Innovation	Variety	Behavioural flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
CARE4	0.03	0.08	0.09	0.05	-0.12	0.02	0.05	0.09	-0.04	0.01	-0.24	0.10	-0.03	**0.68**	-0.05	-0.02	0.02	-0.02	-0.01	0.03	0.08	-0.04
CARE5	0.12	-0.10	-0.14	-0.03	-0.03	0.05	0.00	-0.05	0.05	-0.06	0.11	0.11	0.15	**0.76**	-0.03	0.09	0.08	-0.02	0.04	0.02	-0.04	0.07
PERS1	-0.08	0.09	0.09	-0.14	0.06	-0.05	-0.13	0.14	0.17	0.03	0.09	-0.22	-0.04	0.07	**0.63**	0.14	-0.02	-0.06	0.11	0.05	0.10	0.15
PERS2	-0.05	0.04	-0.08	0.08	-0.05	0.12	-0.02	0.12	0.03	0.11	0.10	0.13	0.02	-0.09	**0.51**	0.33	0.02	-0.06	0.01	0.06	0.02	-0.08
PERS3	-0.02	-0.02	-0.01	0.07	-0.01	0.08	-0.05	0.05	0.20	0.04	0.10	-0.18	0.01	0.05	**0.53**	0.17	0.02	0.05	-0.04	0.12	0.07	0.00
PERS4	-0.05	0.08	0.03	0.08	0.07	-0.02	-0.02	-0.09	0.26	-0.11	0.00	-0.20	0.11	0.04	**0.58**	0.20	0.00	0.16	0.07	-0.03	-0.02	0.06
PERS5	0.10	0.06	0.02	0.09	0.05	-0.07	-0.16	0.01	0.37	0.10	-0.14	0.21	-0.09	-0.12	**0.31**	-0.03	0.23	0.05	0.06	-0.06	0.24	-0.04
LEAD1	-0.22	0.10	-0.01	-0.01	0.06	0.01	-0.13	0.22	-0.16	0.02	0.08	-0.05	-0.11	0.02	0.22	**0.45**	0.04	0.21	0.16	0.07	-0.07	0.10
LEAD2	-0.18	0.03	0.05	0.09	0.01	0.05	-0.12	0.18	-0.22	0.13	0.17	0.14	-0.04	-0.17	0.44	**0.55**	0.04	-0.12	0.02	-0.10	0.10	-0.04
LEAD3	0.00	0.09	-0.05	-0.05	0.10	-0.05	0.00	0.00	0.00	-0.07	0.11	0.14	0.05	0.02	0.25	**0.64**	0.04	0.04	0.17	-0.11	-0.03	0.03
LEAD4	0.01	-0.14	0.20	0.00	-0.01	-0.02	-0.01	0.14	-0.01	0.07	0.06	0.16	-0.11	0.11	-0.10	**0.70**	0.10	-0.05	-0.06	0.01	0.12	0.01
LEAD5	0.08	-0.04	0.03	0.04	0.00	-0.10	0.03	0.20	-0.05	0.02	0.12	-0.02	-0.05	0.12	-0.01	**0.80**	0.00	-0.05	0.03	0.02	0.06	0.03
ATTN2	0.00	-0.20	0.14	-0.09	0.05	-0.03	0.01	-0.09	-0.03	0.02	-0.06	-0.02	-0.06	0.07	0.05	0.10	**0.79**	0.05	-0.16	-0.01	0.13	0.09
ATTN3	0.02	0.05	-0.12	-0.02	-0.05	-0.07	0.05	-0.12	0.03	0.00	-0.07	-0.03	0.00	0.00	-0.01	-0.01	**0.98**	0.01	-0.07	0.01	0.01	0.01
ATTN4	0.02	0.04	0.13	0.07	0.00	0.05	-0.11	0.01	0.02	0.10	0.14	-0.01	0.12	0.00	-0.10	0.06	**0.62**	-0.06	-0.11	-0.06	-0.04	-0.08
ATTN5	-0.05	0.24	-0.14	0.07	-0.08	0.00	-0.06	-0.04	0.07	-0.08	-0.02	-0.11	0.04	0.03	0.25	0.00	**0.73**	0.07	-0.06	-0.04	-0.02	-0.06
GROU1	-0.05	0.01	-0.02	0.06	-0.07	0.11	-0.07	0.01	-0.11	0.00	0.09	-0.05	0.00	-0.09	0.03	0.09	0.05	**0.91**	-0.07	0.02	-0.07	-0.05
GROU2	-0.08	0.10	0.10	-0.06	0.08	-0.06	0.01	-0.17	-0.02	-0.05	-0.14	0.00	0.08	0.06	0.12	-0.13	-0.05	**0.73**	0.11	0.07	0.05	-0.15
GROU3	-0.06	-0.01	-0.15	0.13	0.04	0.11	-0.03	0.00	-0.05	-0.03	-0.09	0.02	-0.03	-0.02	-0.06	-0.03	-0.05	**0.70**	-0.06	-0.07	0.16	0.25
GROU4	0.00	-0.07	0.01	-0.02	0.02	-0.10	0.00	0.10	-0.11	0.08	0.00	-0.05	-0.05	-0.01	-0.01	0.08	0.09	**0.89**	0.06	0.01	-0.09	-0.09
GROU5	-0.04	-0.03	-0.06	-0.07	-0.03	-0.08	0.03	-0.05	-0.05	0.07	0.10	0.03	-0.03	-0.04	-0.02	-0.05	0.01	**1.00**	0.21	0.02	-0.07	-0.09
CONS1	-0.03	-0.02	-0.05	0.23	0.00	0.03	0.06	0.07	0.01	-0.20	0.14	0.19	-0.19	0.05	0.03	0.11	-0.07	0.05	**0.53**	-0.05	-0.07	-0.11

Continued.

	Autonomy	Innovation	Variety	Behavioural flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
CONS2	0.01	-0.02	0.09	0.09	-0.02	-0.22	0.02	-0.04	-0.04	0.04	-0.06	-0.03	0.01	-0.05	0.11	-0.03	-0.14	0.09	**0.55**	0.10	0.20	-0.01
CONS3	-0.02	-0.03	-0.04	-0.05	-0.04	0.06	0.05	-0.23	-0.03	0.06	-0.14	0.03	0.09	-0.10	0.05	0.04	0.03	-0.04	**0.88**	-0.06	0.02	-0.03
CONS4	0.01	-0.02	-0.01	-0.12	-0.11	-0.04	0.02	-0.13	-0.02	0.16	-0.05	0.12	0.09	-0.11	-0.13	0.11	-0.05	-0.10	**0.97**	0.08	0.05	0.01
CONS5	0.12	0.04	0.05	0.06	-0.10	-0.13	-0.14	0.02	0.16	0.18	0.05	0.15	-0.01	0.03	0.05	0.04	-0.18	0.26	**0.42**	0.09	-0.01	-0.02
PEOP1	0.00	0.02	-0.13	-0.07	-0.04	0.18	-0.09	0.20	0.11	-0.15	0.07	0.02	-0.01	0.01	-0.02	-0.07	0.00	0.01	0.15	**0.86**	-0.10	0.03
PEOP2	0.03	-0.15	0.21	0.08	-0.10	0.06	0.03	0.12	0.00	-0.11	-0.15	-0.01	-0.01	0.04	0.05	-0.09	0.05	0.07	0.06	**0.79**	-0.16	0.01
PEOP3	0.08	-0.08	-0.01	0.01	0.07	0.05	-0.02	0.05	0.12	-0.10	0.13	-0.10	0.06	-0.02	-0.05	-0.08	0.04	0.08	-0.08	**0.70**	0.11	0.01
PEOP4	-0.06	0.06	-0.12	-0.02	0.08	-0.03	0.04	-0.08	0.03	-0.02	-0.01	0.03	-0.01	0.00	0.09	0.04	-0.08	-0.06	-0.02	**0.89**	0.08	0.01
PEOP5	-0.06	-0.03	-0.04	0.06	-0.02	0.01	-0.02	-0.07	0.00	-0.05	-0.02	0.00	-0.04	-0.01	-0.01	0.03	-0.10	-0.03	0.05	**0.99**	0.04	-0.02
REWA1	-0.09	0.08	0.03	-0.07	-0.07	-0.06	-0.05	0.02	-0.14	0.07	0.05	0.08	-0.01	-0.01	0.06	0.15	0.09	-0.06	-0.05	0.12	**0.76**	-0.03
REWA2	0.18	-0.02	0.03	-0.02	-0.05	-0.02	0.00	0.02	-0.02	-0.08	-0.13	-0.05	0.09	0.08	0.14	-0.09	-0.07	-0.01	0.12	-0.06	**0.71**	-0.02
REWA4	0.00	-0.05	-0.02	-0.05	-0.06	-0.01	0.01	-0.02	-0.11	0.06	0.07	-0.02	-0.08	-0.01	0.08	0.09	-0.01	-0.05	0.04	0.06	**0.83**	-0.12
REWA5	-0.05	-0.10	-0.02	-0.05	0.02	0.03	0.06	-0.07	0.08	-0.12	-0.08	0.04	-0.02	0.01	0.08	-0.02	0.06	0.10	0.09	-0.16	**0.86**	0.03
EMOT2	-0.02	-0.11	0.15	0.16	0.07	-0.02	0.02	-0.13	0.04	-0.06	0.23	0.02	0.10	0.07	0.14	0.01	-0.05	-0.05	-0.11	-0.01	0.01	**0.60**
EMOT3	-0.04	0.08	0.02	0.06	0.04	0.02	-0.09	-0.06	-0.05	0.08	-0.11	0.01	-0.02	-0.07	0.00	-0.03	-0.01	0.00	-0.02	0.01	-0.06	**0.96**
EMOT4	-0.04	0.11	-0.04	-0.01	-0.08	0.02	-0.04	-0.09	-0.07	0.02	-0.04	0.07	-0.03	-0.09	-0.06	0.06	0.05	-0.04	0.03	0.05	-0.04	**0.98**
EMOT5	-0.03	-0.01	-0.08	0.04	0.06	-0.11	0.10	-0.12	0.07	0.08	0.20	0.01	-0.02	0.04	-0.04	0.08	-0.02	0.03	-0.01	0.04	-0.01	**0.76**

Note. Loading on target factors are in bold. A few items were removed due to convergence issues.

ESEM Target Loadings

As seen from Table 5-9, the factor loadings on the target items remained high (> 0.4) with a few exceptions (e.g. PLAN3 on Planning with a low λ of 0.134). Only six of the 110 target loadings were below 0.40. Thus, the ESEM supported the integrity of the factor structure of the measurement instrument with the items loading on the hypothesised factors, which was consistent with the CFA findings.

ESEM Cross-loadings

As expected, the cross-loadings remained low and under 0.40, except for LEAD2 on Persuasion (λ= 0.44), thus confirming the discriminant validity of the constructs and instrument. However, there was a significant number of factors where the non-target loadings were greater than 0.10, which supported the view that ignoring the loading would have caused a positive bias in the CFA model. These results aligned with Marsh et al.'s (2013) argument that the ICM-CFA factor correlations are likely to be positively biased, sometimes substantially unless non-target loadings are close to zero.

Comparison of ESEM Factor Loading vs. CFA Factor Loading

Table 5-10 shows a sample of the factor loadings for the single cluster ESEM vs. factor loadings for the CFA model for comparison of item behaviour using the two approaches**.**

Table 5-10

Sample Factor Loading for Single Cluster ESEM Vs. CFA

Item	CFA	Single cluster ESEM
	EVALUATE	
EVAL2	0.65	**0.36**
EVAL3	0.76	**0.42**
EVAL4	0.82	**0.78**
EVAL5	0.85	**0.64**
DECI1	0	0.01
DECI2	0	-0.07
DECI3	0	0.19
DECI4	0	0.06
	DECISIVE	
EVAL2	0	-0.08
EVAL3	0	-0.06
EVAL4	0	0.02
EVAL5	0	0.11
DECI1	0.68	**0.57**
DECI2	0.77	**0.50**
DECI3	0.86	**0.42**
DECI4	0.71	**0.60**

Note. The loading on the ESEM target factors is in bold.

In both the CFA model and ESEM, the factor loadings on the target items were high. However, the ESEM loadings were comparatively lower. The order of loading (pattern of items from highest to lowest loading) changed for some factors, indicating that the ESEM generated factors had a different influence on the items.

Morin et al. (2016) observed that small cross-loadings should be seen as the influence of a factor on the construct relevant part of the indicator, stemming from the actual interrelationship between psychological constructs, rather than as a result of a weakness of the statistical technique in influencing the calculation of the factor.

ESEM Factor Correlation

Table 5-11 tabulates the factor correlations for the latent factors derived from the ESEM.

Table 5-11

Factor Correlation Matrix for Single Cluster ESEM Generated Factors

	Autonomy	Innovation	Variety	Behavioural flexibility	Attention to Detail	Abstract thinking	Technology Orientation	Planning	Evaluative	Qualitative	Decisiveness	Application	Tenacity	Career Orientation	Persuasiveness	Leadership	Attention Seeking	Group Sociability	Consultation	People Orientation	Reward Seeking	Emotional Control
Autonomy																						
Innovation	0.40																					
Variety	0.38	0.57																				
Behavioural flexibility	0.42	0.36	0.43																			
Attention to Detail	0.34	0.20	0.27	0.27																		
Abstract thinking	0.31	0.41	0.37	0.32	0.24																	
Technology Orientation	0.30	0.34	0.44	0.34	0.26	0.41																
Planning	0.50	0.32	0.31	0.46	0.45	0.35	0.30															
Evaluative	0.37	0.43	0.35	0.39	0.23	0.65	0.37	0.39														
Qualitative	0.29	0.25	0.27	0.31	0.28	0.65	0.42	0.38	0.67													
Decisiveness	0.44	0.58	0.56	0.73	0.26	0.47	0.35	0.62	0.54	0.38												
Application	0.34	0.26	0.32	0.39	0.37	0.24	0.27	0.64	0.26	0.21	0.40											
Tenacity	0.35	0.19	0.25	0.39	0.35	0.18	0.24	0.67	0.20	0.20	0.34	0.87										
Career Orientation	0.40	0.36	0.35	0.37	0.30	0.25	0.32	0.45	0.32	0.27	0.37	0.46	0.36									
Persuasiveness	0.42	0.53	0.40	0.52	0.30	0.52	0.31	0.56	0.75	0.44	0.75	0.40	0.28	0.37								
Leadership	0.40	0.40	0.47	0.54	0.32	0.37	0.29	0.60	0.39	0.36	0.85	0.46	0.31	0.49	0.76							
Attention Seeking	0.16	0.21	0.25	0.19	0.18	0.19	0.17	0.17	0.18	0.24	0.28	0.13	0.10	0.19	0.31	0.29						
Group Sociability	0.18	0.19	0.22	0.32	0.17	0.15	0.19	0.20	0.17	0.18	0.22	0.20	0.21	0.22	0.30	0.26	0.16					
Consultation	0.36	0.29	0.34	0.50	0.29	0.28	0.27	0.37	0.38	0.21	0.34	0.39	0.37	0.42	0.43	0.37	0.14	0.34				

People Orientation	0.29	0.30	0.32	0.30	0.21	0.29	0.21	0.27	0.39	0.19	0.32	0.21	0.15	0.23	0.40	0.24	0.14	0.18	0.28		
Reward Seeking	0.18	0.16	0.17	0.18	0.14	0.14	0.17	0.18	0.14	0.18	0.15	0.20	0.19	0.27	0.28	0.22	0.37	0.20	0.24	0.14	
Emotional Control	0.24	0.24	0.25	0.55	0.24	0.24	0.23	0.31	0.29	0.27	0.52	0.35	0.31	0.23	0.34	0.35	0.11	0.24	0.26	0.20	0.10

Note. Diagonals are not shown as they are one.

As predicted by the simulation studies (Asparouhov & Muthén, 2009), the above factor correlations for ESEM models were smaller than the corresponding factor correlations for the multifactor congeneric model.

Section Conclusion

As hypothesised, the ESEM models fitted the data substantially better than the CFA model with key indices showing good improvement, changing from an acceptable to excellent fit. The cross-loadings on the non-target factors remained low, confirming the validity of the overall instrument. The significant improvement in the model fit data confirmed Marsh et al.'s (2009) observation that indicators are rarely, if ever, entirely and uniquely related to a single construct. The factor structure remained mostly the same with only a limited number of items displaying high cross-loadings to non-target factors. Overall, the values for the factor loadings were smaller in the ESEM. The correlations among the resulting latent factors were also smaller, indicating that there was better discriminant validity in the factor scores generated by the ESEM.

An implicit objective of Study 1 was to establish the latent factor scores to be used for subsequent analysis in Study 2 and Study 3. Therefore, parsimony was of less importance and could be sacrificed to obtain the factors that reflected the true values and reduced the bias of the restrictive CFA model. Thus, the ESEM provided a better outcome and the factor scores generated by the ESEM will be used for further analysis.

5.3 Investigation of the A-Priori Second-Order Factor Structure

Many psychological constructs are conceived to be hierarchically structured. While some constructs are ordered hierarchically to facilitate understanding and promote analytical efficiency, others represent both psychological and neurological reality (Cohen, 2000). The different aspects of the hierarchical proposition have been studied using a range of approaches including single-factor, hierarchical and bifactor models (Brunner et al., 2012). In the hierarchical approach, interrelationships between the constructs are modelled to manifest as hierarchically organised constructs where the first-order factors mediate between observed items and the higher-order factor. In the bifactor approach, global factors are modelled with a direct influence on the observed items.

This section documents the extent to which the EdMAP instrument and the Hong Kong teacher population supported the psychological reality of a hierarchical structure by

examining its alignment to the a-priori second-order factor structure that was identified when the EMAP instrument was first administered to middle management (Marsh et al., 1996) (Table 5-11).

Table 5-12

Research Question for the Second-Order Factor Structure of the EdMAP Instrument

Number	Research Question
S1-RQ-3: Second-Order Factor Structure	Does the Hong Kong teacher data provide evidence for the existence of a second-order factor structure that closely reflects the factor structure hypothesised in Table 3-1 in Chapter 3?

In keeping with the objectives of increasing parsimony and minimising the contamination by conceptualised non-related items, the following individually examines each a-priori higher-order factor and its hypothesised first-order factors.

Methodology

Following the approach presented in Morin et al. (2016), the global construct was examined for its manifestation as a hierarchical structure and alternatively as a less parsimonious bifactor structure. Additionally, both the CFA model and ESEM model were evaluated. Figure 4-2 presented a pictorial representation of these model sets.

The abbreviations in Table 5-13 are used in the following discussion.

Table 5-13

Abbreviations Used in Describing the Hierarchical Models

Model	Confirmatory Factor Analysis (Congeneric)	Exploratory Structural Equation Models
First-order	CFA	ESEM
Hierarchical	Hierarchical-CFA	Hierarchical-ESEM
Bifactor	Bifactor-CFA	Bifactor-ESEM

Bentler (1990) defined two models as nested when the parameters estimated in the restrictive model are a subset of the parameters estimated in the less restrictive model. Because the parameters estimated in hierarchical models (hierarchical-CFA and hierarchical-ESEM) are primarily a subset of the parameters estimated for first-order models (CFA and ESEM), hierarchical models can be considered as nested models. Marsh (1994) when investigating factorial invariance proposed using the change in the Tucker-Lewis index (TLI) as a means of comparing the model fit. While Cheung and Rensvold (2001) proposed that a

decrease of fit of less than 0.01 for a more parsimonious nested model supports the parsimonious model, Marsh (2007) found that some indices (e.g. TLI and RMSEA) incorporate a parsimony penalty. Thus, the more parsimonious model would be supported if the fit index was as good or better.

For instruments with over three factors, the MPLUS basic hierarchical model will have less estimated parameters than the corresponding first-order model. In contrast, the bifactor model will have more estimated parameters (Muthén & Muthén, 2012). Comparing goodness of fit must consider the resulting parsimony.

The WLSMV estimation method was used.

5.3.1 Global-Leadership

Table 5-14 summarises the goodness of fit indicators for the *global-leadership* factor consisting of the first-order factors of evaluation, decisiveness, persuasion, leadership and emotional control.

Table 5-14

Goodness of Fit for Global-Leadership

Global-Leadership	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	183	3543	265	0.932	0.923	0.11
Hierarchical Confirmatory Factor Analysis	178	3901	270	0.925	0.917	0.12
Bifactor Confirmatory Factor Analysis	198	3163	250	0.940	0.928	0.11
ESEM	263	1172	185	0.980	0.967	0.07
Hierarchical-ESEM	257	1493	191	0.973	0.958	0.08
Bifactor-ESEM	283	853	165	0.986	0.974	0.06

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–root mean square error of approximation.

Congeneric Models

The bifactor-CFA (CFI = 0.940, TLI = 0.928) provided better fit indices than that of CFA (CFI = 0.932, TLI = 0.923) and the hierarchical-CFA (CFI = 0.925, TLI = 0.917), supporting the bifactor model of global-leadership. The chi-square indicator for the bifactor-CFA ($\chi 2$ = 3163, df = 250) was better than that for CFA ($\chi 2$ = 3543, df = 265).

ESEM

The ESEM set of models provided a significantly improved fit over the congeneric models. The bifactor-ESEM (CFI = 0.986, TLI = 0.974) provided a better fit compared to ESEM (CFI = 0.980, TLI = 0.967) and hierarchical-ESEM (CFI = 0.973, TLI = 0.958), supporting the bifactor model of global-leadership. The chi-square indicator for the bifactor-ESEM ($\chi 2$ = 853, df = 165) was better than the value for ESEM ($\chi 2$ = 1172, df = 185).

Hierarchical vs. Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was -0.007/-0.006 and the hierarchical-ESEM vs. ESEM was -0.007/-0.009 indicating that the hierarchical model was no worse than the first-order model. The ΔCFI/ΔTLI for the bifactor-CFA vs. CFA was 0.008/0.005 and the ΔCFI/ΔTLI for bifactor-ESEM vs. ESEM was 0.006/0.007, which supported the bifactor model of global-leadership as being marginally better.

The parsimony adjusted TLI (Marsh & Balla, 1994) shows a relatively smaller change in model fit for the models with more parameters. Thus, the above interpretation and conclusion must be treated with caution considering the observation that "estimation penalties for some indexes monotonically decreases with sample size and monotonically increases with the complexity of nested models" (Marsh et al., 2009, p. 4).

Standardised Factor Loadings

Table 5-15 presents the standardised factor loadings for global-leadership.

Table 5-15

Standardised Factor Loading for Global-Leadership

Item	Global-Leadership	Evaluation	Decisiveness	Persuasion	Leadership	Emotional Control
EVAL2	0.64	**0.08**	-0.01	-0.07	-0.15	-0.10
EVAL3	0.75	**0.04**	-0.12	-0.11	-0.06	-0.07
EVAL4	0.71	**0.63**	0.02	0.10	-0.00	0.02
EVAL5	0.73	**0.40**	0.06	-0.01	-0.07	0.02
DEIC1	0.59	-0.02	**0.47**	0.08	0.06	-0.05
DECI2	0.66	-0.05	**0.41**	0.01	0.02	0.11
DECI3	0.78	0.11	**0.33**	-0.06	0.04	0.04
DECI4	0.64	0.06	**0.52**	-0.10	-0.02	0.01
PERS1	0.71	-0.01	-0.01	**0.28**	0.01	0.00
PERS2	0.76	0.06	0.04	**0.30**	0.12	-0.06
PERS3	0.82	-0.04	0.01	**0.17**	-0.05	-0.03
PERS4	0.80	-0.06	-0.06	**0.10**	0.02	0.05

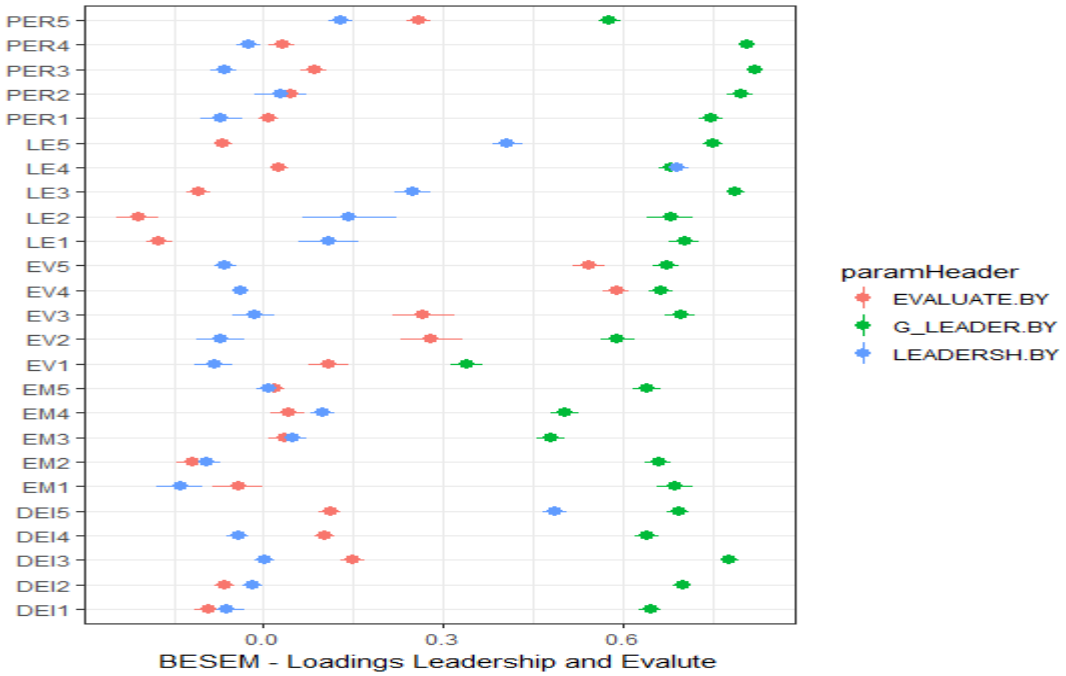
PERS5	0.60	0.2	-0.19	**0.05**	0.13	0.04
LEAD1	0.65	-0.13	0.02	0.18	**0.21**	0.06
LEAD2	0.58	-0.04	0.07	0.43	**0.31**	-0.03
LEAD3	0.74	-0.06	0.00	0.014	**0.36**	0.01
LEAD4	0.67	0.05	-0.03	-0.18	**0.58**	-0.01
LEAD5	0.72	-0.02	0.04	-0.15	**0.54**	-0.02
EMOT2	0.61	-0.06	0.14	0.02	-0.03	**0.43**
EMOT3	0.48	0.02	-0.09	0.04	-0.01	**0.81**
EMOT4	0.51	0.02	-0.04	-0.01	0.02	**0.79**
EMOT5	0.63	0.01	0.12	-0.09	-0.01	**0.56**

Note. The target loadings are in bold. The STDXY of the MPLUS output was used for the standardised factor loadings for the bifactor-ESEM.

Figure 5-1 presents the comparative factor loadings for easy comparison.

Figure 5-1

Factor Loadings for Global-Leadership



Note. The global-leadership factor is in green. For clarity, only two of the first-order factors are shown. BESEM = bifactor-ESEM.

Global-leadership was well-defined by the presence of strong and significant loading between 0.487 and 0.826. The items LEAD1–LEAD5 had the second-highest loading on their target factor of leadership, and EVAL2, EVAL4 and EVAL5 had the second-highest loadings on their target factor of evaluation, indicating that the first-order factors maintained a stronger

influence on the items compared to the non-target factors. The integrity of the underlying psychological construct (first-order factor) was supported. Except for a few rogue items, the maximum non-global loading was on the target factor. PERS5, which is an exception, had a 0.602 loading on the global-leadership, a loading of 0.2 on the non-target factor evaluation and a lower loading of 0.056 on its target factor, i.e. persuasion. Such rogue items can be considered as examples of Morin and Maïano's (2011) assertion that ESEM may reveal a few unexpected results and helps reveal sources of misfit in psychometric measures that would otherwise remain hidden in CFA.

Factor Correlation

Table 5-16 shows the correlation among the latent factors.

Table 5-16

Factor Correlations for Global-Leadership

	Global-Leadership	Evaluate	Decisiveness	Persuasion	Leadership
Global-Leadership					
Evaluate	0				
Decisiveness	0	-0.06			
Persuasion	0	-0.11	-0.03		
Leadership	0	0.06	0.07	0.08	
Emotional Control	0	0.06	0.29	-0.01	0.04

Note. The correlations are from the bifactor-ESEM.

As expected, the introduction of a global factor led to a reduction in the correlation among the first-order factors.

Conclusion

The fit indices for the bifactor-ESEM (CFI = 0.986, TLI = 0.974) showed an excellent fit (CFI/TLI > 0.95) and was marginally better than the first-order ESEM. The substantial factor loadings on global-leadership further supported the bifactor-ESEM. The comparatively lower loadings on persuasion, when evaluated in the second-order model, suggested that it may be appropriate to reconsider the inclusion of persuasion as a first-order factor related to the global-leadership construct. Overall, the bifactor model of global-leadership consisting of

evaluation, decisiveness, leadership and emotional control was well supported by the goodness of fit indicators and loading patterns.

From a parsimony perspective, the bifactor and hierarchical models represent the two extremes of introducing a second-order factor, with the hierarchical model being the most parsimonious. Therefore, fit indices that account for parsimony can favour models differently to those that do not.

5.3.2 Global-Application

Table 5-17 summarises the goodness of fit indicators for *global-application* consisting of attention to detail, planning, application and tenacity.

Table 5-17

Goodness of Fit for Global-Application

Global-Application	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	142	1630	164	0.950	0.942	0.10
Hierarchical Confirmatory Factor Analysis	140	1625	166	0.950	0.942	0.10
Bifactor Confirmatory Factor Analysis	156	1370	150	0.958	0.947	0.10
ESEM	190	637	116	0.982	0.971	0.07
Hierarchical-ESEM	187	635	119	0.982	0.971	0.07
Bifactor-ESEM	206	447	100	0.988	0.977	0.06

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

The congeneric models are shown for comparison. However, only the ESEM set of models that provided a better solution are discussed in detail below**.**

ESEM

The ESEM set of models provided a superior fit to the more parsimonious congeneric models with ΔCFI/ΔTLI of over 0.03. The bifactor-ESEM (CFI = 0.988, TLI = 0.977) provided the best fit whereas the ESEM (CFI = 0.982, TLI = 0.972) and hierarchical-ESEM (CFI = 0.982, TLI = 0.972) also showed an excellent fit. The chi-square indicator for the bifactor-ESEM ($\chi 2 = 447$, df = 100) was better than the value for ESEM ($\chi 2 = 637$, df = 116).

Hierarchical vs. Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was -0.010/-0.014 and the hierarchical-ESEM vs. ESEM was -0.000/-0.001, indicating that the hierarchical model was not better than the first-order model. The ΔCFI/ΔTLI for the bifactor-CFA vs. CFA was 0.008/0.005 and the bifactor-ESEM vs. ESEM was 0.006/0.006, showing a marginal improvement and support for the bifactor model.

Standardised Factor Loading

Table 5-18 presents the standardised factor loading for global-application.

Table 5-18

Standardised Factor Loading for Global-Application

Items	Global-Application	Planning	Application	Tenacity	Attention to Detail
PLAN1	0.50	**0.49**	0.07	-0.08	0.08
PLAN2	0.72	**0.26**	-0.19	-0.03	0.00
PLAN3	0.52	**0.27**	0.09	-0.03	0.05
PLAN5	0.75	**0.37**	0.02	0.03	-0.01
APPL2	0.76	-0.06	**0.28**	-0.07	-0.02
APPL3	0.55	-0.08	**0.27**	-0.01	0.12
APPL4	0.73	0.06	**0.32**	0.05	-0.01
APPL5	0.53	0.07	**0.54**	-0.01	-0.02
TENA1	0.73	0.11	-0.11	**-0.15**	-0.08
TENA2	0.84	-0.07	0.05	**-0.01**	-0.03
TENA3	0.89	-0.02	0.16	**-0.01**	-0.03
TENA4	0.69	-0.06	-0.04	**0.32**	0.10
TENA5	0.8	-0.01	-0.07	**0.20**	-0.06
DETA1	0.46	0.01	-0.08	-0.08	**0.71**
DETA2	0.59	0.13	0.02	0.24	**0.43**
DETA3	0.59	-0.11	0.01	-0.15	**0.73**
DETA4	0.54	0.06	0.04	0.13	**0.56**
DETA5	0.46	0.04	0.02	0.018	**0.66**

Note. The target loadings are in bold. The STDXY of the MPLUS output was used as the standardised factor loadings for the bifactor-ESEM.

The bifactor-ESEM showed that the global-application was well-defined by the presence of strong and substantial loadings with |λ| between 0.46 and 0.89. Planning, application and attention to detail maintained reasonable individual loadings. The comparatively high loading of the indicator items for tenacity (TENA1–TENA5) on global-application coupled with low

loading on the target first-order factor indicated that tenacity was indistinguishable from the second-order factor of global-application.

Latent Factor Correlation

Table 5-19 shows the correlation among the latent factors.

Table 5-19

Factor Correlations for Global-Application

	Global-application	Planning	Application	Tenacity
Global-Application				
Planning	0			
Application	0	0.08		
Tenacity	0	0.20	0.01	
Attention to Detail	0	0.38	0.24	0.19

Note. The correlations are from the bifactor-ESEM.

The introduction of the global-application recalibrated the factors to reduce the correlation among the latent factors.

Conclusion

The hierarchical-ESEM, congeneric bifactor and bifactor-ESEM bifactor showed excellent fit. The ΔCFI/ΔTLI of 0.006/0.005 between the hierarchical-ESEM and bifactor-ESEM indicated that both models were similar and there was no strong support for the less parsimonious bifactor model. Global-application defined by the first-order factors of attention to detail, planning, application and tenacity was well supported. However, with small differences in fit indices, the comparison between the hierarchical and bifactor models was inconclusive.

5.3.3 Global-Interpersonal

Table 5-20 summarises the goodness of fit indicators for g*lobal-interpersonal*, consisting of people orientation, consultation, group sociability and behavioural flexibility.

Table 5-20

Goodness of Fit for Global-Interpersonal

Global- Interpersonal	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	136	1533	164	0.947	0.938	0.10
Hierarchical Confirmatory Factor Analysis	134	1443	166	0.950	0.943	0.09
Bifactor Confirmatory Factor Analysis	150	732	150	0.977	0.971	0.07
ESEM	184	795	116	0.974	0.957	0.08
Hierarchical-ESEM	182	732	118	0.976	0.961	0.08
Bifactor-ESEM	200	457	100	0.986	0.974	0.06

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

The congeneric models are shown for comparison. However, only the ESEMs that provided a better solution are discussed in detail below

ESEM

The ESEM set of models provided a significantly improved fit over the congeneric models. The bifactor-ESEM had an excellent fit (CFI = 0.986, TLI = 0.974) and the hierarchical-ESEM (CFI = 0.976, TLI = 0.961) provided a better fit over ESEM (CFI = 0.974, TLI = 0.957). The chi-square indicator for the bifactor-ESEM ($\chi 2 = 457$, df = 100) was better than the value for ESEM ($\chi 2 = 795$, df = 116).

Hierarchical vs. Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was 0.003/0.005 and the hierarchical-ESEM vs. ESEM was -0.002/0.004, indicating better goodness of fit for the hierarchical model over the first-order model. The ΔCFI/ΔTLI for the bifactor-CFA vs. CFA was 0.030/0.035 and bifactor-ESEM vs. ESEM was 0.012/0.017. The better fit of the bifactor models over the first-order and hierarchical models provided strong support for the bifactor model.

Factor Loading

Table 5-21 presents the standardised factor loadings for the global-interpersonal factor.

Table 5-21

Factor Loadings for Global-Interpersonal

Items	Global-Interpersonal	Behavioural Flexibility	Group Sociability	Consultation	People Orientation
BEHA1	0.66	**0.27**	-0.05	0.09	0.10
BEHA2	0.74	**0.24**	0.02	-0.04	-0.08
BEHA3	0.53	**0.53**	0.02	0.02	-0.05
BEHA4	0.66	**0.50**	0.05	-0.03	-0.03
BEHA5	0.59	**0.59**	-0.01	0.03	0.05
GROU1	0.51	0.10	**0.16**	-0.06	-0.02
GROU2	0.51	-0.06	**0.37**	-0.01	0.01
GROU3	0.54	0.03	**0.66**	0.01	0.03
GROU4	0.52	-0.01	**0.77**	0.01	-0.05
GROU5	0.60	0.03	**0.25**	0.02	0.13
CONS1	0.58	-0.12	-0.07	**0.48**	-0.11
CONS2	0.58	-0.03	-0.03	**0.44**	-0.01
CONS3	0.37	-0.03	-0.04	**0.48**	0.02
CONS4	0.48	0.06	0.05	**0.70**	0.01
CONS5	0.71	0.09	0.05	**0.82**	0.04
PEOP1	0.66	0.04	-0.15	0.01	**0.60**
PEOP2	0.69	-0.11	0.12	0.08	**0.48**
PEOP3	0.56	0.12	0.01	-0.10	**0.46**
PEOP4	0.49	0.02	0.01	-0.01	**0.65**
PEOP5	0.46	-0.07	0.04	-0.02	**0.72**

Note. The target loadings are in bold. The STDXY of the MPLUS output was used as the standardised factor loadings for the bifactor-ESEM.

The global-interpersonal was well-defined by strong and substantial loading with $|\lambda|$ between 0.37 and 0.70. For all the items, the highest non-global loading was on the target loading. The comparative loadings between the first-order factors and the loadings on the global-interpersonal followed a different pattern to the two previous global factors. In general, the loading on the target factor was closer to the loading on the global factor and some loadings were stronger on the first-order factor (e.g. PEOP5 = 0.46 vs. 0.72, CONS5 = 0.71 vs. 0.82), indicating the dominance of the first-order factor over the global factor.

Latent Factor Correlation

Table 5-22 shows the correlation among the latent factors.

Table 5-22

Factor Correlations for Global-Interpersonal

	Global-Interpersonal	Behavioural Flexibility	Consultation	People Orientation
Global-Interpersonal				
Behavioural Flexibility	0			
Consultation	0	0.035		
People Orientation	0	0.043	0.034	
Group Sociability	0	0.035	0.033	0.034

Note. The correlations are from the bifactor-ESEM.

The introduction of the global-interpersonal recalibrated the factors to reduce the correlation among the latent factors.

Conclusion

The fit indices for the hierarchical-ESEM and bifactor-ESEM showed an excellent fit (CFI/TLI > 0.95), lending support for the existence of a global-interpersonal factor defined by the chosen first-order factors. The substantial factor loadings on global-interpersonal further confirmed the global factor. However, unlike global-leadership and global-application, the first-order factors for global-interpersonal maintained high loadings on most items. The bifactor model of global-interpersonal consisting of behavioural flexibility, consultation, people orientation and group sociability was well supported by the goodness of fit indicators and factor loadings.

5.3.4 Global-Goal Orientation

Table 5-23 summarises the goodness of fit indicators for *global-goal orientation* consisting of attention seeking, career orientation and rewards.

Table 5-23

Goodness of Fit for Global-Goal Orientation

Global-Goal Orientation	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	108	1221	87	0.947	0.936	0.12
Hierarchical Confirmatory Factor Analysis	108	1221	87	0.947	0.936	0.12
Bifactor Confirmatory Factor Analysis	120	786	75	0.966	0.953	0.10
ESEM	132	526	63	0.978	0.964	0.09
Hierarchical-ESEM	132	526	63	0.978	0.964	0.09
Bifactor-ESEM	144	265	51	0.990	0.979	0.07

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

The congeneric models are shown for comparison. However, only the ESEM set of models that provided a better solution are discussed in detail below.

ESEM

The ESEM set of models provided a significantly improved fit over the congeneric models. The bifactor-ESEM (CFI = 0.990, TLI = 0.979) provided a better fit over ESEM (CFI = 0.978, TLI = 0.964) and the hierarchical-ESEM (CFI = 0.978, TLI = 0.964). The chi-square indicator for the bifactor-ESEM ($\chi 2 = 265$, df = 61) was better than the value for ESEM ($\chi 2 = 526$, df = 63).

Hierarchical vs. Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was -0.010/0.00 and the hierarchical-ESEM vs. ESEM was -0.002/0.00 indicating that the hierarchical model was not better than the first-order model. However, both bifactor-CFA and bifactor-ESEM provide excellent fit indicating an improvement of ΔCFI/ΔTLI of 0.019/0.017 and 0.012/0.015, respectively, over the corresponding hierarchical models, showing strong support for the bifactor model for global-goal orientation.

Standardised Factor Loading

Table 5-24 presents the standardised factor loading for global-goal orientation.

Table 5-24

Factor Loading for Global-Goal Orientation

	Global-Goal Orientation	Career Orientation	Attention Seeking	Recognition
CARE1	0.56	**0.69**	0.02	0.01
CARE2	0.55	**0.46**	0.09	-0.06
CARE3	0.54	**0.66**	0.05	0.05
CARE4	0.62	**0.56**	-0.07	-0.05
CARE5	0.47	**0.67**	0.05	0.06
ATTE2	0.62	-0.02	**0.49**	-0.04
ATTE3	0.56	-0.09	**0.74**	-0.05
ATTE4	0.29	0.17	**0.65**	0.10
ATTE5	0.37	0.08	**0.70**	0.09
REWA1	0.67	0.07	0.18	**0.40**
REWA2	0.69	-0.01	-0.28	**0.19**
REWA4	0.61	0.03	0.13	**0.57**
REWA5	0.84	-0.08	-0.10	**0.26**

Note. The target loadings are in bold. The STDXY of the MPLUS output was used as the standardised factor loadings for the bifactor-ESEM.

Global-goal orientation was well-defined by the presence of strong and significant loadings with $|\lambda|$ between 0.29 and 0.84. Except for a few items, the target factors maintained high loadings. All the maximum non-global loadings were on the target factor.

Unlike the global-leadership, where the global factor had higher factor loadings than the individual factors for all items, global-goal orientation had a mix, with some items loading more to the global factor, while others loaded more to the first-order factor (e.g. CARE1, ATTE1) indicating that the strong influence of the first-order factors was maintained.

Conclusion

The fit indices did not support that the hierarchical model had a better fit for the data. The bifactor-CFA and bifactor-ESEM showed excellent fit and the substantial factor loadings on global-goal orientation confirmed this result. Therefore, the data supported the bifactor model of global-goal orientation, consisting of the first-order factors of attention seeking, career orientation and rewards orientation.

5.3.5 Global-Abstract Thinking

Table 5-25 summarises the goodness of fit indicators for g*lobal-abstract thinking* consisting of abstract thinking, technical orientation and quantitative.

Table 5-25

Goodness of Fit for Global-Abstract Thinking

Global-Abstract Thinking	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	106	1047	87	0.968	0.961	0.11
Hierarchical Confirmatory Factor Analysis	106	1047	87	0.968	0.961	0.11
Bifactor Confirmatory Factor Analysis	118	506	75	0.985	0.980	0.08
ESEM	130	525	63	0.984	0.974	0.09
Hierarchical-ESEM	130	525	63	0.984	0.974	0.09
Bifactor-ESEM	142	253	51	0.993	0.986	0.07

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

The congeneric models are shown for comparison. However, only the ESEM set of models that provided a better solution are discussed in detail below.

ESEM

The ESEM set of models provided a significantly improved fit over the congeneric models. The bifactor-ESEM model (CFI = 0.993, TLI = 0.986) provided a better fit over the ESEM (CFI = 0.984, TLI = 0.974) and the hierarchical-ESEM (CFI = 0.984, TLI = 0.974). The chi-square indicator for the bifactor-ESEM ($\chi 2 = 253$, df = 51) was better than the value for ESEM ($\chi 2 = 525$, df = 63).

Hierarchical and Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was -0.00/0.00 and the hierarchical-ESEM vs. ESEM was 0.00/0.00, indicating that the hierarchical model was not better than the first-order model. The bifactor-CFA and bifactor-ESEM showed improvement with ΔCFI/ΔTLI of 0.017/0.029 and 0.009/0.012, respectively, over the corresponding hierarchical models. The bifactor-ESEM model provided the best fit (CFI = 0.993, TLI = 0.986), indicating an excellent fit with strong support for the bifactor model.

Standardised Factor Loading

Table 5-26 presents the standardised factor loadings for global-abstract thinking.

Table 5-26

Factor Loading for Global-Abstract Thinking

	Global-Abstract Thinking	Abstract Thinking	Technical Orientation	Quantitative
ABST1	0.49	**0.47**	0.09	0.01
ABST2	0.61	**0.39**	-0.02	0.01
ABST3	0.78	**0.48**	-0.05	-0.07
ABST4	0.79	**0.42**	0.01	-0.06
ABST5	0.47	**0.48**	-0.01	0.11
TECH1	0.55	-0.05	**0.65**	-0.10
TECH2	0.53	0.08	**0.52**	0.11
TECH3	0.58	0.06	**0.59**	-0.14
TECH4	0.57	-0.08	**0.63**	0.04
TECH5	0.61	0.02	**0.42**	0.15
QUAN1	0.77	0.02	-0.06	**0.23**
QUAN2	0.86	-0.09	0.00	**0.14**
QUAN3	0.65	0.01	0.03	**0.62**
QUAN4	0.71	0.03	0.07	**0.25**
QUAN5	0.72	0.01	-0.02	**0.61**

Note. The target loadings are in bold. The STDXY of the MPLUS output was used as the standardised factor loadings for the bifactor-ESEM.

All items load into the global factor, with $|\lambda|$ ranging from 0.47 to 0.86, showed a strong influence on the items. All items had their highest non-global loading on the target factors. Even though QUAN1 and QUAN4 had smaller loadings of 0.23 and 0.25, respectively, on the target factors, each factor had three or more strong loadings to the items targeting the factor.

Conclusion

The fit indices did not support that the hierarchical model had a better fit for the data. The bifactor-CFA and bifactor-ESEM with excellent fit was strong evidence for a bifactor model. The substantial factor loading on global-abstract thinking further confirmed this result. Therefore, the bifactor model of global-abstract thinking consisting of abstract thinking, technical orientation and quantitative was well supported.

5.3.6 Global-Variety

Table 5-27 summarises the goodness of fit indicators for g*lobal-variety* consisting of autonomy, innovation and variety.

Table 5-27

Goodness of Fit for Global-Variety

Global-Variety	Parameters	ChiSqM Value	ChiSqM DF	CFI	TLI	RMSEA Estimate
Confirmatory Factor Analysis	141	2833	164	0.886	0.868	0.14
Hierarchical Confirmatory Factor Analysis	139	2999	166	0.879	0.861	0.14
Bifactor Confirmatory Factor Analysis	155	2193	150	0.913	0.889	0.12
ESEM	189	833	116	0.969	0.950	0.08
Hierarchical-ESEM	187	854	118	0.968	0.949	0.08
Bifactor-ESEM	205	608	100	0.978	0.959	0.08

Note. CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

The congeneric models are shown for comparison. However, only the ESEM set of models that provided a better solution are discussed in detail below.

ESEM

The ESEM set of models provided a significantly improved fit over the congeneric models. The bifactor-ESEM with excellent fit (CFI = 0.978, TLI = 0.959) was better than the ESEM (CFI = 0.969, TLI = 0.95) and hierarchical-ESEM (CFI = 0.968, TLI = 0.949). The chi-square indicator for the bifactor-ESEM ($\chi 2 = 608$, df = 100) was better than the value for ESEM ($\chi 2 = 883$, df = 116).

Hierarchical and Bifactor Models

The ΔCFI/ΔTLI for the hierarchical-CFA vs. CFA was -0.007/-0.005 and the hierarchical-ESEM vs. ESEM was -0.001/-0.001 indicating that the hierarchical model was not better than the first-order model. The bifactor-CFA and bifactor-ESEM showed improvement in ΔCFI/ΔTLI of 0.034/0.018 and 0.010/0.010, respectively, over the corresponding hierarchical models, and thus indicated support for the bifactor model.

Additional details for global-variety is not shown here as it followed a similar pattern to global-goal orientation.

Conclusion

The fit indices did not support that the hierarchical model had a better fit for the data. The bifactor-CFA and bifactor-ESEM with excellent fit was strong evidence for a bifactor model. The substantial factor loadings on global-variety further confirmed this result. Therefore, the bifactor model of global-variety consisting of autonomy, innovation and variety was supported.

5.3.7 Summary for the Investigation of the A-Priori Second-Order Factors

Table 5-28 summarises the CFI/TLI values for the global factors examined in this section.

Table 5-28

Summary of CFI/TLI for all Global Factors

	Bifactor-CFA	Bifactor-ESEM	CFA	ESEM	Hierarchical-CFA	Hierarchical-ESEM
CFI						
Global-Leadership	0.940	0.986	0.932	0.980	0.925	0.973
Global-Goal Orientation	0.966	0.990	0.947	0.978	0.947	0.978
Global-Application	0.950	0.988	0.950	0.982	0.950	0.982
Global-Variety	0.913	0.978	0.886	0.969	0.879	0.968
Global-Abstract Thinking	0.985	0.993	0.968	0.984	0.968	0.984
Global-Interpersonal	0.977	0.986	0.947	0.974	0.950	0.976
TLI						
Global-Leadership	0.928	0.974	0.923	0.967	0.917	0.958
Global-Goal Orientation	0.953	0.979	0.936	0.964	0.936	0.964
Global-Application	0.942	0.977	0.942	0.971	0.942	0.971
Global-Variety	0.889	0.959	0.868	0.950	0.861	0.949
Global-Abstract Thinking	0.980	0.986	0.961	0.974	0.961	0.974
Global-Interpersonal	0.971	0.974	0.938	0.957	0.943	0.961

Note. The above is a summary of Tables 5-1 to 5-6. CFI–Comparative fit index, TLI–Tucker-Lewis index, RMSEA–Root mean square error of approximation. CFA- Confirmatory factor analysis, ESEM–Exploratory structural equation model.

For all the global factors, the ESEM models with CFI/TLI values greater than 0.95 indicated an excellent fit. Except for global-variety, CFA indicated an acceptable to excellent fit with a CFI/TLI greater than 0.90. Similarly, the bifactor-CFA and bifactor-ESEM

indicated an excellent fit except for global-variety. Thus, when considered individually, each set of factors except global-variety strongly supported the existence of the corresponding global factor. The ESEM set of models showed a better fit than the restrictive and parsimonious CFA models. The bifactor models that allowed the global factors to load directly into the items (compared to the hierarchical models where the first-order factor mediated the interaction) offered a better fit.

Table 5-29 summarises the change in model fit when the global factor was introduced.

Table 5-29

Summary of Change in Goodness of Fit by Introducing the Global Factor

Global factor	First-order factors	ΔCFI/ΔTLI for ESEM vs. Hierarchical-ESEM	ΔCFI/ΔTLI for ESEM vs. Bifactor-ESEM	ΔCFI/ΔTLI for CFA vs. Hierarchical-CFA	ΔCFI/ΔTLI for CFA vs. Bifactor-CFA
Global-Leadership	Evaluation, Decisiveness, Persuasion, Leadership, Emotional Control	-0.007/ -0.009	0.006/0.007	-0.007/0.006	0.008/0.005
Global GoalOrientation	Attention Seeking, Career Orientation, Rewards	0.00/0.00	0.012/0.015	0.00/0.00	0.019/0.017
Global-Interpersonal	People Orientation, Consultation, Group Sociability, Behavioural Flexibility	0.002/0.004	0.012/0.017	0.00/0.00	0.030/0.033
Global-Application	Attention to Detail Planning, Application, Tenacity	0.00/0.00	0.006/0.006	0.00/0.00	0.022/0.017
Global-Abstract Thinking	Abstract Thinking, Technical Orientation, Quantitative	0.00/0.00	0.009/0.012	0.00/0.00	0.017/0.019
Global-Variety	Autonomy, Innovation Variety	-0.001/-0.001	0.009/0.009	-.007/0.005	0.027/0.021

Note. ΔCFI–Change in comparative fit index, ΔTLI–Change in Tucker-Lewis index, CFA–Confirmatory factor analysis, ESEM–Exploratory structural equation model

The research question S1-RQ-3 queried the support for second-order factors. The results provided support for a second-order factor structure for the teachers that closely followed the second-order factor structure obtained when the instrument was administered to middle management (Marsh, 1993). The teacher population had a similar second-order factor

structure to that of managers. In the past, there has been debate on whether teaching is a form of labour, a type of craft or an artistic endeavour (Rowan, 1994). This finding adds insight that at the individual EdMAP attribute level teachers are akin to middle managers.

5.4 Measurement Invariance of the EdMAP Attributes

The previous sections established the validity of the EdMAP instrument and investigated a second-order factor structure. This section examines the measurement invariance to determine the generalisability of the instrument.

Human behaviour is a result of nature and nurture, reinforced by past experiences and guided by expected valency of rewards. Therefore, as discussed in Chapter 3, context variables such as gender, age and grades taught can lead to differences in teacher behaviour manifesting as differences in the measurement model. As a consequence, Marsh et al. (2009) recommended that measurement invariance of instruments must be established before they are used.

Table 5-30 lists the research questions examined for establishing measurement invariance of the EdMAP instrument.

Table 5-30

Summary of Research Questions for Invariance of Measurement Model

Number	Research Questions
S1-RQ-3 Gender Invariance	Is the measurement model invariant across gender?
S1-RQ-4 Age Invariance	Is the measurement model invariant across age groups?
S1-RQ-5 Grade Taught Invariance	Is the measurement model invariant across primary and secondary teachers?

The EdMAP instrument consists of 23 factors with 115 items. Analysing the complete instrument as one consolidated instrument may hide variations or confound constructs that need to be kept separate in relation to theory or specific research questions (Marsh et al., 2009). Thus, the factors are grouped based on the a-priori second-order factors identified in the previous section (listed in Table 5-31) and analysed for invariance.

Table 5-31

Hypothesised A-Priori Global Factors

Global Factor	First-order factors
Global-Leadership	Evaluation, Decisiveness, Persuasion, Leadership and Emotional Control
Global-Goal Orientation	Attention Seeking, Career Orientation, Recognition and Rewards
Global-Interpersonal	People Orientation, Consultation, Group Sociability and Behavioural Flexibility
Global-Application	Attention to Detail, Planning, Application and Tenacity
Global-Abstract Thinking	Abstract Thinking, Technical orientation and Quantitative/Logical
Global-Variety	Autonomy, Innovation and Variety

Note. Extracted from Marsh (1991).

The global-variety set of factors is not presented, as there were issues with model convergence.

5.4.1 Methodology

The following framework of increasingly restrictive models (Marsh et al., 2014) was used to investigate measurement invariance. To be consistent with the previous analysis, the Estimator = WLSMV was used.

Table 5-32

Invariance Models and Naming Convention

Model	Parameters constrained to be invariant
M1	Configural Invariance: This implies that the pattern of fixed and free parameters is equivalent across groups. Same item structure is used for the groups, and no constraints are imposed. This model serves as a baseline model for evaluating the more restrictive models that follow.
M2	Weak factorial invariance: Factor loadings are held invariant across the groups.
M3	Strong factorial invariance: Factor loadings and item intercepts are held invariant across the groups
M4	Strict factorial invariance: Factor loadings, item intercepts and item uniqueness are held invariant across the groups

Note. Extracted from Marsh et al. (2014).

5.4.2 Gender Invariance of the Global-Leadership Set of Factors

Table 5-33 summarises the model fit for the global-leadership set of factors.

Table 5-33

Gender Invariance Models for Global-Leadership

Model/Parameters held invariant	Parameters	χ2	df	CFI	TLI	RMSEA Estimate
M1- Configural - Same item configuration	302	772	296	0.965	0.940	0.06
M2- Weak factorial - Factor loading	230	1117	470	0.955	0.943	0.05
M3- Strong Measurement - Factor loading and item intercepts	210	1168	490	0.953	0.943	0.05
M4- Strict Measurement - Factor loading, intercepts, and item uniqueness	185	1231	515	0.951	0.943	0.05

Note. χ2-Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 (with the exact same item structure for both groups) indicated an excellent/acceptable fit (CFI = 0.965, TLI = 0.940). The chi-square indicator for the model M1 ($\chi 2 = 772$, df = 296) was within the acceptable range. The weak factorial invariance model M2 (invariant factor loadings) indicated an acceptable fit (CFI = 0.954, TLI = 0.943), supporting the invariance of factor loadings across genders. Comparing models M1 to M2, the change in CFI (ΔCFI = -0.01) (Cheung & Rensvold, 2002), and the corresponding change in the parsimony adjusted TLI (ΔTLI +0.003) was within the range of 0.01 (Chen, 2007), to accept the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 (invariant factor loadings and item intercepts) indicated an acceptable/excellent fit (CFI = 0.953, TLI = 0.943), and thus no evidence of differential item functioning. The critical comparison between models M2 and M3 (Marsh et al., 2010) indicated only a small change in fit (ΔCFI = 0.002, ΔTLI = 0.000), suggesting that the mean-level differences in factors could explain the item level differences.

Strict Measurement Invariance

The strict measurement invariance model M4 (invariant factor loadings, item intercepts and item uniqueness) indicated an excellent/acceptable fit (CFI = 0.951, TLI = 0.943). The

minimal change in fit between models M3 and M4 (ΔCFI = -0.002, ΔTLI = 0.000) supported the strict measurement invariance.

Table 5-34 shows the factor loadings for model M1.

Table 5-34

Factor Loadings for Males and Females for Global-Leadership – Model M1

	Evaluate		Decisive		Persuasion		leadership		Emotional Control	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
EVAL1	**0.14**	**0.21**	0.12	0.20	0.23	0.06	-0.06	-0.10	0.15	0.03
EVAL2	**0.56**	**0.44**	0.27	0.14	-0.02	0.28	-0.01	0.02	-0.04	-0.13
EVAL3	**0.54**	**0.49**	0.08	0.03	0.22	0.27	0.04	0.15	-0.02	0.00
EVAL4	**0.74**	**0.64**	-0.16	0.10	0.21	0.08	-0.03	-0.02	0.16	0.09
EVAL5	**0.69**	**0.65**	0.09	0.13	0.12	0.09	-0.12	-0.06	0.14	0.07
DECI1	-0.11	-0.08	**0.73**	**0.69**	0.10	0.15	0.08	0.05	0.01	-0.02
DECI2	-0.04	-0.06	**0.84**	**0.61**	-0.02	0.06	0.09	0.07	0.10	0.24
DECI3	0.18	0.30	**0.64**	**0.53**	0.04	0.08	0.06	0.02	0.17	0.13
DECI4	0.11	0.14	**0.82**	**0.95**	0.02	-0.14	-0.09	-0.06	0.15	0.04
DECI5	0.15	0.22	**0.38**	**0.38**	-0.14	-0.26	0.73	0.85	0.06	-0.03
PERS1	0.13	0.18	0.00	0.09	**0.47**	**0.50**	0.20	0.11	0.12	0.06
PERS2	0.19	0.12	0.17	0.10	**0.42**	**0.46**	0.21	0.28	0.02	0.04
PERS3	0.29	0.21	0.19	0.14	**0.35**	**0.45**	0.14	0.16	0.03	0.04
PERS4	0.24	0.24	0.13	0.02	**0.31**	**0.43**	0.23	0.12	0.03	0.18
PERS5	0.33	0.40	-0.15	-0.10	**0.17**	**0.11**	0.26	0.15	0.05	0.11
LEAD1	-0.17	-0.03	0.13	0.07	0.47	0.38	**0.46**	**0.31**	0.12	0.20
LEAD2	-0.30	-0.19	0.16	0.13	0.65	0.52	**0.51**	**0.55**	0.08	0.03
LEAD3	0.06	-0.01	0.12	0.14	0.18	0.25	**0.48**	**0.44**	0.09	0.11
LEAD4	0.07	0.15	0.11	0.11	-0.20	-0.21	**0.97**	**1.03**	0.09	0.06
LEAD5	0.05	0.03	0.26	0.20	0.03	0.06	**0.65**	**0.77**	0.05	0.10
EMOT1	0.23	-0.03	0.31	0.30	0.03	0.10	-0.13	-0.03	**0.48**	**0.54**
EMOT2	0.04	-0.10	0.17	0.24	0.19	0.09	-0.03	0.00	**0.58**	**0.64**
EMOT3	-0.05	-0.03	-0.16	-0.26	-0.09	0.01	0.03	0.02	**1.19**	**1.16**
EMOT4	-0.08	-0.02	-0.14	-0.11	-0.10	-0.12	0.09	0.05	**1.21**	**1.17**
EMOT5	0.00	0.08	0.13	0.16	-0.08	-0.06	-0.04	0.00	**0.88**	**0.79**

Note. The target loadings are in bold. The loadings are for model M1 where the same item structure was used for both groups.

Visual inspection of the factor loadings for males and females showed a similar pattern of loading, indicating a similar configural model. The target items for each factor had a substantial loading across both genders (e.g. DECI1–DECI5 with values from 0.38 to 0.84 for decisiveness), whereas the non-target values had consistently lower loadings (e.g. EVAL1–

EVAL5 for decisiveness had loadings less than 0.18). LEAD1 (I am seen as an effective leader) and LEAD2 (I can keep a group working together as a team) are an interesting exception, having higher loadings into persuasion (0.38 to 0 .65), while having a lesser but significant loading to its target factor of leadership (0.31 to 0.55). When comparing leadership with PERS1 (I can convince others with my argument) and PERS2 (I can argue persuasively for my point of view), it is possible to view PERS1 and PERS2 as prerequisites to being an effective leader and keeping a group together, and thus as a plausible explanation for such exception.

The four-model invariance framework and loading patterns supported the hypothesis that the measurement model for the global-leadership set of factors was invariant across genders.

5.4.3 Gender Invariance of the Global-Goal Orientation Set of Factors

Table 5-35 summarises the model fit for the global-goal orientation set of factors.

Table 5-35

Gender Invariance Models for Global-Goal Orientation

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	397	126	0.961	0.935	0.14
M2-Weak factorial - Factor loading	108	447	162	0.959	0.947	0.10
M3-Strong Measurement - Factor loading and item intercepts	96	478	174	0.956	0.947	0.09
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	524	189	0.952	0.947	0.08

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.961, TLI = 0.935). The chi-square indicator for the model M1 ($\chi2 = 397$, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.959, TLI = 0.947), supporting the invariance of factor loadings across genders. Comparing models M1 to M2, the change in fit (ΔCFI = -0.002, ΔTLI +0.008) was within the range to accept the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an excellent/acceptable fit (CFI = 0.956, TLI = 0.947), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.003, ΔTLI = 0.000), suggesting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an excellent/acceptable fit (CFI = 0.952, TLI = 0.947). The chi-square indicator for the model M4 ($\chi 2$ = 524, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.004, ΔTLI = 0.000) supported the strict measurement invariance of the global-goal orientation set of factors.

5.4.4 Gender Invariance of the Global-Application Set of Factors

Table 5-36 summarises the model fit for the global-application set of factors.

Table 5-36

Gender Invariance Models for Global-Application

Model/Parameters held invariant	n	χ2	ChiSqM DF	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	442	126	0.952	0.919	0.07
M2-Weak factorial - Factor loading	108	495	162	0.949	0.934	0.06
M3-Strong Measurement - Factor loading and item intercepts	96	567	174	0.940	0.927	0.07
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	593	189	0.938	0.931	0.06

Note. n–number of parameters, $\chi 2$–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.952, TLI = 0.919). The chi-square indicator for the model M1 ($\chi 2$ = 442, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.949, TLI = 0.934), supporting the invariance of factor loadings across genders. Comparing

models M1 to M2, the change in fit (ΔCFI = -0.003, ΔTLI +0.015) was evidence to accept the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.940, TLI = 0.927), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated a change in fit (ΔCFI = -0.009, ΔTLI = -0.007) supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 (invariant factor loadings, item intercepts and item uniqueness) indicated an excellent/acceptable fit (CFI = 0.938, TLI = 0.931). The chi-square indicator for the model M4 ($\chi 2 = 593$, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.002, ΔTLI = 0.004) supported the strict measurement invariance of the global-application set of factors.

5.4.5 Gender Invariance of the Global-Interpersonal Set of Factors

Table 5-37 summarises the model fit for the global-interpersonal set of factors.

Table 5-37

Gender Invariance Models for Global-Interpersonal

Model/Parameters held invariant	n	χ2	ChiSqM DF	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	228	605	232	0.959	0.933	0.06
M2-Weak factorial - Factor loading	144	769	316	0.950	0.940	0.05
M3-Strong Measurement - Factor loading and item intercepts	114	854	346	0.944	0.938	0.05
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	144	779	316	0.941	0.939	0.05

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, DF–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.959, TLI = 0.933). The chi-square indicator for the model M1 ($\chi 2 = 605$, df = 232) was within the

acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.950, TLI = 0.940), supporting the invariance of factor loadings across genders. Comparing models M1 to M2, the change in fit (ΔCFI = -0.009, ΔTLI +0.007) was within the range to accept the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.944, TLI = 0.938), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.006, ΔTLI = -0.002), suggesting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an acceptable fit (CFI = 0.941, TLI = 0.939). The chi-square indicator for the model M4 ($\chi 2 = 779$, df = 318) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.004, ΔTLI = 0.001) supported strict measurement invariance of the global-interpersonal set of factors.

5.4.6 Gender Invariance of the Global-Abstract Thinking Set of Factors

Table 5-38 summarises the model fit for the global-abstract thinking set of factors.

Table 5-38

Gender Invariance Models for Global-Abstract Thinking

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	329	126	0.975	0.958	0.06
M2-Weak factorial - Factor loading	108	427	162	0.967	0.958	0.60
M3-Strong Measurement - Factor loading and item intercepts	96	474	174	0.963	0.955	0.06
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	526	189	0.959	0.954	0.06

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent fit (CFI = 0.975, TLI = 0.958). The chi-square indicator for the model M1 ($\chi 2 = 329$, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an excellent fit (CFI = 0.967, TLI = 0.958), supporting the invariance of factor loadings across genders. Comparing models M1 to M2, the change in fit (ΔCFI = -0.008, ΔTLI = 0.000) was within the range to accept the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an excellent fit (CFI = 0.963, TLI = 0.955), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.004, ΔTLI = -0.003), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an excellent fit (CFI = 0.959, TLI = 0.954). The chi-square indicator for the model M4 ($\chi 2 = 526$, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.004, ΔTLI = 0.001) supported the strict measurement invariance of the global abstract set of factors.

5.4.7 Conclusion for Gender Invariance

The research question S1-RQ-4 examined the measurement invariance of the EdMAP instrument across the two genders. Starting from the least restrictive configural invariance (model M1) to the more restrictive strict measurement invariance (model M4), CFI, TLI and RMSEA were examined. As more stringent models were introduced, the fit indices changed. However, the changes were small, with a few instances where the parsimony adjusted TLI showed improvement while the CFI showed a reduced fit.

Thus, the results are evidence of gender invariance of the EdMAP instrument and the EdMAP measures the same constructs for males and females.

5.4.8 S1-RC-5: Age Invariance

William James (1892) believed that personality was fixed by age 30. However, as discussed in Chapter 3, subsequent studies and theories such as la dolce vita effect (Marsh et al., 2010) and the maturity principle (Caspi et al., 2005) have established that personality does indeed change with age. Similarly, competence, self-esteem and the need for different types of rewards change with age (Bieldorn et al., 2015), leading to the possibility that EdMAP responses may not be invariant with age. Therefore, the following section examines age invariance of the measurement model of the EdMAP instrument.

For efficient analysis, the population was grouped into the following age ranges shown in Table 5-39 to ensure sufficient numbers in each group.

Table 5-39

Three Age Groups of Teachers

Age Range (years)	Number of Teachers
Group1: Age =<40	472
Group 2: Age >=41 and Age <= 50	211
Group3: Age >=51	135

Note. The groups were chosen to balance the number of observations with a comparable age range in each group and generic life changes and to ensure at least 100 participants in each group.

Research Question S1-RQ-5 investigated whether the measurement model was invariant across the age groups.

5.4.9 Age Invariance of the Global-Leadership Set of Factors

Table 5-40 summarises the model fit for the global-leadership set of factors.

Table 5-40

Age Invariance of Global-Leadership

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	491	1171	559	0.954	0.926	0.06
M2-Weak factorial - Factor loading	295	1501	755	0.944	0.932	0.06
M3-Strong Measurement - Factor loading and item intercepts	255	1558	795	0.943	0.935	0.05
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	205	1657	845	0.939	0.935	0.05

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 (same item structure for the three age groups) indicated excellent/acceptable fit (CFI = 0.954, TLI = 0.926). The chi-square indicator for the model M1 (χ^2 = 1171, df = 559) was within the acceptable range. The weak factorial invariance model M2 (invariant factor loadings) indicated an acceptable fit (CFI = 0.944, TLI = 0.932), supporting the invariance of factor loadings across age groups. Comparing models M1 to M2, the change in CFI (ΔCFI= -0.010) and the corresponding change in the parsimony adjusted TLI (ΔTLI = +0.006) was within the range of 0.01 (Cheung & Rensvold, 2002); thus, the more constrained model M2 was accepted.

Strong Measurement Invariance

The strong measurement invariance model M3 (invariant factor loadings and item intercepts) indicated an acceptable fit (CFI = 0.943, TLI = 0.935), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.001, ΔTLI = -0.003), suggesting that item level differences can be explained by the mean-level differences.

Strict Measurement Invariance

The strict measurement invariance model M4 (invariant factor loadings, item intercepts and item uniqueness) indicated an acceptable fit (CFI = 0.939, TLI = 0.935). The chi-square indicator for the model M4 (χ2 = 1657, df = 845) was within the acceptable range. The

minimal change in fit between models M3 and M4 (ΔCFI = -0.004, ΔTLI = 0.000) supported strict measurement invariance of the global-leadership set of factors.

5.4.10 Age Invariance of the Global-Goal Orientation Set of Factors

Table 5-41 summarises the model fit for the global-goal orientation set of factors.

Table 5-41

Age Invariance of Global-Goal Orientation

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	442	126	0.952	0.919	0.07
M2-Weak factorial - Factor loading	108	495	162	0.949	0.934	0.06
M3-Strong Measurement - Factor loading and item intercepts	96	567	174	0.941	0.927	0.07
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	593	189	0.938	0.931	0.06

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.952, TLI = 0.919). The chi-square indicator for the model M1 (χ2 = 442, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.949, TLI = 0.934), supporting the invariance of factor loadings across age groups. Comparing models M1 to M2, the change in fit (ΔCFI= -0.003, ΔTLI = +0.015) supported the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.941, TLI = 0.927), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.008, ΔTLI = -0.007), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an acceptable fit (CFI = 0.938, TLI = 0.931). The chi-square indicator for the model M4 ($\chi 2 = 593$, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.003, ΔTLI = 0.003) supported strict measurement invariance of the global-goal orientation set of factors.

5.4.11 Age Invariance of the Global-Application Set of Factors

Table 5-42 summarises the model fit for the global-application set of factors.

Table 5-42

Age Invariance of Global-Application

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	216	435	189	0.963	0.938	0.06
M2-Weak factorial - Factor loading	144	555	261	0.955	0.946	0.06
M3-Strong Measurement - Factor loading and item intercepts	120	631	285	0.947	0.942	0.06
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	90	737	315	0.936	0.936	0.07

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated excellent/acceptable fit (CFI = 0.963, TLI = 0.938). The chi-square indicator for the model M1 ($\chi 2 = 435$, df = 189) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.955, TLI = 0.946), supporting the invariance of factor loadings across age groups. Comparing models M1 to M2, the change in fit (ΔCFI= -0.008, ΔTLI = +0.008) supported the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.947, TLI = 0.942), and thus no evidence of differential item functioning. The comparison between

models M2 and M3 indicated only a small change in fit (ΔCFI = -0.008, ΔTLI = -0.004), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an acceptable fit (CFI = 0.936, TLI = 0.936). The chi-square indicator for the model M4 ($\chi 2$ = 737, df = 315) was within the acceptable range. The change in fit between models M3 and M4 (ΔCFI = -0.011, ΔTLI = 0.006) suggested that holding item uniqueness invariant had some impact (>0.01) on fit, and thereby there was no support for the strict measurement invariance of the global-application set of factors.

5.4.12 Age Invariance of the Global-Interpersonal Set of Factors

Table 5-43 summarises the model fit for the global-interpersonal set of factors.

Table 5-43

Age Invariance of Global-Interpersonal

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	342	792	348	0.947	0.914	0.06
M2-Weak factorial - Factor loading	214	1039	476	0.934	0.920	0.06
M3-Strong Measurement - Factor loading and item intercepts	182	1123	508	0.927	0.918	0.06
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	142	1204	548	0.922	0.919	0.06

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.947, TLI = 0.914). The chi-square indicator for the model M1 ($\chi 2$ = 792, df = 348) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI = 0.934, TLI = 0.920), supporting the invariance of factor loadings across age groups. Comparing models M1 to M2, the change in fit (ΔCFI= -0.007, ΔTLI = +0.006) supported the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.927, TLI = 0.918), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.007, ΔTLI = -0.002), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 (invariant factor loadings, item intercepts and item uniqueness) indicated an acceptable fit (CFI = 0.922, TLI = 0.919). The chi-square indicator for the model M4 ($\chi 2 = 1204$, df = 548) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.005, ΔTLI = 0.001) supported the strict measurement invariance of the global-interpersonal set of factors.

5.4.13 Conclusion for Age Invariance

The research question S1-RQ-5 examined measurement invariance of the EdMAP instrument across the selected age groups. The comprehensive examination of weak factorial invariance (factor loadings invariant), strong measurement invariance (factor loadings and item intercepts invariant) and strict measurement invariance (factor loadings, item intercepts and item uniqueness), analysed in three age groups, confirmed the overall age invariance of EdMAP with strong support for most of the models, with only a few instances of weak or no support.

5.4.14 S1-RC-6 Grades Taught Invariance

Many researchers have reported differences in behaviour between primary and secondary teachers, including sensitivity (Courtis, 1973), behavioural management (Ecceles & Midgley, 1989), teacher expectations of students (Ball, 2000) and view of self-efficacy (Wolters & Daugherty, 2007).

Research Question S1-RC-6 investigated whether the measurement model was invariant across primary and secondary teachers.

For the sake of brevity, global-interpersonal and global abstract are not presented, as they followed a similar pattern of invariance to the other factors.

5.4.15 Grades Taught Invariance for the Global-Leadership Set of Factors

Table 5-44 summarises the model fit for grades taught invariance of the global-leadership set of factors.

Table 5-44

Grades Taught Invariance for Global-Leadership

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	330	910	370	0.962	0.938	0.05
M2-Weak factorial - Factor loading	230	1077	470	0.957	0.945	0.05
M3-Strong Measurement - Factor loading and item intercepts	214	1225	540	0.953	0.943	0.05
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	185	1167	515	0.954	0.947	0.05

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 (same items structure for primary and secondary teachers) indicated excellent/acceptable fit (CFI = 0.962, TLI = 0.938). The chi-square indicator for the model M1 (χ^2 = 910, df = 370) was within the acceptable range. The weak factorial invariance model M2 (invariant factor loadings) indicated an excellent/acceptable fit (CFI = 0.957, TLI = 0.945), supporting the invariance of factor loadings across grades taught. Comparing models M1 to M2, the change in fit (ΔCFI= -0.005, ΔTLI = +0.007) was within the range of 0.01 (Cheung & Rensvold, 2002); therefore, the more constrained model M2 was accepted.

Strong Measurement Invariance

The strong measurement invariance model M3 (invariant factor loadings and item intercepts) indicated an acceptable fit (CFI = 0.953, TLI = 0.943), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.004, ΔTLI = -0.002), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 (invariant factor loadings, item intercepts and item uniqueness) indicated an acceptable fit (CFI = 0.954, TLI = 0.947). The chi-square indicator for the model M4 ($\chi 2 = 1167$, df = 515) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = 0.001, ΔTLI = 0.004) supported the strict measurement invariance of the global-leadership set of factors.

5.4.16 Grades Taught Invariance of the Global-Goal Orientation Set of Factors

Table 5-45 summarises the model fit grades taught invariance for the global-goal orientation set of factors.

Table 5-45

Grades Taught Invariance for Global-Goal Orientation

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	386	126	0.962	0.937	0.06
M2-Weak factorial - Factor loading	108	464	162	0.956	0.943	0.06
M3-Strong Measurement - Factor loading and item intercepts	96	492	174	0.954	0.944	0.06
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	556	189	0.947	0.941	0.06

Note. n–number of parameters, $\chi 2$–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.962, TLI = 0.937). The chi-square indicator for the model M1 ($\chi 2 = 386$, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI =956, TLI = 0.943), supporting the invariance of factor loadings across grades taught. Comparing models M1 to M2, the change in CFI (ΔCFI= -0.006) and the corresponding change in the parsimony adjusted TLI (ΔTLI = +0.008) supported the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.954, TLI = 0.944), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.002, ΔTLI = 0.001), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an acceptable fit (CFI = 0.947, TLI = 0.941). The chi-square indicator for the model M4 ($\chi 2 = 556$, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.007, ΔTLI = -0.003) supported the strict measurement invariance of the global-goal orientation set of factors.

5.4.17 Grades Taught Invariance of the Global-Application Set of Factors

Table 5-46 summarises the model fit for grades taught invariance for the global-application set of factors.

Table 5-46

Grades Taught Invariance for Global-Application

Model/Parameters held invariant	n	χ2	df	CFI	TLI	RMSEA Estimate
M1-Configural - Same item configuration	144	441	126	0.951	0.919	0.07
M2-Weak factorial - Factor loading	108	535	162	0.942	0.925	0.07
M3-Strong Measurement - Factor loading and item intercepts	96	556	174	0.941	0.929	0.07
M4-Strict Measurement - Factor loading, intercepts, and item uniqueness	81	578	189	0.940	0.933	0.06

Note. n–number of parameters, χ2–Chi-square, CFI–Comparative fit index, TLI–Tucker-Lewis index, df–degrees of freedom, RMSEA–Root mean square error of approximation.

Weak Factorial/Measurement Invariance

The configural invariance model M1 indicated an excellent/acceptable fit (CFI = 0.951, TLI = 0.919). The chi-square indicator for the model M1 ($\chi 2 = 441$, df = 126) was within the acceptable range. The weak factorial invariance model M2 indicated an acceptable fit (CFI =942, TLI = 0.925), supporting the invariance of factor loadings across grades taught.

Comparing models M1 to M2, the change in fit (ΔCFI= -0.009, ΔTLI = +0.006) supported the more constrained model M2.

Strong Measurement Invariance

The strong measurement invariance model M3 indicated an acceptable fit (CFI = 0.941, TLI = 0.929), and thus no evidence of differential item functioning. The comparison between models M2 and M3 indicated only a small change in fit (ΔCFI = -0.001, ΔTLI = 0.004), supporting strong measurement invariance.

Strict Measurement Invariance

The strict measurement invariance model M4 indicated an acceptable fit (CFI = 0.940, TLI = 0.933). The chi-square indicator for the model M4 ($\chi 2$ = 578, df = 189) was within the acceptable range. The minimal change in fit between models M3 and M4 (ΔCFI = -0.001, ΔTLI = 0.004) supported the strict measurement invariance of the global-goal orientation set of factors.

5.4.18 Conclusion for Grades Taught Invariance

The research question S1-RQ-6 examined the invariance of the measurement model of the EdMAP instrument across primary and secondary teachers. Starting from the least restrictive configural invariance (model M1) to the most restrictive strict measurement invariance (model M4), the changes in fit indices (CFI and TLI) were under or marginally over the 0.01 rule of thumb for accepting change. Thus, the EdMAP instrument measured the same construct for primary and secondary teachers across the analysed factors, and thus did not support the hypothesis.

5.4.19 Overall Summary for Invariance

Marsh (2014) asserted that if grouping variables vary substantially for different items, in a manner unrelated to the true levels on the latent construct, then the observed differences might be idiosyncratic. This section investigated measurement invariance across well-established contextual variables of gender, age and grade taught. Analysis through the four-model invariance framework found no evidence of non-invariance across the above variables, thereby establishing a fundamental requirement for construct validity and generalisability

(Marsh et al., 2009). The results provide a green light for evaluating mean differences and the subsequent structural analysis.

5.5 Mean Differences of EdMAP Attributes by Gender and Age

5.5.1 Introduction

Gender and age have been extensively studied in relation to the psychological makeup of individuals. As discussed in Chapter 3, it is well-established that males have a different psychological makeup to females and that both males and females show different age-related changes. The previous section investigated the manifestation of gender and age differences in the measurement model. This section examines the manifestation of gender and age differences in the mean levels of the EdMAP attributes (Table 5-47). Grade taught was not examined for mean difference because the predominance of female primary teachers and potential for gender differences to bias the results. The number of male primary teachers was too low.

Table 5-47

Research Question Examined

Number	Research Question
S1-RQ-7: Mean Differences	Are there differences in teacher attributes by gender and age that manifest as mean differences in the EdMAP attributes in the sample population

The age/gender breakdown of the Hong Kong teacher sample is shown in Table 5-48.

Table 5-48

Number of Teachers by Age

Age Group (years)	Male	Female
<=35	88 (29%)	213 (71%)
36–45	92 (38%)	154 (62%)
46–55	61 (39%)	97 (61%)
56+	21 (47%)	24 (53%)

Note. The percentage of each gender by age is in brackets.

The ratio of males to females changed with age group. The low percentage of males under 30 confirmed the recent findings that the number of male teachers entering the profession is decreasing (Cruickshank, 2018) and that many males lack the necessary

personal resources to cope with the challenges of teaching. Thus, teaching is considered a natural job for females (Sumsion, 2005).

The mean differences by gender and age were evaluated via a two-way ANOVA for main effects and interaction effects and detailed analysis via plots of the attributes.

5.5.2 Mean Differences in Leadership

Two-way ANOVA with an interaction term indicated a significant interaction between the effects of gender and age on leadership with F (3, 742) = 2.71 and $p = 0.044$ (Table 5-49). Simple main effects analysis showed that both gender ($p = 0.044$) and AgeGroup ($p = 0.026$) were significant.

Table 5-49

Two-Way ANOVA for Leadership

Source	ss	df	Ms	f	*p(>f)*
	With Interaction Term				
AgeGroup	8.1	3	2.70	3.12	0.025*
Gender	3.5	1	3.50	4.06	0.044*
AgeGroup*Gender	7.0	3	2.34	2.71	0.044*
Residual	641.7	742	0.865		
	Without Interaction Term				
AgeGroup	8.1	3	2.07	3.10	0.026*
Gender	3.5	1	3.50	4.04	0.044*
Residual	648.7	745	0.87		

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** = $p < 0.001$, ** = $p < 0.01$, * = <0.05, '•' indicates $p < 0.1$

Table 5-50 shows that males in the group of teachers under 45 years of age had a higher mean, whereas females over 46 years of age had a higher mean, with the most significant difference being in the under 35 group.

Table 5-50

Mean Values for Leadership by Gender and Age

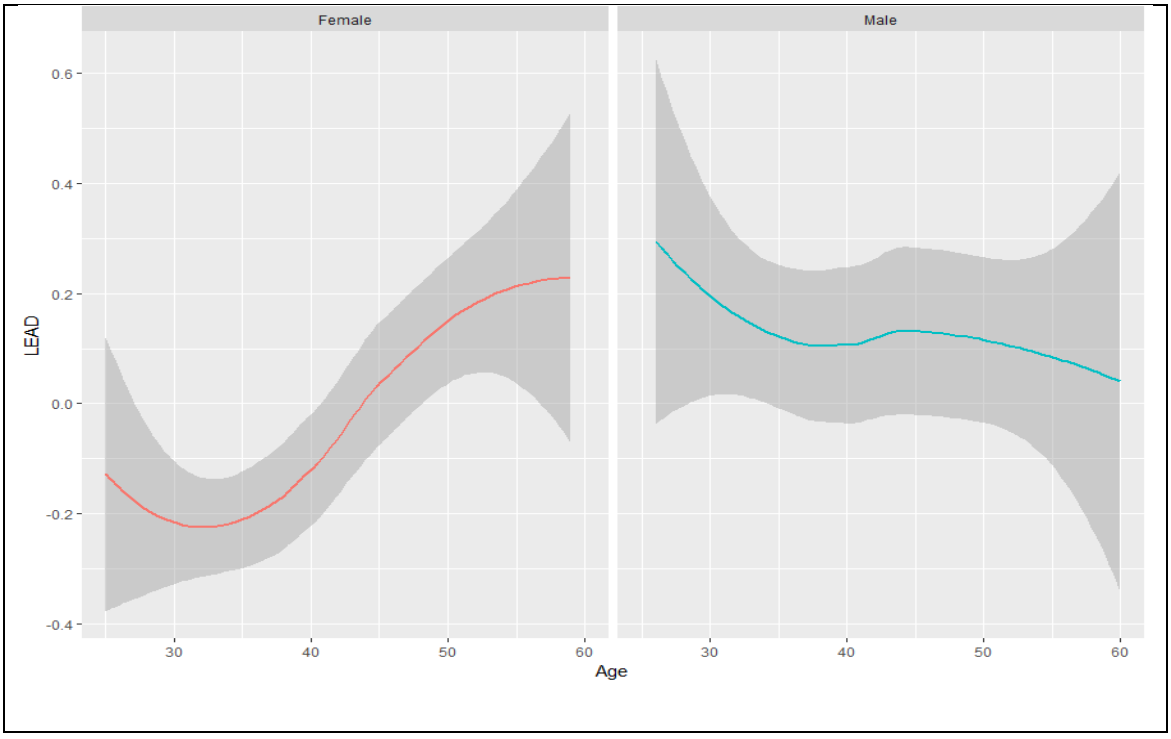
	Males		Females	
AgeGroup	Mean	Sd	mean	Sd
<=35	0.132	1.11	-0.205	0.90
36-45	0.137	0.87	-0.046	0.91
46-55	0.085	0.85	0.180	0.90
56+	-0.002	1.03	0.324	1.01

Note. The values are for the standardised factors.

Figure 5-2 shows the plot of leadership with age grouped by gender.

Figure 5-2

Leadership With Age, Grouped by Gender



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-2, which plots leadership measured by items such as "I can keep a group working together as a team", shows differences between the two genders and different patterns of change with age. The career life cycle phases of a teacher, moving from novice, apprentice, professional, expert and emeritus (Reeves & Lowenhaupt, 2016), predicts a gradual increase in leadership as teachers gain confidence, knowledge and respect from

colleagues. Consequently, this increase is expected to be reflected in the age groups that reflect increasing maturity. However, the plots do not support this view and suggest that there are additional dynamics at play.

The males start with a high value in their late 20s and reduce with increasing age before stabilising after their 40s. The high starting value can be indicative of the initial high "cockiness of the novice" gradually giving-way to reality. On the other hand, recent studies indicate that even new teachers desire leadership roles (Stone-Johnson, 2014). Thus alternatively, the rapid reduction may be an indicator that males with a high perception of their leadership capabilities are leaving the profession or adjusting their expectations. Similarly, the decreasing values from the mid-40s could be indicative of a loss of motivation associated with life phases.

The female teachers start lower than males with a smaller dip in their mid-30s, followed by an increase with age that is consistent with the teacher's professional life cycle moving from novice to emeritus. While 48% of individuals choose to teach for personal fulfilment, 21% choose it for practical considerations (Howes & Goodman-Delahunty, 2015). Consequently, many see teaching as a profession that allows the balancing of a career with family, especially for females having or planning to have school-aged children. Thus, females are likely to have lower leadership aspirations and are less likely to move out of the profession. The above results are consistent with existing knowledge of the workplace dynamics found in previous research as applicable to teachers and confirms the mean differences in leadership (Stone-Johnson, 2014).

5.5.3 Mean Differences in Emotional Control

Two-way ANOVA with an interaction term with $F(3, 742) = 1.93$ and $p = 0.124$ indicated no significant interaction between the effects of gender and age on emotional control. Simple main effects analysis showed that gender had no significant effect ($p = 0.156$) while AgeGroup with $p < 0.001$ was significant.

Table 5-51

Two-Way ANOVA for Emotional Control

Source	Ss	Df	Ms	f	*p(>f)*
	With Interaction Term				
AgeGroup	15.4	3	5.14	5.54	0.001***
Gender	1.9	1	1.86	2.01	0.156
AgeGroup*Gender	5.4	3	1.79	1.93	0.124
Residual	688.0	742	0.927		
	Without Interaction Term				
AgeGroup	15.4	3	5.14	5.52	0.000***
Gender	1.9	1	1.86	2.00	0.156
Residual	691	745	0.931		

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, '^' indicates $p < 0.1$

Table 5-52 shows that the means for emotional control follow a different pattern with age for males and females.

Table 5-52

Mean Values for Emotional Control With Gender and Age

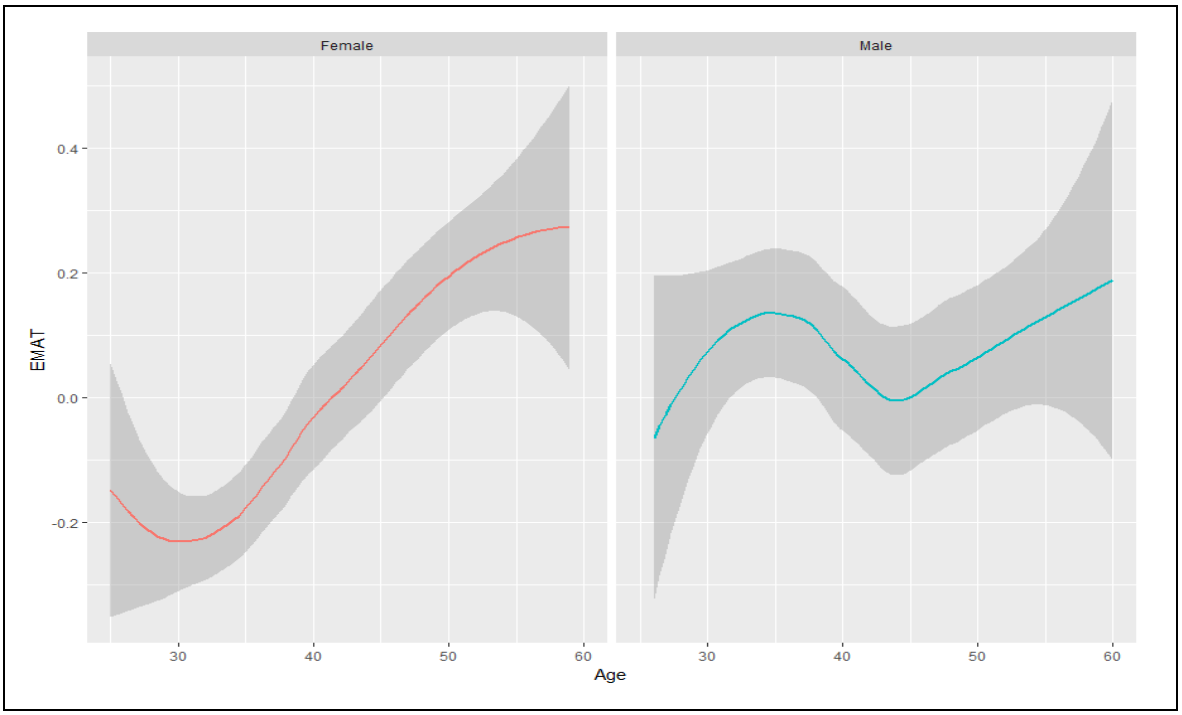
	Males		Females	
AgeGroup	mean	sd	mean	sd
<=35	0.07	1.02	-0.23	0.95
36–45	0.09	1.01	0.01	0.97
46–55	0.18	0.90	0.26	0.93
56+	-0.03	1.08	0.25	0.84

Note. The values are for the standardised factors.

Figure 5-3 displays the plot of emotional control with age, grouped by gender.

Figure 5-3

Emotional Control With Age, Grouped by Gender



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-3 which plots emotional control measured by items such as "I remain calm when emergencies occur", shows differences between the two genders and different pattern of change with age. Emotional control is expected to increase with age and experience.

The male teachers showed an increase in their early 30s as most teachers would move from novice to apprentice to professional. However, there was a small drop in their late 40s, followed by a subsequent rise. This might be a manifestation of a mid-life crisis (Jaques, 1965), where men undergo a transition in identity and self-confidence.

The female teachers showed more variability than their male counterparts. Young female teachers showed the lowest value. Additionally, female teachers showed a small dip in the mid-30s group, followed by a steady increase indicating increasing maturity.

5.5.4 Mean Differences in Career Orientation

Two-way ANOVA with an interaction term indicated a significant interaction between the effects of gender and age on career orientation with F (3, 742) = 4.52 and p = 0.003

(Table 5-53). Simple main effects analysis showed that both gender (p = 0.269) and AgeGroup (p = 0.678) were not significant.

Table 5-53

Two-Way ANOVA for Career Orientation

Source	ss	df	ms	f	*p(>f)*
	With Interaction Term				
AgeGroup	1.4.	3	0.45	0.51	0.673
Gender	1.1	1	1.09	1.22	0.269
AgeGroup*Gender	12.1	3	4.30	4.52	0.003**
Residual	661	742	0.891		
	Without Interaction Term				
AgeGroup	1.4	3	0.45	0.50	0.678
Gender	1.1	1	1.08	1.20	0.269
Residual	673	745	0.903		

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, '^' indicates $p < 0.1$

The means for career orientation for males and females in Table 5-54 indicate different patterns with age.

Table 5-54

Mean Values for Career Orientation With Gender and Age

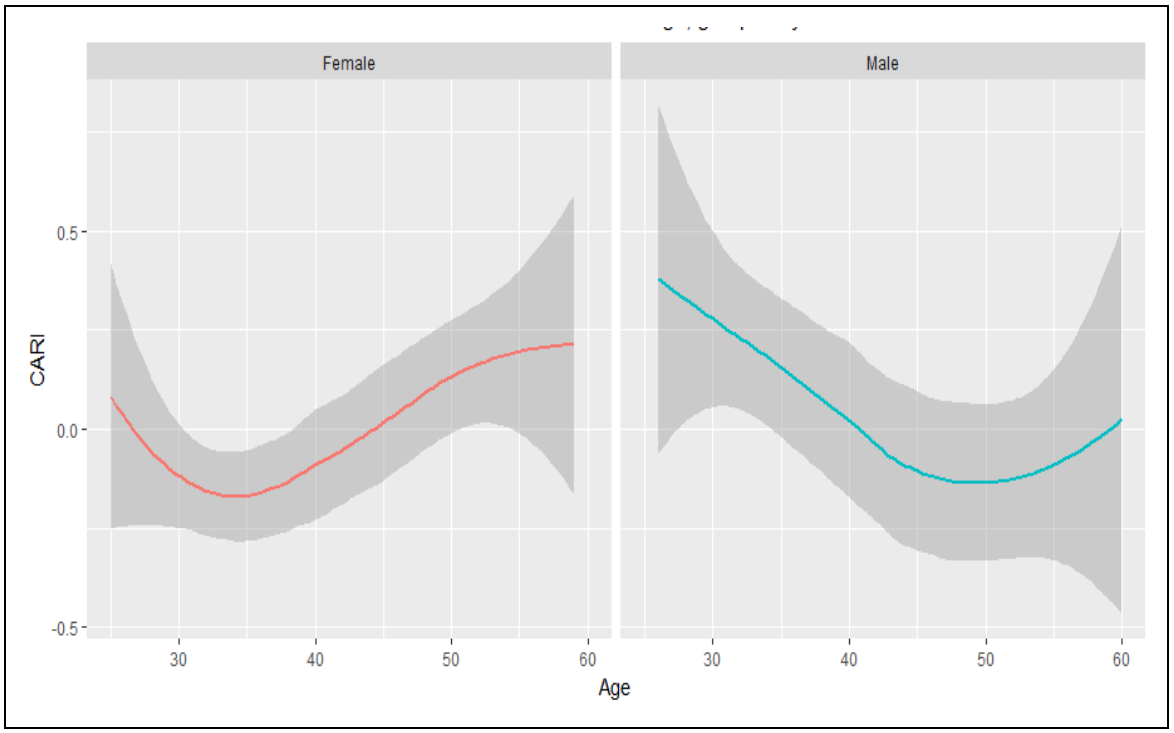
	Males		Females	
AgeGroup	mean	sd	mean	sd
<=35	0.23	0.97	-0.12	0.89
36–45	0.06	1.00	-0.06	0.90
46–55	-0.14	0.94	0.17	1.00
56+	-0.04	1.08	0.29	1.06

Note. The values are from the standardised factors.

Figure 5-2 displays the plot of career orientation with age, grouped by gender.

Figure 5-4

Career Orientation by Gender and Age



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-4, which plots career orientation, measured by items such as "I am ambitious about my career", shows differences between the two genders and different patterns of change with age.

The male teachers start from a high value, followed by a rapid decline. Weaver-Hightower (2011) investigating the worldwide crisis in male teachers, documented many barriers to male teachers including being alone with children especially in girls-only schools, the traditional division of work that makes men take physical work and disciplinary roles, and isolation within the school environment, which has been stereotyped as a feminine environment. While educators are addressing some of these barriers, the reducing career orientation can be interpreted as a manifestation of both the ethos of the period in which an individual joined the profession and the more career-oriented individuals leaving the profession. Furthermore, the view that teaching is a vocation rather than a job is changing as more individuals see teaching as a starting career (Watt & Richardson, 2008), thus explaining the high initial values.

The female teachers followed a predictable pattern with a drop over the childbearing years, followed by the gradual increase in aspiration, which is consistent with a teacher's career phases.

5.5.5 Mean Differences in Group Sociability

Two-way ANOVA with an interaction term indicated no significant interaction between the effects of gender and age on group sociability with F (3, 742) = 0.85 and $p = 0.466$ (Table 5-55). Simple main effects analysis showed that both gender ($p = 0.096$) and AgeGroup ($p = 0.967$) were not significant.

Table 5-55

Two-Way ANOVA for Group Sociability

Source	Ss	Df	ms	f	*p(>f)*
	With Interaction Term				
AgeGroup	0.2	3	0.07	0.08	0.9675
Gender	2.6	1	2.55	2.77	0.0963^
^AgeGroup*Gender	2.4	3	0.78	0.85	0.4663
Residual	684	742	0.92		
	Without Interaction Term				
AgeGroup	0.2	3	0.07	0.08	0.9675
Gender	2.6	1	2.55	2.77	0.0963^
Residual	687.2	745	0.922		

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, '^' indicates $p < 0.1$

The means for group sociability for males and females in Table 5-56 indicate different patterns with age.

Table 5-56

Mean Values for Group Sociability by Age and Gender

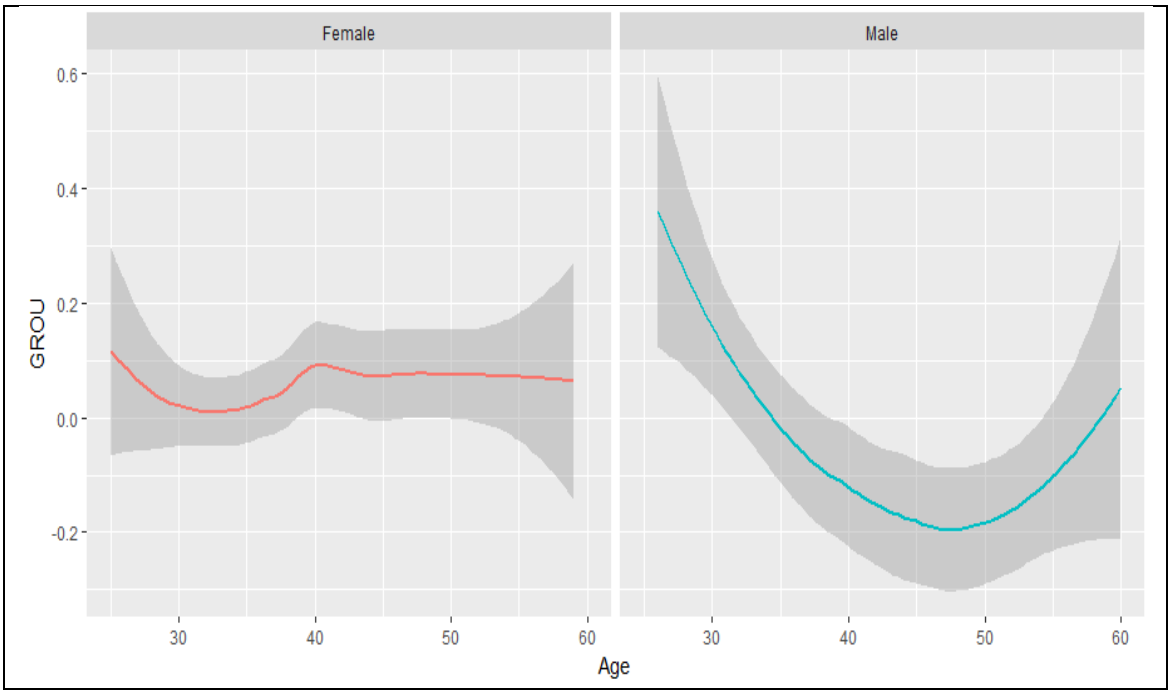
	Males		Females	
AgeGroup	mean	Sd	mean	sd
<=35	0.04	0.96	0.01	0.86
36–45	-0.06	0.99	-0.12	0.94
46–55	-0.15	0.94	0.11	1.00
56+	-0.11	1.01	0.13	1.02

Note. The values are from the standardised factors.

Figure 5-5 displays the plot of group sociability with age, grouped by gender.

Figure 5-5

Group Sociability by Gender and Age



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-5, which plots group sociability measured by items such as “I make friends easily”, shows differences between the two genders and different patterns of change with age. The items on group sociability were specified in a broader context (e.g. “I make friends easily”), without limiting the scope to the workplace. The ability to make friends peaks in the late 20s followed by a decline as work and family responsibilities reduce the time (time

budget) for friendships and the range of possible friends become more limited (Bhattacharya et al., 2016).

The male teachers showed a dip right into their 50s, followed by a slow increase in their late 50s. The female teachers showed an increase following the expected reduction in their mid-30s, indicating a different dynamic to males.

5.5.6 Mean Differences in Planning

Two-way ANOVA with an interaction term indicated no significant interaction between the effects of gender and age on planning with F (3, 742) = 0.743 and $p = 0.526$ (Table 5-57). Simple main effects analysis showed that gender ($p = 0.003$) was significant while AgeGroup ($p = 0.103$) was not significant.

Table 5-57

Two-Way ANOVA for Planning

Source	Ss	Df	ms	F	*p(>f)*
	With Interaction Term				
AgeGroup	4.7	3	1.56	2.06	0.103
Gender	6.3	1	6.34	8.39	0.003**
AgeGroup*Gender	1.7	3	0.56	0.743	0.526
Residual	561	742	0.75		
	Without Interaction Term				
AgeGroup	4.7	3	1.56	2.06	0.103
Gender	6.3	1	6.34	8.40	0.003**
Residual	562	745			

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, '.' indicates $p < 0.1$

The means for planning for males and females in Table 5-58 indicate similar patterns with age.

Table 5-58

Planning by Gender and Age

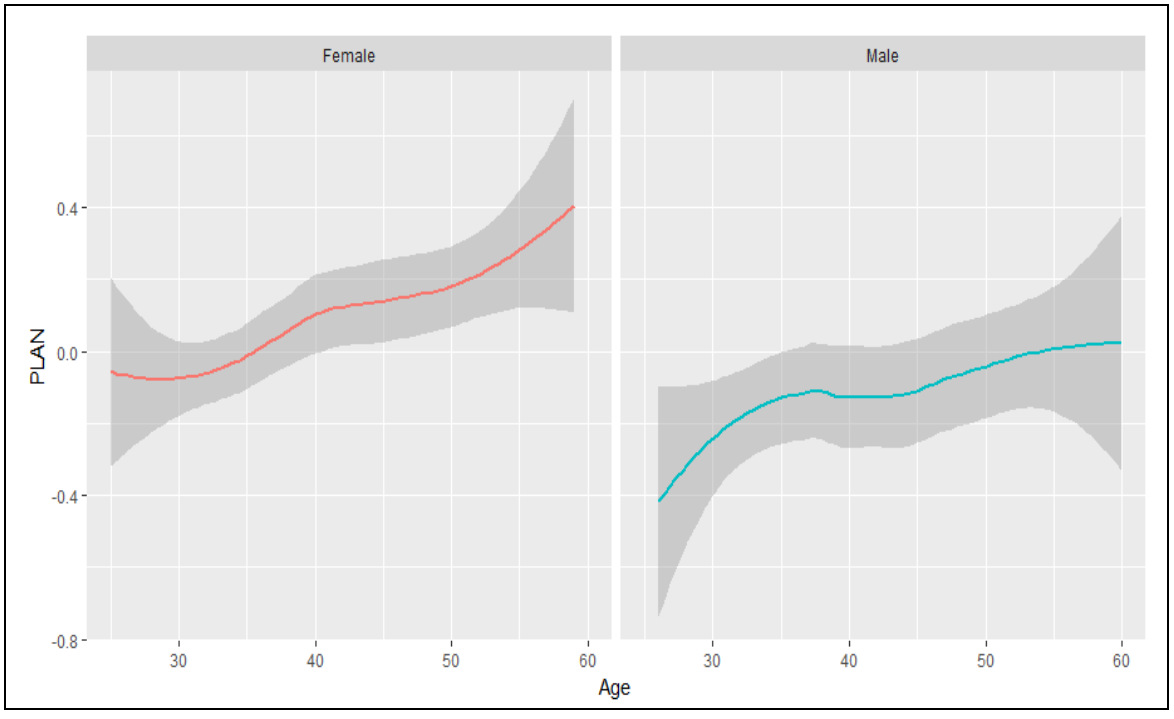
	Males		Females	
AgeGroup	mean	Sd	mean	sd
<=35	-0.20	0.91	-0.05	0.86
36–45	-0.17	0.84	0.11	0.87
46–55	-0.13	0.85	0.09	0.81
56+	-0.04	0.99	0.38	1.09

Note. The values are from the standardised factors.

Figure 5-6 displays the plot of planning with age grouped by gender.

Figure 5-6

Planning by Gender and Age



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-6, which plots planning measured by items such as “I like to plan and work with schedules”, shows differences between the two genders and a similar pattern of change with age. The plots confirm the findings by Laired and Garver (2006) that female teachers spend more time on planning functions. Both male and female teachers showed increased planning with age.

5.5.7 Mean Differences in Abstract Thinking

Two-way ANOVA with an interaction term indicated no significant interaction between the effects of gender and age on abstract thinking with F (3, 742) = 0.70 and $p = 0.54$ (Table 5-59). Simple main effects analysis showed that both gender ($p = 1.82e-06$) and AgeGroup ($p = 0.008$) were significant.

Table 5-59

Two-Way ANOVA for Abstract Thinking

Source	Ss	df	ms	F	*p(>f)*
	With Interaction Term				
AgeGroup	9.9	3	3.29	3.92	0.008**
Gender	19.5	1	19.45	23.14	<0.001***
AgeGroup*Gender	1.8	3	0.592	0.70	0.54
Residual	625.4	742			
	Without Interaction Term				
<0.001AgeGroup	9.9	3	3.29	3.93	0.008**
Gender	19.5	1	19.45	23.17	<0.001***
Residual	623.6	742			

Note. ss–Partial sum of squares, df–Degrees of freedom. ms–Mean square, f–f-statistic. *p(>f)*–2-tailed p-value.

*** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$, '.' indicates $p < 0.1$

The means for abstract thinking for males and females in Table 5-60 indicate different patterns with age.

Table 5-60

Abstract Thinking by Gender and Age

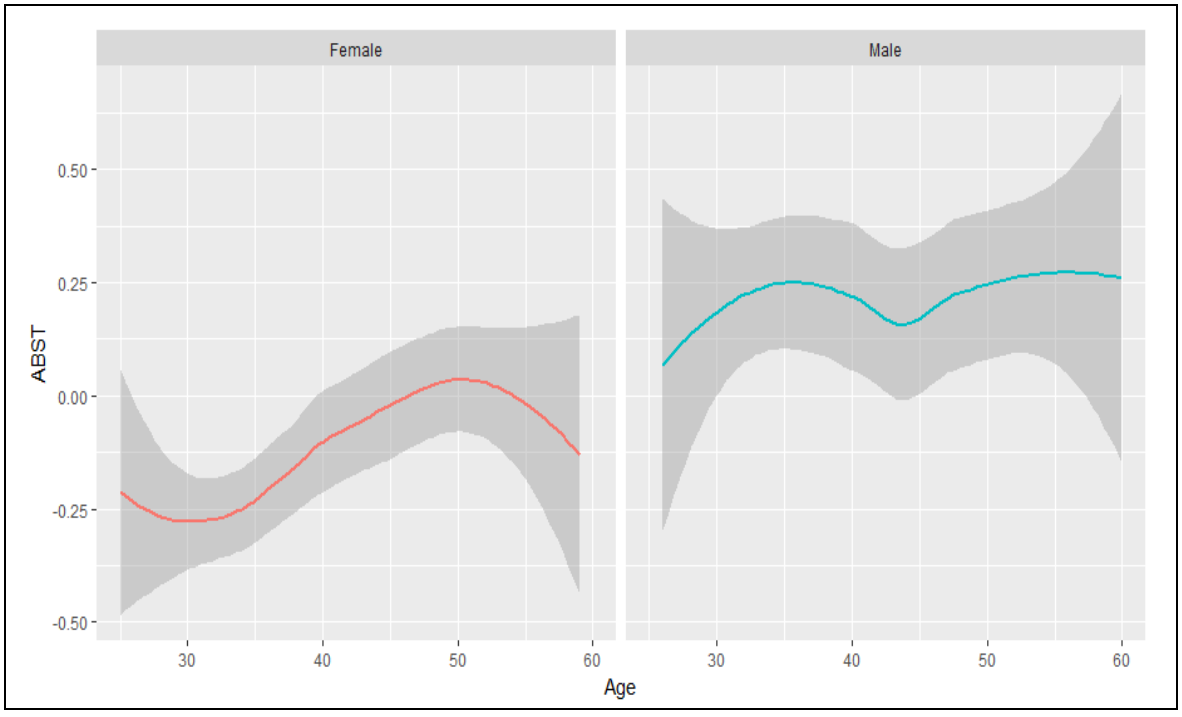
	Males		Females	
AgeGroup	mean	Sd	mean	sd
<=35	0.19	0.99	-0.27	0.88
36–45	0.24	0.98	-0.07	0.89
46–55	0.26	0.92	0.08	0.94
56+	0.08	1.03	-0.27	0.88

Note. The values are from the standardised factors.

Figure 5-7 displays the plot of abstract thinking with age grouped by gender.

Figure 5-7

Abstract Thinking by Gender and Age



Note. Loess smoothing with span = 0.9 was used. The confidence band is 95%.

Figure 5-7. which plots abstract thinking measured by items such as "I prefer working with complex theoretical questions", shows differences between the two genders and different patterns of change with age.

The male teachers had a dip around the mid-40s whereas the female teachers showed a small increase in the later years. Morley (2011) investigating gender and age differences of

teachers in the use of ICT, found that while there was no evidence of gender and age differences in the approach to ICT, teaching experience played a role. Since expertise is indirectly related to age, the above patterns need to be interpreted with caution.

5.5.8 Conclusion for Mean Differences by Age and Gender

Research Question S1-RQ-7 required a detailed investigation of the EdMAP factors for mean differences by gender and age. The analysis showed different age-related patterns in males and females. While in some instances, the statistically rigorous ANOVA indicated no significant impact, the factor plots indicated different age-related patterns for males and females consistent with other research findings and known dynamics in the workplace.

However, any specific individual's response is a complex interplay of many factors such as marital status, number of children and the school environment where a particular school may have a bias towards a specific gender and other individual circumstances. Therefore, workplace interventions and policy formulation need to consider these results.

Chapter 6 Study 2: Predictive Power of EdMAP on Workplace Outcomes

6.1 Introduction

Chapter 5 investigated the psychometric properties of the EdMAP instrument and established it as a valid instrument. However, the practical usefulness of a measurement instrument lies in its ability to relate an individual's profile to workplace outcomes and ultimately be used to predict behaviours and responses to workplace interventions. Holland (1997) in the personal career theory, predicted that individuals who choose to work in an environment similar to their personality type are more likely to be successful, satisfied and display positive outcomes. Thus, this chapter investigates the nexus between the EdMAP attributes and workplace outcomes of job satisfaction, job self-concept and PWBW.

The investigation consisted of:

- Regression analysis: To examine the structural relationship (regression coefficients) between the EdMAP attributes and workplace outcomes (Table 6-1).
- Invariance analysis: To investigate the invariance of the regression relationship between the EdMAP attributes and workplace outcomes with gender and age by analysing the interaction effects. The presence of a significant interaction would indicate that the relationship between the EdMAP attributes and workplace outcomes is influenced by gender and age.

Table 6-1

List of Research Questions Examined for Regression Analysis

Number	Research Questions
S2-RQ-1: Job Satisfaction	Is there a nexus between the EdMAP attributes and the workplace outcome of job satisfaction?
S2-RQ-2: Self-Concept	Is there a nexus between the EdMAP attributes and the workplace outcome of job self-concept?
S2-RQ-3: Psychological Well-being at Work	Is there a nexus between the EdMAP attributes and the workplace outcome of PWBW?

6.2 Methodology

The structural relationship between the EdMAP attributes and the outcomes is indicated by the regression coefficients (β). A high β coefficient supported by significant p-values indicates a strong predictive relationship. Because the factors were normalised values, the β can be considered as standardised β coefficients.

Marsh and Dawson (2004) noted that multicollinearity is a general problem in structural equation modelling that threatens valid interpretation and recommends that researchers provide a sufficiently clear audit trail to allow the reader to evaluate the appropriateness of their alternative models and conclusions. This study was no exception. In keeping with the above recommendation, the following models are presented:

- Regression of individual EdMAP attributes with each of the outcomes,
- Regression of integrated EdMAP instrument with each of the outcomes,
- Regression after adjusting for multicollinearity using the LASSO technique.

A model is only as useful as its predictive accuracy. Thus, the predictive accuracy of the chosen models was evaluated by drawing from the techniques of machine learning. The dataset was partitioned into training and testing datasets. The model trained using a training set was evaluated against a test dataset.

6.3 Results

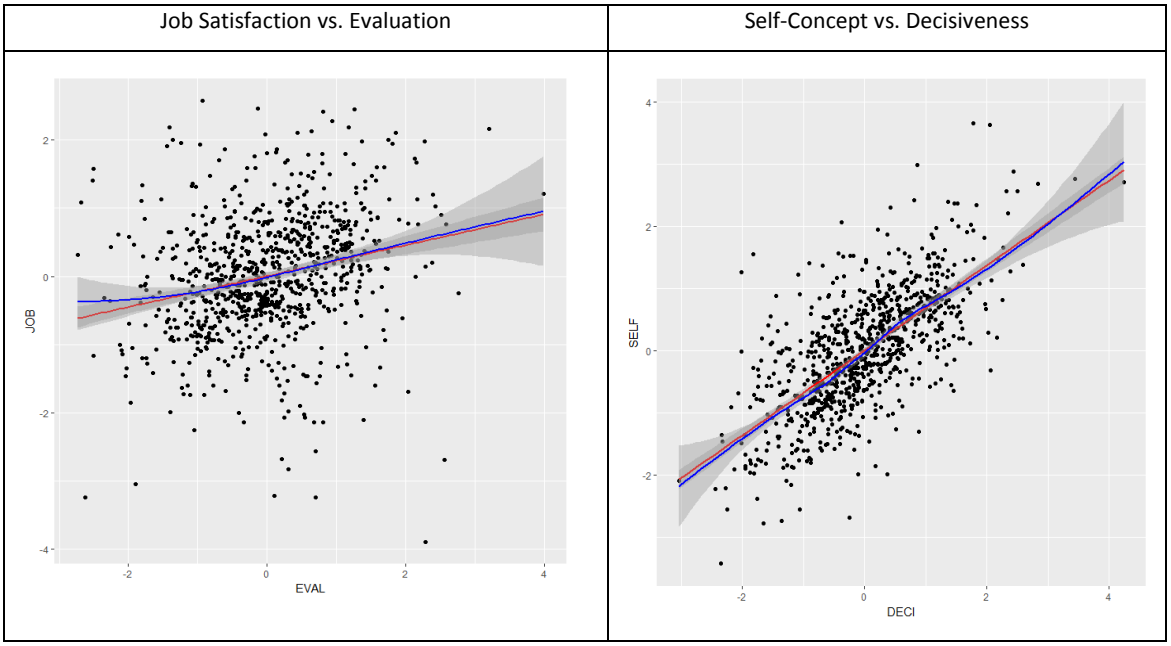
6.3.1 Regression of Individual EdMAP Attributes with Each of the Outcomes

The smoothed regression plot for two sample factors is shown in Figure 6-1. The plot closely resembles a linear plot with a small deviation in the extremities. Thus, the relationship

can be subject to analysis by linear regression.

Figure 6-1

Loess Line Fit for Sample Factors



Note. Line colour: Blue–linear fit, Red–Loess smooth fit using ggplot of R

Table 6-2 lists the results of individual regressions.

Table 6-2

Regression Coefficients for Individual EdMAP Factors on Job Satisfaction and Job Self-Concept

	Job Satisfaction			Self-Concept		
Factor	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)
Evaluation	0.13***	0.03	< .001	0.39 ***	0.03	< .001
Decisiveness	0.15***	0.03	< .001	0.49 ***	0.03	< .001
Persuasion	0.26 ***	0.03	< .001	0.53 ***	0.03	< .001
Leadership	0.27 ***	0.03	< .001	0.62 ***	0.02	< .001
Emotional Control	0.32 ***	0.02	< .001	0.55 ***	0.02	< .001
Career Orientation	0.37 ***	0.02	< .001	0.63 ***	0.02	< .001
Attention Seeking	0.19 ***	0.03	< .001	0.45 ***	0.03	< .001
Reward	0.26 ***	0.03	< .001	0.38 ***	0.03	< .001
Planning	0.12 ***	0.03	< .001	0.35 ***	0.03	< .001
Application	0.12 ***	0.03	< .001	0.14 ***	0.03	< .001
Attention to Detail	0.28 ***	0.03	< .001	0.45 ***	0.03	< .001
Behavioural Flexibility	0.35 ***	0.02	< .001	0.61 ***	0.02	< .001
People Orientation	0.13 ***	0.03	< .001	0.34 ***	0.03	< .001
Consultation	0.39 ***	0.02	< .001	0.55 ***	0.02	< .001
Group Sociability	0.28 ***	0.02	< .001	0.49 ***	0.02	< .001
Variety	0.20 ***	0.03	< .001	0.47 ***	0.02	< .001
Innovation	0.05**	0.03	0.013	0.30 ***	0.03	< .001
Routine	0.07	0.03	0.083	0.21 ***	0.03	< .001
Autonomy	0.16 ***	0.03	< .001	0.33 ***	0.03	< .001
Abstract Thinking	0.24 ***	0.03	< .001	0.55 ***	0.02	< .001
Technical Orientation	-0.27 ***	0.03	< .001	-0.21 ***	0.03	< .001
Quantitative	0.02 ^	0.03	0.073	0.10 **	0.03	< .001

Note. Significance Codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Job Satisfaction

Table 6-2 indicates that 20 out of 22 EdMAP factors significantly predicted job satisfaction with most coefficients ranging from $\beta = 0.12$ for planning to $\beta = 0.39$ for consultation.

The top five predictors were consultation (β = 0.39), career orientation (β = 0.37), behavioural flexibility (β = 0.35), emotional control (β = 0.32) and group sociability (β = 0.29).

Technical orientation indicated a negative β coefficient (β = -0.27, $p < 0.001$).

Innovation (β = 0.05, $p = 0.0132$), routine (β = 0.07, p = 0.083) and quantitative (β = 0.02, $p = 0.073$) did not predict job satisfaction.

Self-Concept

Table 6-2 indicates that all 22 out of the 22 EdMAP factors predicted self-concept ($|\beta| > 0.10$, $p < 0.001$). The coefficient values ranged from β = 0.14 for application to β = 0.63 for career orientation.

The top five predictors were career orientation (β = 0.63, $p < 0.001$), leadership (β = 0.62, $p < 0.001$), behavioural flexibility (β = 0.61, $p < 0.001$), emotional control (β = 0.57, $p < 0.001$) and persuasion (β = 0.53, $p < 0.001$). The least influential predictors were routine (β = 0.07, $p < 0.001$) and quantitative (β = 0.02, $p < 0.001$).

Technical orientation indicated a negative β coefficient (β = -0.21, $p < 0.001$).

Interpersonal Fit at Work

Table 6-3 indicates that all 22 out of the 22 EdMAP factors significantly predicted interpersonal fit at work ($|\beta| > 0.10$, $p < 0.001$). The coefficient values ranged from β = 0.16 for application to β = 0.62 for group sociability.

The top five predictors were consultation (β = 0.64, $p < 0.001$), group sociability (β = 0.62, $p < 0.001$), behavioural flexibility (β = 0.61, $p < 0.001$), career orientation (β = 0.57, $p < 0.001$) and leadership (β = 0.52, $p < 0.001$).

Planning, application, autonomy, technical orientation and quantitative had comparatively lower β coefficients. The high β coefficients for the person-oriented attributes such as consultation and group sociability that relate to the teacher as a person and less stronger coefficients for task-oriented attributes such as planning and routine were as anticipated.

Table 6-3

Regression Coefficients for Individual EdMAP Factors on Facets of Psychological Well-Being at Work

	Interpersonal Fit at Work			Thriving at Work			Feeling of Competence			Perceived Recognition at Work			Desire for Involvement at Work		
Factor	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)
Evaluation	0.32***	0.03	< .001	0.38***	0.03	< .001	0.23***	0.03	< .001	0.27***	0.03	< .001	0.46***	0.03	< .001
Decisiveness	0.31***	0.03	< .001	0.41***	0.03	< .001	0.24***	0.03	< .001	0.15***	0.03	< .001	0.33***	0.03	< .001
Persuasion	0.44***	0.03	< .001	0.46***	0.03	< .001	0.39***	0.03	< .001	0.38***	0.03	< .001	0.42***	0.03	< .001
Leadership	0.52***	0.02	< .001	0.60***	0.02	< .001	0.30***	0.03	< .001	0.36***	0.03	< .001	0.68***	0.02	< .001
Emotional Control	0.51***	0.02	< .001	0.54***	0.02	< .001	0.36***	0.03	< .001	0.40***	0.02	< .001	0.51***	0.02	< .001
Career Orientation	0.57***	0.02	< .001	0.68***	0.02	< .001	0.41***	0.03	< .001	0.42***	0.02	< .001	0.73***	0.02	< .001
Attention Seeking	0.44***	0.03	< .001	0.47***	0.03	< .001	0.14***	0.03	< .001	0.23***	0.03	< .001	0.50***	0.03	< .001
Reward	0.47***	0.03	< .001	0.41***	0.03	< .001	0.34***	0.03	< .001	0.27***	0.03	< .001	0.51***	0.03	< .001
Planning	0.19***	0.03	< .001	0.18***	0.03	< .001	0.30***	0.03	< .001	0.19***	0.03	< .001	0.15***	0.03	< .001
Application	0.16***	0.03	< .001	0.12**	0.03	0.001	0.23***	0.03	< .001	0.13***	0.03	< .001	0.15***	0.03	< .001
Attention to Detail	0.46***	0.03	< .001	0.46***	0.03	< .001	0.33***	0.03	< .001	0.32***	0.03	< .001	0.50***	0.03	< .001
Behavioural Flexibility	0.61***	0.02	< .001	0.65***	0.02	< .001	0.38***	0.03	< .001	0.48***	0.02	< .001	0.69***	0.02	< .001
Consultation	0.64***	0.02	< .001	0.61***	0.02	< .001	0.47***	0.02	< .001	0.46***	0.02	< .001	0.68***	0.02	< .001
People Orientation	0.37***	0.03	< .001	0.36***	0.03	< .001	0.26***	0.03	< .001	0.25***	0.03	< .001	0.44***	0.03	< .001
Group Sociability	0.62***	0.02	< .001	0.54***	0.02	< .001	0.36***	0.03	< .001	0.42***	0.02	< .001	0.57***	0.02	< .001
Variety	0.49***	0.02	< .001	0.46***	0.02	< .001	0.23***	0.03	< .001	0.28***	0.03	< .001	0.66***	0.02	< .001
Innovation	0.30***	0.03	< .001	0.29***	0.03	< .001	0.14***	0.03	< .001	0.12***	0.03	< .001	0.35***	0.03	< .001
Routine	0.20***	0.03	< .001	0.27***	0.03	< .001	0.03***	0.03	0.350	0.16***	0.03	< .001	0.25***	0.03	< .001

Continued

	Interpersonal Fit at Work			Thriving at Work			Feeling of Competence			Perceived Recognition at Work			Desire for Involvement at Work		
Factor	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)	Estimate	StdError	Pr(>|t|)
Autonomy	0.25***	0.03	< .001	0.27***	0.03	< .001	0.42***	0.03	< .001	0.24***	0.03	< .001	0.28***	0.03	< .001
Abstract Thinking	0.43***	0.03	< .001	0.51***	0.03	< .001	0.26***	0.03	< .001	0.31***	0.03	< .001	0.52***	0.03	< .001
Technical Orientation	-0.26***	0.03	< .001	-0.34***	0.03	< .001	-0.19***	0.03	< .001	-0.21***	0.03	< .001	-0.31***	0.03	< .001
Quantitative	0.15***	0.01	< .001	0.12**	0.03	0.001	0.01***	0.03	< .001	0.09**	0.03	0.0057	0.17***	0.03	< .001

Note. The five facets of PWBW are shown separately.
Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

Thriving at Work

Table 6-3 indicates that all the 22 EdMAP factors significantly predicted thriving at work with high β coefficients (> 0.12, $p < 0.001$).

The top five predictors were career orientation (β = 0.68, $p < 0.001$), behavioural flexibility (β = 0.65, $p < 0.001$), consultation (β = 0.63, $p < 0.001$), leadership (β = 0.60, $p < 0.001$) and group sociability (β = 0.54, $p < 0.001$).

Planning, autonomy, application, technical orientation and quantitative had weaker β coefficients.

Thriving at work had the same set of attributes with strong β coefficients as interpersonal fit at work. This finding suggests the possible significant influence of interpersonal relationships in evaluating thriving at work. This finding is also aligned with Holland's (1987) view of teachers as "social" individuals.

From a workplace dynamics point of view, this close relationship between the predictors of thriving at work and interpersonal fit at work can be a consequence of teaching success being highly dependent on establishing a strong personal bond and being able to influence students.

Feeling of Competence at Work

Table 6-3 indicates that 21 out of the 22 EdMAP factors significantly predicted the feeling of competence at work with strong coefficients ($|\beta| > 0.10$, $p < 0.001$).

The top five predictors were consultation (β = 0.47, $p < 0.001$), career orientation (β = 0.41, $p < 0.001$), behavioural flexibility (β = 0.38, $p < 0.001$), emotional control (β = 0.36, $p < 0.001$) and group sociability (β = 0.36, $p < 0.001$).

Perceived Recognition at Work

Table 6-3 indicates that all 22 EdMAP factors significantly predicted perceived recognition at work with a β coefficient > 0.10 and significant p-value (all $p < 0.001$).

The top five predictors were behavioural flexibility (β = 0.38, $p < 0.001$), consultation (β = 0.47, $p < 0.001$), career orientation (β = 0.41, $p < 0.001$), emotional control (β = 0.36, $p < 0.001$) and persuasion (β = 0.36, $p < 0.001$).

The top predictors for perceived recognition at work were the same as the predictors for the feeling of competence. This similarity of the related EdMAP factors may indicate a common aetiology between the two facets of perceived recognition at work and the feeling of competence. As proposed by the cognitive evaluation sub-theory of SDT (Deci & Ryan, 1985), it is plausible that perceived recognition at work may figure prominently as one of the contributors to the feeling of competence.

Desire for Involvement at Work

Table 6-3 indicates that all the 22 EdMAP factors significantly predicted the desire for involvement at work with strong coefficients ($|\beta| > 0.10$) and significant p-value (all $p < 0.001$).

The top five predictors were career orientation ($\beta = 0.73$, $p < 0.001$), behavioural flexibility ($\beta = 0.69$ $p < 0.001$), consultation ($\beta = 0.68$, $p < 0.001$), leadership ($\beta = 0.68$, $p < 0.001$) and variety ($\beta = 0.66$, $p < 0.001$).

The same factors that had high β coefficients for interpersonal fit at work and thriving at work had high β coefficients for the desire for involvement at work. Additionally, variety ($\beta = 0.66$) had a high β coefficient, suggesting that the desire for involvement at work (measured by items such as "I want to be involved in my school beyond my work duties") may also be driven by the need for variety.

Conclusion

When considered individually, all except technology orientation were positively correlated and the majority of the EdMAP factors showed a significant predictive relationship to job satisfaction, job self-concept and facets of PWBW. The above was anticipated as the factors were chosen for their relevance to the workplace. However, the factors that had a strong β coefficient for job satisfaction were different from the factors that were relevant to job self-concept. Furthermore, the EdMAP attributes had stronger β coefficients with job self-concept than with job satisfaction, thereby corroborating the inward orientation of the job self-concept, compared to the more external orientation of job satisfaction. Considering that job satisfaction is influenced by environmental items (e.g. pay and work conditions), individuals relate differently to the two psychological constructs. Therefore, the teacher behaviour was consistent with similar findings for other professions such as nurses where job satisfaction and job self-concept have different predictors (Cowin et al., 2007).

When the attributes with strong β coefficients were considered, attributes such as leadership, emotional control, career orientation, behavioural flexibility, consultation and group sociability maintained strong β coefficients across all the outcomes compared to other EdMAP attributes. This pervasiveness of people-centred factors across all aspects of the teachers' workplace is a reaffirmation of Holland's (1997) categorisation of teaching as a "social" career. Similarly, task-oriented factors of evaluation, application, innovation, routine, technical orientation and quantitative had a lesser influence across all outcomes. The results are also an affirmation of the importance of social relationships at work (Hackman & Oldham, 1975).

Technical orientation measured with items "I like to learn new technology and approaches" had a negative β coefficient for job satisfaction, job self-concept and facets of PWBW. This result needs further analysis as to its origins and clarification as to whether the gap between available technology in the school sector vs. other sectors would have been used for comparison.

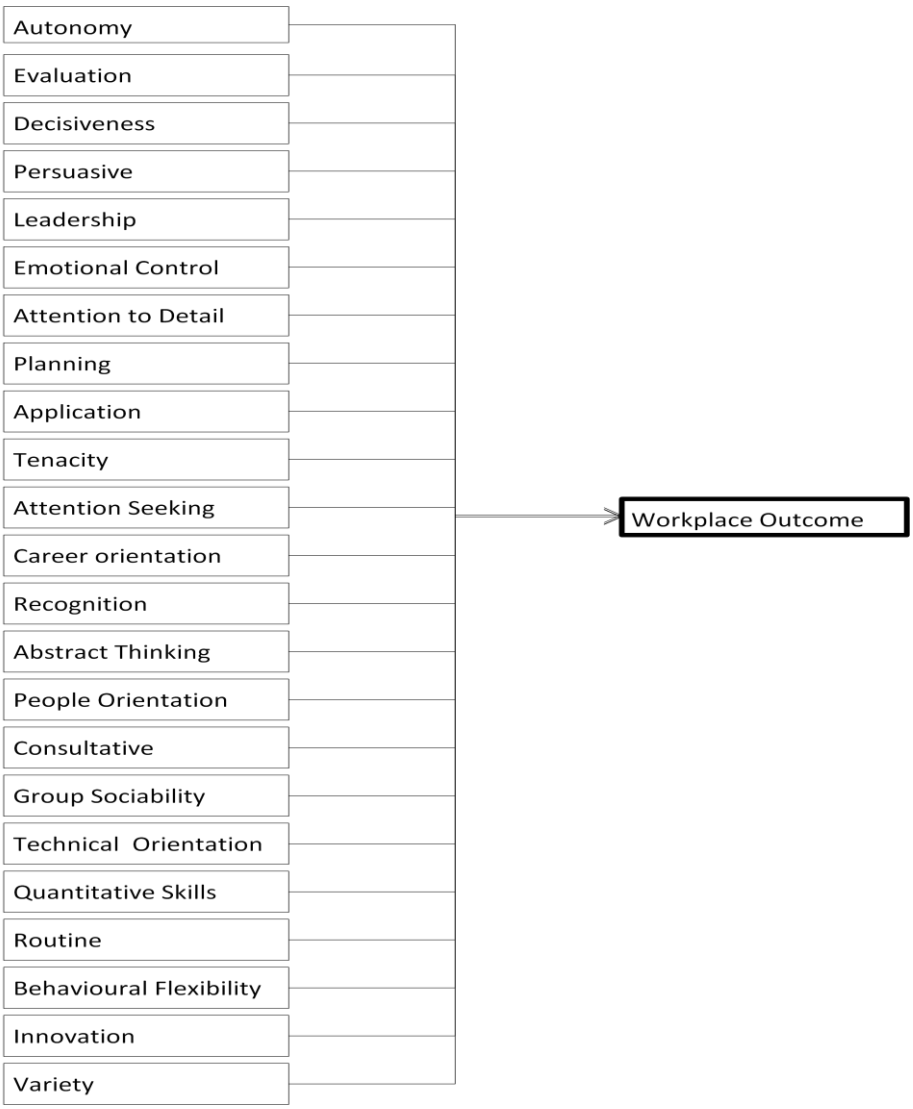
6.3.2 Regression of the Integrated EdMAP Instrument with Workplace Outcomes

In the previous section, EdMAP attributes, when considered individually, indicated a good predictive relationship with the workplace outcomes of job satisfaction, job self-concept and PWBW. However, the value of an instrument is in its ability to predict individual outcomes using all known attributes to optimise accuracy and relevance. The following examines EdMAP as an integrated instrument with all attributes used concurrently to predict the workplace outcomes.

Table 6-4, presents the result of the regression of all EdMAP factors on job satisfaction and job self-concept and Table 6-5 presents the results for the facets of PWBW. All the attributes were included in a single regression run (Figure 6-2).

Figure 6-2

Regression Model for the Integrated EdMAP Instrument With Workplace Outcomes



Note. The regression results are for the full instrument in one run

Table 6-4

Regression Coefficients for the EdMAP Instrument on Job Satisfaction and Job Self-Concept

	Job Satisfaction			Job Self-Concept		
	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)
(Intercept)	0.01	0.03	0.703	-0.01	0.02	0.801
Evaluative	0.07	0.06	0.184	0.04	0.04	0.334
Decisiveness	0.02	0.05	0.730	0.29***	0.04	< .001
Persuasion	0.11	0.06	0.065	0.16***	0.05	0.000
Leadership	0.07	0.07	0.268	0.00	0.05	0.965
Emotional Control	0.01	0.05	0.788	0.08	0.04	0.061
Career Orientation	0.10	0.09	0.249	0.28***	0.07	0.0001
Attention Seeking	-0.04	0.06	0.455	0.09	0.05	0.058
Reward	0.03	0.06	0.633	0.00	0.04	0.995
Planning	-0.02	0.05	0.770	0.19***	0.04	< .001
Attention to Detail	0.00	0.06	0.957	-0.07	0.05	0.136
Application	0.17**	0.06	0.003	0.22***	0.05	< .001
Variety	-0.12	0.06	0.055	0.15**	0.05	0.003
Innovation	-0.08	0.06	0.210	0.02	0.05	0.742
Routine	0.13*	0.06	0.024	0.22***	0.05	< 0.001
Autonomy	-0.07	0.06	0.220	-0.01	0.05	0.833
Abstract Thinking	0.09	0.07	0.206	0.17**	0.05	0.002
Technical Orientation	-0.12	0.06	0.037	0.00	0.05	0.947
Quantitative	-0.19**	0.06	0.001	-0.18**	0.05	0.0002
Behavioural Flexibility	0.02	0.07	0.823	-0.04	0.06	0.493
People Orientation	-0.08	0.05	0.154	-0.18***	0.04	< .001
Consultation	0.22***	0.07	0.0008	0.05	0.05	0.314
Group Sociability	0.08	0.05	0.128	-0.03***	0.04	< .001
R-squared	0.3147			0.6595		
Adjusted R-squared	0.2856			0.645		
p-value	p < 0.001			p < 0.001		
F value	10.79 on 22 and 517 DF			45.52 on 22 and 517 DF		

Note. Each outcome was evaluated by a separate run with all attributes.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

Table 6-5

Regression Coefficients for EdMAP Instrument on Facets of Psychological Well-Being at Work

	Interpersonal Fit at Work			Thriving at Work			Feeling of Competence			Perceived Recognition at Work			Desire for Involvement at Work		
	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)
(Intercept)	-0.007	0.04	0.080	-0.06•	0.03	0.087	0.09**	0.04	0.035	-0.05	0.04	0.203	-0.03	0.03	0.293
Evaluative	-0.02	0.03	0.060	0.0•6	0.03	0.083	0.01	0.04	0.734	0.07*	0.04	0.091	0.07	0.03	0.022
Decisiveness	0.10**	0.03	0.003	0.19***	0.03	<0.001	0.26***	0.03	<0.001	-0.06*	0.04	0.087	0.06*	0.03	0.048
Persuasion	0.13**	0.04	0.002	0.18***	0.03	<0.001	0.03	0.04	0.466	0.27***	0.04	<0.001	0.05	0.03	0.139
Leadership	0.04	0.04	0.329	-0.07	0.04	0.102	0.08•	0.05	0.084	0.01	0.05	0.736	0.08*	0.04	0.031
Emotional Control	0.06*	0.03	0.092	0.08*	0.03	0.020	0.05	0.04	0.211	0.01	0.04	0.768	0.00	0.03	0.912
Career Orientation	0.02	0.06	0.713	0.30***	0.05	0.000	0.09	0.06	0.162	0.10	0.06	0.122	0.36***	0.05	<0.001
Attention Seeking	-0.02	0.04	0.581	0.05	0.03	0.172	-0.05	0.04	0.197	-0.08	0.04	0.054	0.03	0.03	0.409
Reward	0.07	0.04	0.084	-0.02	0.03	0.444	0.12•	0.04	0.004	-0.07	0.04	0.112	0.01	0.03	0.741
Planning	-0.06•	0.03	0.080	-0.11***	0.03	0.001	0.17***	0.03	<0.001	-0.07*	0.04	0.060	-0.06*	0.03	0.032
Attention to Detail	0.04•	0.04	0.281	0.10**	0.03	0.007	0.26***	0.04	<0.001	0.03	0.04	0.457	0.08*	0.03	0.028
Application	0.08**	0.04	0.036	0.03	0.03	0.424	-0.01	0.04	0.773	0.07*	0.04	0.093	0.03	0.03	0.301
Variety	-0.02	0.04	0.616	0.02	0.04	0.558	-0.17***	0.04	0.000	-0.21***	0.04	<0.001	0.11**	0.03	0.003
Innovation	0.015	0.04	0.724	-0.03	0.03	0.432	0.02	0.04	0.647	-0.06	0.04	0.179	-0.04	0.03	0.242
Routine	0.19***	0.03	<0.001	0.41***	0.03	<0.001	-0.11**	0.04	0.005	0.25***	0.04	0.000	0.19***	0.03	<0.001
Autonomy	-0.05	0.04	0.194	-0.03	0.03	0.363	0.23***	0.04	<0.001	-0.04	0.04	0.365	-0.04	0.03	0.180
Abstract Thinking	0.001	0.04	0.988	0.13**	0.04	0.004	-0.07	0.05	0.141	0.01	0.05	0.725	0.02	0.04	0.539
Technical Orientation	-0.06	0.04	0.129	-0.10**	0.04	0.009	-0.04	0.04	0.304	-0.08*	0.04	0.081	0.02	0.03	0.483
Quantitative	-0.05	0.04	0.223	-0.13***	0.03	<0.001	-0.06	0.04	0.156	0.02	0.04	0.991	-0.03	0.03	0.333

Behavioural Flexibility	0.04	0.05	0.359	0.05	0.04	0.231	-0.13*	0.05	0.017	0.25***	0.05	<0.001	0.08*	0.04	0.050
	Interpersonal Fit at Work			Thriving at Work			Feeling of Competence			Perceived Recognition at Work			Desire for Involvement at Work		
	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)	Estimate	Std. Error	Pr(>|t|)
People Orientation	-0.12**	0.03	0.01	-0.19***	0.03	<0.001	0.02	0.04	0.05	-0.08*	0.04	0.05	-0.12***	0.03	<0.001
Consultation	0.25***	0.04	<0.001	0.11**	0.04	0.007	0.27***	0.05	<0.001	0.15**	0.05	-0.02	0.15***	0.04	<0.001
Group Sociability	0.31***	0.03	<0.001	0.09**	0.03	0.004	0.05	0.04	0.2	0.15***	0.04	<0.001	0.07*	0.03	0.02

	Interpersonal Fit at Work	Thriving at Work	Feeling of Competence	Perceived Recognition at Work	Desire for Involvement at Work
Residual standard error	0.649	0.601	0.721	0.716	0.544
R-squared	0.546	0.635	0.436	0.392	0.698
Adjusted R-squared	0.530	0.627	0.417	0.372	0.687
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
F-statistic	35.19 on 22 and 517 DF	50.89 on 22 and 517 DF	22.64 on 22 and 517 DF	18.9 on 22 and 517 DF	67.57 on 22 and 517 DF

Note. Each outcome was evaluated by a separate run with all attributes.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

The results of the regression indicated the EdMAP attributes explained 31.4% of the variance of job satisfaction ($R^2 = 0.314$, Adjusted-$R^2 = 0.281$, $F(22, 517) = 10.79$, $p < 0.001$), and 65% of variance in job self-concept ($R^2 = 0.659$, Adjusted-$R^2 = 0.645$, $F(22, 517) = 45.52$, $p < 0.001$). Similarly, EdMAP attributes explained 54.64% of the variance of interpersonal fit at work ($R^2 = 0.546$, Adjusted-$R^2 = 0.530$, $F(22, 517) = 35.19$, $p < 0.001$), 63.5% of the variance of thriving at work ($R^2 = 0.635$, Adjusted-$R^2 = 0.627$, $F(22, 517) = 60.89$, $p < 0.001$), 43.6% of the variance of feeling of competence ($R^2 = 0.436$, Adjusted- $R^2 = 0.417$, $F(22, 517) = 22.64$, $p < 0.001$), 39.2% of the variance of perceived recognition at work ($R^2 = 0.392$, Adjusted-$R^2 = 0.272$, $F(22, 517) = 18.90$, $p < 0.001$) and 69.8% of the variance of the desire for involvement at work ($R^2 = 0.698$, Adjusted-$R^2 = 0.687$, $F(22, 517) = 67.57$, $p < 0.001$), indicating a good model fit.

Comparing the result for each attribute in Table 6.4 with the corresponding result when evaluated individually (Table 6-3), multicollinearity distorted the β coefficients. The affected factors showed sharp changes from the individual coefficients. For instance, the coefficients for leadership on job satisfaction changed from $\beta = 0.267$ to $\beta = -0.028$ and for leadership on self-concept changed from $\beta = 0.537$ to $\beta = 0.072$. This result questions whether the leadership was genuinely less related or appeared so due to distortion by multicollinearity. Table 6-5 shows a similar distortion effect on the attributes predicting the facets of PWBW. As predicted by Marsh and Dawson (2004), multicollinearity is a ubiquitous phenomenon that has produced strange, uninterpretable, and misleading results across the range of workplace outcomes considered.

While some researchers have argued that the model may still be used for forecasting (benign neglect of multicollinearity), Marsh and Dawson (2004) illustrated how benign neglect could lead to inappropriate interpretation. Unless adjusted for, multicollinearity may diminish the value of EdMAP to inform interventions in the workplace.

Addressing Multicollinearity

An easily recognisable symptom of multicollinearity is the high correlation between any two factors. The factor scores correlation matrix in Table 5-11 did not find many factors with very high correlation (> 0.9), thus ruling out “exact” multicollinearity and the ability to use a straightforward approach to identify the offending factors. Data can also be distorted by “near extreme” multicollinearity if there is a high correlation between at least one variable and

some linear combination of the others. The ensuing difficulty in identifying multicollinearity prompted the observation that, within a construct validity perspective, the mindset of the researcher should be that of a competent data detective who investigates many alternative leads (Marsh & Yeung, 1997). Researchers were advised to pursue additional models to resolve these issues, to ensure that structurally problematic models do not support inappropriate interpretations. The following presents the results of further analysis to adjust for multicollinearity.

6.3.3 Regression After Adjusting for Multicollinearity

This section addresses multicollinearity to develop a theoretically coherent set of attributes that can be used to predict outcomes. As explained in Chapter 4, the well-established method of LASSO was used. LASSO reduces the variability of the estimates by shrinking some of the coefficients to be exactly zero (Oyeyemi et al., 2015). The overall magnitudes of the coefficients are constrained, important predictors are included in the model and less important predictors are progressively shrunk to zero.

The following presents the result of factor selection via the LASSO module of the glmnet package (R Core Team, 2013).

Table 6-6

Regression Results for LASSO Selected EdMAP Factors

	Job Satisfaction		Job Self-Concept		Interpersonal Fit at Work		Thriving at Work		Feeling of competence		Perceived Recognition at Work		Desire for Involvement at Work	
	B	Pr(>|t|)	B	Pr(>|t|)	β	Pr(>|t|)	β	Pr(>|t|)	β	Pr(>|t|)	β	Pr(>|t|)	β	Pr(>|t|)
(Intercept)	0.01	0.697	0.01	0.770	0.001	0.948	-0.03	0.2573	0.00	0.9642	-0.04	0.222	-0.04	
Evaluative	0.08	.001												
Decisiveness			0.23***	< .001	0.11**	0.003	0.22***	< .001	0.26***	< .001				
Persuasion	0.12	0.066	0.12***	< .001			0.15***	< .001			0.21***	< .001		
Leadership			0.19***	< .001										
Emotional Control	0.13***	0.001	0.14***	< .001										
Career Orientation			0.3***	< .001			0.5***	< .001					0.45	< .001
Attention Seeking														
Reward														
Planning			0.2***	< .001					0.10*	0.015				
Attention to Detail														
Application	0.10**	0.009							0.26***	< .001				
Variety									0.23***	< .001	-0.17***	< .001		
Innovation														
Routine					0.14***	< .001	0.37***	< .001			0.18***	< .001	0.25	< .001
Autonomy									0.32***	< .001				
Abstract Thinking														
Technical Orientation	-0.22***	< .001												

Continued

	Job Satisfaction		Job Self-Concept	Interpersonal Fit at Work		Thriving at Work		Feeling of competence		Perceived Recognition at Work		Desire for Involvement at Work	
Quantitative													
Behavioural Flexibility				0.11**	0.0395					0.33***	< .001	0.12	0.010
People Orientation	-0.09	0.018				-0.14***	< .001						
Consultation	0.25***	< .001		0.38***	< .001	0.22***	< .001	0.36***	< .001			0.18***	< .001
Group Sociability				0.25***	< .001					0.22***	< .001	0.11**	0.002

Model Fit

	Job Satisfaction	Self-Concept	Interpersonal Fit at Work	Thriving at Work	Feeling of competence	Perceived Recognition at Work	Desire for Involvement at Work
Residual standard error	0.7094	0.602	0.5855	0.61	0.7564	0.7427	0.5855
R-squared	0.2653	0.5989	0.6313	0.6126	0.355	0.3354	0.6313
Adjusted R-squared	0.257	0.5944	0.6279	0.6082	0.347	0.3292	0.6279
p-value	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001
F-statistic	32.08 on 6 and 533	132.7 on 6 and 533	107.8 on 5 and 534	140.50 on 6 and 533	48.9 on 6 and 533	53.91 on 5 and 534	182.9 on 5 and 534

Note. The above presents the result of factor selection via the LASSO module of the glmnet package (R Core Team, 2013).

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

As seen in Table 6-6, most of the LASSO selected factors had high β coefficients ($|\beta| > 0.10$) with significant p-values ($p < 0.01$). The overall models for each of the outcomes had $p < 0.001$, indicating a good overall fit. When compared to the model with all the attributes, the change in the amount of variance explained by the subset of LASSO selected factors was small (e.g. for job satisfaction, $R^2 = 0.31$ for 22 factors changed to $R^2 = 0.26$ for the LASSO selected six factors).

When all outcome variables of job satisfaction, job self-concept and PWBW were considered, LASSO provided a plausible subset of factors. While the overall fit of models (model p-value and adjusted-R^2) with LASSO selected variables was marginally inferior to the model with all factors, most LASSO selected factors were significant and consistent with the results that were obtained when analysed individually.

The ultimate test of a model and its value stems from its ability to predict outcomes. The following section examines the predictive accuracy of the LASSO selected subsets of attributes.

6.4 Predictive Accuracy of the EdMAP instrument

The previous section looked at the ability of the EdMAP attributes to account for variances in the workplace outcomes. This section evaluates the ability of the model to successfully predict workplace outcomes. It presents the investigation of the predictive accuracy of EdMAP on job satisfaction, job self-concept and PWBW.

Theories of social and human behaviour are used to address two distinct goals of science, i.e. understanding and prediction (Shmueli, 2010). These distinctly separate goals are neither inconsistent nor incompatible. Furthermore, predictive performance and model adequacy are two sides of the same coin as they are inextricably linked. Predictive failure implies model inadequacy and model inadequacy manifests as a predictive failure. Drawing from research on machine learning, the following steps were used to evaluate predictive accuracy:

- Data partitioning–Divide the data into two groups of training data and testing data.
- Training–Learn the model using the training dataset.
- Evaluation–Use the model on the test dataset and compare the results.

The training dataset was randomly chosen as 75% of the sample. Each of the tests was performed 10 times using a different randomly selected test dataset.

Table 6-7

Model Fit on Training Data for LASSO Selected Factors

Model Fit on Training Data for LASSO selected factors							
	Job satisfaction	Job self-concept	Interpersonal fit at work	Thriving at work	Feeling of competence	Perceived recognition at work	Desire for involvement at work
Residual standard error	0.76	0.6	0.58	0.61	0.75	0.74	0.58
R-squared	0.23	0.58	0.63	0.61	0.35	0.33	0.63
Adjusted R-squared	0.21	0.56	0.62	0.6	0.34	0.32	0.62
p-value	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001	p < 0.001
Predictive Accuracy on Test Dataset by running model on the test dataset							
RMSE	0.75	0.63	0.71	0.69	0.62	0.74	0.66
R-squared	0.24	0.53	0.44	0.54	0.45	0.57	0.62
MAE	0.53	0.48	0.51	0.48	0.42	0.55	0.42

Note. Training data (n = 660) and test data (n = 220) data. RMSE: Root mean square error, MAE: Mean absolute error.

The predictive accuracy values are the average from 10 runs with 10 different random selections of test data.

Job Satisfaction

As shown in Table 6-7, the model learnt from the training data had a residual standard error of 0.76 and an adjusted-R^2 value of 0.21, supported by an overall p-value < .001 indicating a good model fit to the training data.

When the learnt model was used on the test data to predict job satisfaction, the comparison between predicted and actual values provided an RMSE of 0.75, R^2 value of 0.24 and MAE value of 0.53, indicating an acceptable predictive accuracy.

Job Self-Concept

As shown in Table 6-7, the model learnt from the training data provided a residual standard error of 0.60 and an adjusted-R^2 value of 0.59, supported by an overall p-value < 0.001, indicating a good model fit to the training data.

When the learnt model was used on the test data to predict job self-concept, the comparison between predicted and actual values showed ab RMSE of 0.63, R^2 value of 0.53 and MAE value of 0.48, indicating good predictive accuracy.

Psychological Well-Being at Work

For the facets of PWBW, the models learnt from the training data indicated a residual standard error ranging from 0.58 to 0.74 and an adjusted-R^2 value in the range of 0.22 to 0.74, supported by significant p-values (< 0.001), indicating a good model fit to the training data.

When the learnt models were used on the test data to predict facets of PWBW, the comparison between predicted and actual values found an RMSE ranging from 0.62 to 0.74, R^2 values ranging from 0.44 to 0.62 and MAE value ranging from 0.42 to 0.55, indicating good predictive accuracy.

6.5 Section Summary

Table 6-8 summarises the findings from the investigation into LASSO selection after accounting for multicollinearity. However, while addressing some of the impacts of multicollinearity, LASSO has the weakness of being entirely statistically driven. Backward elimination that starts with all predictors in the model removes the least significant variable for each step without any theoretical consideration. Thus, if predictors are correlated, LASSO

arbitrarily selects one and different selection methods and statistical software may provide different results (Wang et al., 2011). Consequently, to ensure a balanced view, the top five attributes of each regression is also shown in Table 6-8. The following summarises the findings and their practical implications.

Table 6-8

LASSO Selected Values

	Job Satisfaction	Self-Concept	Interpersonal Fit at Work	Thriving at Work	Feeling of competence at Work	Perceived Recognition at Work	Desire for Involvement at Work
Evaluation	LS						
Decisiveness		LS	LS	LS	LS		
Persuasion	LS	LS/T5		LS	T5	LS	T5
Leadership		LS/T5	T5	T5			LS/T5
Emotional Control	LS/T5	LS/T5				T5	
Career Orientation	T5	LS/T5	T5	LS/T5	T5	T5	LS/T5
Attention Seeking							
Reward							
Planning		LS			LS		
Application					LS		
Attention to Detail							
Behavioural Flexibility	T5	T5	LS			LS/T5	LS/T5
Consultation	LS/T5		LS/T5	LS/T5	LS/T5	LS/T5	LS/T5
People Orientation			LS	LS			
Group Sociability			LS/T5	T5	T5	T5	LS
Variety					LS	LS	##
Innovation						LS	
Routine			LS	LS			LS
Autonomy					LS/T5		
Abstract Thinking							
Technical Orientation	LS						
Quantitative							

Note. LS - indicates a LASSO selected factor. T5- indicates a top five attribute from the individual regression.

Evaluation measured with "I am not prepared to accept things at face value" predicted job satisfaction. The classroom is a dynamic workplace. Therefore, in determining teaching strategies, teachers are required to be evaluative of individual needs as well as the needs of the entire classroom. While inexperienced teachers usually focus on the entire classroom, experienced teachers possess knowledge of many strategies for managing students and focus more on individual performance (Housner & Griffey, 1985). Consequently, the teacher's evaluation attribute of looking beneath the surface contributes to adjustments in lesson planning, adoption of teaching strategies, selection of instructional tasks and other dynamics such as grouping students for assignments. Thus, these results confirmed that the ability to evaluate a situation was a key requirement in determining the appropriate strategies and success that increase job satisfaction.

Decisiveness with "I am able to make decisions easily" predicted self-concept, thriving at work and feeling of competence at work. Teachers are called on to make many instantaneous decisions and the ability to be decisive has an impact on the overall outcomes. Rogers (1969, cited in Brady, 2011) when identifying the qualities of an ideal teacher, found that a teacher must be decisive, is often called upon to make difficult choices in the interest of the students and must not nullify their own authority for the sake of appearing to be democratic. While this may be counter-intuitive to the trend that more democracy in the classroom is conducive to learning, it highlights the tight balance a teacher is called upon to make. Therefore, teachers need to avoid selecting strategies and tasks on the basis that they will engender student cooperation instead of choosing based on educational relevance (Housner & Griffey, 1985). Thus, the level of decisiveness is a strategic one, in determining the level of democracy practised in the classroom. Consequently, a decisive teacher would have a strong self-concept and confidence in oneself and thrive at work.

Persuasion measured with "I am skilful arguing a point of view" predicted job self-concept and perceived recognition at work. This finding supports the premise that teaching is a social influence process, requiring teachers to persuade students to change their existing beliefs, behaviours and attitudes towards subjects and work such as reading books or completing assignments (Kearney, 2008). Furthermore, the classroom is a place where inputs from several teachers intersect, and thus teachers need to persuade colleagues in approaches to dealing with classroom situations and individual student needs. Additionally, teachers need to persuade administrators on the usefulness and relevance of policies and interventions

(Hargreaves, 2011). The ability to persuade will manifest in student performance, job self-concept and recognition from colleagues.

Leadership measured with "I am seen as an effective leader" predicted job self-concept and desire for involvement at work. It was also within the top five predictors for interpersonal fit at work and thriving at work. When teachers lead, they create an environment for learning that influences the school community and affects students and teachers alike (Liberman & Miller, 2005). Additionally, a teacher is not only expected to lead students in a classroom, but also lead in classroom practice within the school and the "middle space" of regional policies. The above finding can also be interpreted as a reciprocal relationship where an individual who is seen as an effective leader would want to contribute more by being involved in other aspects of work. Furthermore, analysing the progress of educational reform since World War II, Hargreaves (2011) identified four eras of educational change. The first three eras were named as an era of innovation and inconsistency, an era of markets and standardisation, and an era of performance and partnership. Notably, the current (fourth) era is distinguished by a bold paradigm change and a shift in mindset, requiring teachers to increase public engagement, facilitate corporate involvement, engage students in partnership and take lifelong learning beyond the confines of the school. Similarly, teachers are also expected to be leaders in changing school culture and mentors in improving instructional practices. Therefore, the strong predictive relationship of leadership on several of a teacher's workplace outcomes is evidence that teachers who are effective leaders will thrive as they are increasingly called upon to take a leadership role and find a positive influence on their self-concept and PWBW.

Emotional Control measured with "I control my emotions in all circumstances" predicted job satisfaction, job self-concept and thriving at work and was within the top five predictors for perceived recognition at work, thus contributing to many of the workplace outcomes. This finding is well supported by Hargreaves (2000) who found that teachers face challenging situations, and thus need to regulate students and their own emotions in the classroom. Contributing to the impact on the classroom, the socio-economic background of students and students with behavioural problems pose specific challenges to teachers (Leikin & Dinur, 2007). Additionally, the role of teachers extends beyond the classroom to parents and the community, where interactions tend to be emotionally charged (Hargreaves (2000). Furthermore, teachers need to teach children emotional control and they cannot do it if they do not possess such skills themselves. Consequently, emotional control can be a major

determinant of the teacher's emotional resilience and workplace outcomes, with implications on both selection and training of teachers.

Career Orientation measured with "I am ambitious about my career" predicted job self-concept, desire for involvement at work and thriving at work. It was within the top five predictors for interpersonal fit at work, feeling of competence at work and perceived recognition at work, indicating a pervasive influence on many workplace outcomes. The above results with ambitious teachers finding positive workplace outcomes are a contradiction of the common stereotype that teachers are an unambitious group and the education system has no opportunities for ambitious individuals. This is confirmation of the more recent findings that long-term teachers have a special type of ambition characterised by difficult and pro-social goals, showing a connection and concern for others. Furthermore, teachers who are committed, ambitious and seek perfection in their work were found to last longer in the profession (Jones, 2016). Considered from an alternative view, this result can also be interpreted in the context of the gradual paradigm shift of teaching being a vocation to teaching as a career, with the high ambition being reflected in self-concept, desire for involvement at work and thriving at work. Thus, the above findings have ramifications for policymakers in ensuring opportunities and career paths as in school administration, and curriculum development.

Attention Seeking measured with "I like to be the centre of attention" did not appear in the individual top five predictors of any of the workplace outcomes. Unlike professions such as engineering or accounting, the teacher is implicitly the centre of attention during most of the time in the classroom. Thus, this contradictory result indicates that teachers do not deliberately seek attention on themselves, but rather the topics at hand.

Recognition measured with "I seek recognition from superiors" did not appear in the individual top five predictors of any of the workplace outcomes. The need for recognition from superiors arises from the basic psychological need for competence as defined in the basic psychological needs sub-theory of the SDT (Ryan & Deci, 2000). Thus, the low nexus between recognition and workplace outcomes suggest that teachers may be getting recognition via other means such as student performance and parent feedback. The above can also be seen as a special feature of the education system where teachers receive timely, objective feedback via student achievement (tests and grading) and are less dependent on superiors for recognition.

Attention to Detail measured with "I pay attention to detail in my work" was not identified by LASSO as a predictive input and did not appear in the individual top five predictors of any of the workplace outcomes. Since previous research has identified lesson preparation as an essential task (e.g. Fernet et al., 2008) and many benefits of attention to detail have been confirmed (Jensen, 2013), the lack of a nexus between attention to detail and teachers workplace outcomes suggests that attention to detail may be embedded in other task-related attributes such as planning.

Planning measured with "I have a planned approach to activities" predicted job self-concept. Effective teachers plan their lessons and use rules, procedures and routines to ensure that students participate in learning that is tailored to their needs and are actively involved in learning (Marzano, Marzano, & Pickering, 2003). Furthermore, the authors confirmed planning as an essential task for teachers both as a personal process to enhance the primary task of teaching as well as the means of linking the classroom with existing social and cognitive structures. Consequently, teachers must plan over different time horizons, with classroom planning being the formulation of a long-term plan over a year or semester, which is percolated into short-term plans such as daily, weekly or unit planning. The finding that planning is a predictor of self-concept highlights a need to ensure the appropriate training and support structures that facilitate planning.

Application measured with "I sustain effort over a long period of time" predicted the feeling of competence at work. Thus, the common cliché that "success comes to those who sustain a consistent effort" is not specific to teachers.

Behavioural Flexibility measured with "I change my behaviour as circumstances demand" predicted perceived recognition at work and was in the top five for job satisfaction, job self-concept, interpersonal fit at work, thriving at work, perceived recognition at work, feeling of competence at work and desire for involvement at work. Recent studies have identified the need for a teacher to be flexible at many levels and be able to adjust to creating a shared, meaningful environment. This flexibility can be displayed in terms of defining outcomes, selecting teaching strategies, adjusting communications with students to match their individual needs and adjusting to differences in school environments stemming from the socio-economic background of students (Leikin & Dinur, 2007). Furthermore, teachers do not operate in a stable environment, but rather are challenged by the social environment of the school, as well as other factors such as high-needs areas, urban and rural contexts, special

education and the socio-economic background of individual students (Castro et al., 2010). Moreover, the teacher's behavioural flexibility contributes to resilience and the ability to adjust to the environment. Therefore, this result indicating the pervasiveness of behavioural flexibility across many of the outcomes is a confirmation of the challenges faced by present-day teachers and is likely to be a key attribute to be looked for and developed.

Consultation measured with "I consider different views in reaching consensus" predicted job satisfaction, interpersonal fit at work, feeling of competence at work and desire for involvement at work and was in the top five predictors for perceived recognition at work and thriving at work. The teacher-student relationship is the foundation of a good classroom. There is an increased paradigm shift in this relationship, from a teacher being a sculptor creating each student to an imagined finished outcome, to a teacher being a gardener creating an environment for students to flourish (Leach, 2018). Therefore, teachers are called on to be consensus builders by empowering students to direct themselves and learn to accommodate diversity, while creatively and constructively managing conflict. Furthermore, Brown (2004) found that consensus can be used in the classroom to build a lively learning community when used as an instructional and classroom management strategy, thus suggesting that consensus-building will achieve better outcomes for teachers as well as students. The contribution of consultation to positive workplace outcomes is a confirmation of this paradigm shift and the growing trend towards democracy in the classroom. As discussed under leadership, this ability to consider different views is an essential attribute for success in the teacher's evolving role as a leader outside the classroom and in the social context.

Group Sociability measured with "I like to develop close friendships" predicted interpersonal fit at work and is in the top five for job satisfaction and perceived recognition at work. While the predictive relationship to interpersonal fit at work was as expected, the predictive outcome into perceived recognition at work suggested that recognition at work was not limited to managers and superiors, but was possibly heavily influenced by feedback from close friends.

Routine measured with "I see routine work as important" predicted thriving at work and perceived recognition at work. A public school teacher spends 20% of the time grading student work and 15% of the time in routine administrative tasks (Hattie, 2003). For back-office workers in banks, routine tasks with little variation lead to a low motivation potential score (Hackman & Oldham, 2005). However, this result showed that teachers who recognise

the task significance of routine work have higher thriving at work and perceived recognition scores, with the practical implication that principals and trainers need to emphasise and reinforce the idea of the importance of routine work for their PWB. It is important to recognise that grading a teacher's own students offers a different motivation experience to blind grading. Grading their own students can be considered as a form of feedback mechanism within the SDT, where a teacher can derive satisfaction from students doing well, and thus contribute to increased inherent intrinsic motivation.

Autonomy measured with "I need the freedom to do my own thing" predicted perceived recognition at work. This finding indicates that teachers may also be attributing some of the autonomy to be associated with recognition at work. Starting from Hackman and Oldham (1980), autonomy has been extensively investigated for its role on workplace outcomes and was found to lead to increased job satisfaction and figured prominently in job redesign considerations (Barnabe, 1985). Thus, its lack of prominence in job satisfaction for teachers is indicative of many differences in the teachers' environment related to other professions such as managers and engineers. The school as a workplace differs in many aspects from business systems. The school has a flat structure, a teacher spends most of their work time with students and isolated from other adults. Furthermore, the set syllabuses with predefined content and activities limit the areas where a teacher can exercise judgement and autonomy. Thus, the above result can be interpreted as teachers accepting the loss of autonomy arising from the education system.

Technical Orientation measured with "I enjoy mastering new equipment and techniques" negatively predicted job satisfaction. Teachers are expected to integrate technology into the instruction media. However, the approach taken by an individual teacher is dependent on the teacher's preference for "teacher-centred learning" based on traditional teaching methods vs. "student-centred learning" that emphasises the student's responsibility for learning (Liu, 2011). Many countries, including Hong Kong, have made significant investments in the last two decades to construct technological environments in educational settings. Thus, this negative result can be an indication that the Hong Kong teacher population is still in a "teacher-centred" pedagogical belief and the investment has not been fully utilised in translating to positive outcomes for teachers. On the other hand, this result can also be interpreted as the comparison of the slower adoption of technology within the education system, with fewer opportunities for mastering new technologies in the teaching profession when compared to other similar professions such as engineering or medicine.

The EDMAP attributes of variety, innovation and abstract thinking were not in the top 5 or LASSO selected attributes and are not detailed above.

In summary, these results are a confirmation of Holland's classification of teaching as a social profession with "social" attributes contributing more to workplace outcomes. By meaningfully and plausibly relating the individual attributes to the outcomes of job satisfaction, job self-concept and PWBW with high β coefficients and significant p-values, the results establish that the majority of the attributes of the EdMAP instrument have the potential to be used in future research and guide policy formulation. These attributes, such as behavioural flexibility and consultation, have a pervasive influence that predicts both social and task-oriented outcomes.

As investigated in Research Questions S2-RQ-1, S2-RQ-2 and S2-RQ-3, there is a nexus between individual EdMAP attributes and outcomes of job satisfaction, job self-concept and PWBW. The EdMAP instrument can thus be used to predict aspects of the workplace outcomes.

Having found a strong predictive relationship between EdMAP and workplace outcomes, the following investigates the predictive invariance with gender and age.

6.6 Predictive Invariance of EdMAP attributes

Millsap (2007) defined predictive invariance as the notion that the relationship between an outcome and a set of predictors does not vary depending on other characteristics that are not in focus. The following examines predictive invariance of EdMAP, i.e. whether the relationships between EdMAP attributes and workplace outcomes found in the previous section vary with the contextual variables of gender and age. Positioning the content of this section from a statistical perspective, the measurement invariance analysis in Chapter 5 section 4 examined whether context variables of age, gender and grade taught led to differences in the behaviour of individuals that manifested in structural equation models as differences in measurement parameters. The mean differences analysis in Chapter 5 section 5 examined the manifestation of the selected contextual variables in the means of the latent constructs. This section examines the impact of the selected contextual variables on the regression relationship between EdMAP attributes and workplace outcomes. Furthermore, after finding examples of the existence of strict measurement invariance without strong regression invariance and vice versa, Millsap (2007) argued that predictive invariance is of intrinsic value to the practitioner, as it influences the regression relationship that is used as a

basis for inferences and decision making. Thus, it is vital to know the impact of contextual variables on the regression relationship so that interventions can be targeted at specific subpopulations. The research questions in this section examined the predictive invariance of EdMAP on gender and age (Table 6-9).

Table 6-9

List of Research Questions Investigated for Invariance Analysis

Number	Research Questions
S2-RQ-4: Gender invariance of EdMAP Prediction models	Are there differences in the predictive relationship between EdMAP attributes and outcomes between males and females?
S2-RQ-5: Age invariance of EdMAP Prediction models	Are there differences in the predictive relationship between EdMAP attributes and the workplace outcomes between different age groups?

The predictive invariance was investigated using the following sets of models.

- Model with interactions - Model with all data and context variable with interactions.
- Each group separately
- Nested Model- All groups in one dataset and parameters set free to vary by group
- Constrained Model- All groups in one dataset and regression coefficients constrained to be equal across groups.

Since the results were very similar only the models with interaction effects are presented below.

6.6.1 Gender Invariance of the EdMAP Prediction Models

Gender differences in human behaviour is a widely accepted phenomenon attributed to evolutionary origins. Hyde (2005) noted that while there are gender similarities among most traits, there are also significant differences arising from mating pressure and the social role. The following examines the role of gender in the predictive relationship between EdMAP attributes and workplace outcomes, and thus the extent to which gender differences may translate to a modern-day work environment.

The LASSO selected predictors identified in the previous section are examined for predictive invariance by examining the interaction effects. Genders were coded as “F” for female and “M” for male, with females forming the baseline.

Since p > 0.05 indicates that no effect is observed, and we cannot conclude that the effect exists in the population. However, this can be a result of the evidence not being strong enough because the sample size is small, the effect itself is small or there is too much variability for the test to detect it. Thus, the knowledge of non-significance is also relevant and is presented in the following results.

6.6.2 Job Satisfaction

Table 6-10 and Table 6-11 show the results for multiple regression, including interaction among variables.

Table 6-10

Job Satisfaction With LASSO Selected EdMAP Factors and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.05	0.04	0.186	
Persuasion	0.14	0.05	0.006	**
Emotional Control	0.15	0.05	0.002	**
Application	0.13	0.05	0.009	**
Consultation	0.25	0.06	< 0.001	***
People Orientation	-0.12	0.05	0.011	*
Technical Orientation	-0.20	0.05	0.000	***
GenderM	-0.12	0.07	0.072	.
Persuasion:GenderM	-0.22	0.09	0.019	*
Emotional Control:GenderM	-0.06	0.08	0.513	
Application:GenderM	-0.12	0.08	0.164	
Consultation:GenderM	0.03	0.10	0.765	
People Orientation:GenderM	0.14	0.08	0.111	
Technical Orientation:GenderM	0.02	0.08	0.809	

Note. GenderM=Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '•' = $p < 0.1$

Table 6-11

Comparison of Models for Job Satisfaction With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual standard error	0.709	0.705
R-squared	0.265	0.283
Adjusted R-squared	0.257	0.266
p-value	< 0.001	< 0.001
Value	32.08 (6, 533)	15.91 (13, 522)

Note. The details for the model without gender is shown in the previous section.

Table 6-10 indicates a significant interaction effect between persuasion and gender (β = -0.22, p = 0.019). The main effect of persuasion was significant (β = 0.14, p = 0.006), whereas gender (β = -0.12, p = 0.072) was not significant. Table 6-10 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by EdMAP factors (adjusted-R^2 = 0.257 to adjusted-R^2 = 0.266).

6.6.3 Self-Concept

Table 6-12 and Table 6-13 show the results for multiple regression, including interaction among the variables.

Table 6-12

Self-Concept With LASSO Selected EdMAP Factors and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.01	0.03	0.692	
Decisiveness	0.27	0.05	<.001	***
Persuasion	0.21	0.05	<.001	***
Leadership	0.30	0.05	<.001	***
Emotional Control	0.25	0.05	<.001	***
Routine	0.04	0.05	0.432	
GenderM	-0.05	0.06	0.431	
Decisiveness:GenderM	-0.09	0.08	0.233	
Persuasion:GenderM	0.00	0.08	0.981	
Leadership:GenderM	0.03	0.08	0.767	
Emotional Control:GenderM	0.03	0.07	0.718	
Routine:GenderM	0.03	0.09	0.727	

Note. GenderM=Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

Table 6-13

Comparison of Models of Self-Concept With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual standard error	0.64	0.64
R-squared	0.541	0.542
Adjusted R-squared	0.535	0.535
p-value	<.001	<.001
F value	125.50 (5, 534)	56.70(1,524)

Note. The details for the model without gender is shown in the previous section.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

Table 6-12 indicates that the interaction effects were not significant. Gender ($\beta = -0.05$, $p = 0.788$) was not significant.

Table 6-13 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.535 to adjusted-R^2 = 0.533).

6.6.4 Interpersonal Fit at Work

Table 6-14and Table 6-15 show the results for multiple regression, including interaction among the variables.

Table 6-14

Interpersonal Fit at Work and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.00	0.04	0.990	
Decisiveness	0.05	0.05	0.336	
Routine	0.15	0.05	<.001	***
Behavioural Flexibility	0.15	0.07	0.036	*
Consultation	0.38	0.06	<.001	***
Group Sociability	0.22	0.05	<.001	***
GenderM	-0.02	0.06	0.779	
Decisiveness: GenderM	0.16	0.08	0.036	*
Routine: GenderM	-0.03	0.08	0.675	
Behavioural Flexibility: GenderM	-0.10	0.11	0.353	
Consultation: GenderM	-0.01	0.10	0.876	
Group Sociability: GenderM	0.10	0.09	0.237	

Note. GenderM=Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$.

Table 6-15

Comparison of Models of Interpersonal Fit at Work With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual standard error	0.661	0.663
R-squared	0.502	0.508
Adjusted R-squared	0.497	0.497
p-value	<.001	<.001
F value	107.80 (5,534)	49.21 (11,524)

Note. The details for the model without gender is shown in the previous section.

Table 6-14 indicates a significant interaction effect between decisiveness and gender (β = 0.16, $p = 0.036$). Gender (β = -0.02, $p = 0.779$) was not significant.

Table 6-15 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.497 to adjusted-R^2 = 0.497).

6.6.5 Thriving at work

Table 6-16 and Table 6-17 show the results for multiple regression, including interaction among the variables.

Table 6-16

Thriving at Work and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.01	0.03	0.654	
Decisiveness	0.22	0.04	<.001	***
Persuasion	0.16	0.05	<.001	***
Career Orientation	0.53	0.05	<.001	***
Routine	0.36	0.04	<.001	***
People Orientation	-0.09	0.05	0.057	^
Consultation	0.18	0.06	0.002	**
GenderM	-0.04	0.06	0.447	
Decisiveness: GenderM	0.01	0.07	0.888	
Persuasion: GenderM	-0.02	0.08	0.844	
Career Orientation : GenderM	-0.05	0.09	0.542	
Routine: GenderM	0.01	0.08	0.936	
People Orientation: GenderM	-0.12	0.08	0.124	
Consultation: GenderM	0.04	0.09	0.628	

Note. GenderM–Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-17

Comparison of Models of Thriving at Work With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual standard error	0.613	0.607
R-squared	0.612	0.620
Adjusted R-squared	0.608	0.610
p-value	<.001	<.001
F value	140.50 (6, 533)	65.56 (13, 522)

Note. The details for the model without gender is shown in the previous section.

Table 6-16 and Table 6-17 show the results for multiple regression, including interaction among the variables.

Table 6-16Table 6-16 indicates that the interaction terms were not significant. Gender (β = -0.04, $p = 0.447$) was not significant.

Table 6-17 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.608 to adjusted-R^2 = 0.610).

6.6.6 Feeling of Competence

Table 6-18 and Table 6-19 show the results for multiple regression, including interaction among the variables.

Table 6-18

Feeling of Competence and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.02	0.04	0.633	
Decisiveness	0.23	0.05	<.001	***
Planning	0.11	0.06	0.048	*
Application	0.22	0.05	<.001	***
Variety	-0.23	0.06	<.001	***
Autonomy	0.39	0.05	<.001	***
Consultation	0.32	0.06	<.001	***
GenderM	-0.07	0.07	0.363	
Decisiveness:GenderM	0.10	0.09	0.254	
Planning:GenderM	-0.03	0.09	0.716	
Application:GenderM	0.13	0.09	0.162	
Variety:GenderM	0.00	0.10	0.961	
Autonomy:GenderM	-0.15	0.09	0.088	^
Consultation:GenderM	0.07	0.10	0.489	

Note. GenderM–Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-19

Comparison of Models of Feeling of Competence With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual Standard error	0.756	0.756
R-squared	0.355	0.366
Adjusted R-squared	0.347	0.350
p-value	<.001	<.001
F value	48.9(6, 533)	23.18(13, 522)

Note. The details for the model without gender is shown in the previous section. *Note*. GenderM–Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-19Table 6-18 indicates that the interaction terms were not significant. Gender (β = -0.07, p = 0.363) was not significant.

Table 6-19 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.347 to adjusted-R^2 = 0.350).

6.6.7 Perceived Reward at Work

Table 6-20 and Table 6-21 show the results for multiple regression, including interaction among the variables.

Table 6-20

Perceived Reward at Work With LASSO Selected EdMAP Factors and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.06	0.05	0.199	
Persuasion	0.14	0.06	0.028	*
Variety	-0.17	0.07	0.014	*
Routine	-0.11	0.06	0.063	^
Behavioural Flexibility	0.32	0.08	<.001	***
Group Sociability	0.13	0.07	0.046	*
GenderM	-0.14	0.08	0.071	^
Persuasion:GenderM	0.23	0.11	0.033	*
Variety:GenderM	0.03	0.13	0.803	
Routine:GenderM	0.17	0.11	0.123	
Behavioural Flexibility:GenderM	-0.19	0.13	0.157	
Group Sociability:GenderM	-0.04	0.11	0.699	

Note. GenderM–Males. The factors are the LASSO selected factors.

Significance codes: *** = p < 0.001, ** = p < 0.01, * = p <0.05, '^' = p < 0.1

Table 6-21

Comparison of Models of Perceived Reward at Work with and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual standard error	0.859	0.858
R-squared	0.165	0.180
Adjusted R-squared	0.157	0.163
p-value	<.001	<.001
F value	21.18 (5, 534)	10.49 (11, 524)

Note. The details for the model without gender is shown in the previous section

Table 6-20 indicates a significant interaction effect between persuasion and gender (β = 0.23, p = 0.033). Persuasion (β = 0.14, p = 0.02) was significant and gender (β = -0.14, p = 0.071) was not significant.

Table 6-21 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.157 to adjusted-R^2 = 0.163).

6.6.8 Desire for Involvement at Work

Table 6-22 and Table 6-23 show the results for multiple regression, including interaction among the variables.

Table 6-22

Desire for Involvement at Work and Gender Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.06	0.03	0.039	*
Career Orientation	0.48	0.05	<.001	***
Routine	0.22	0.03	<.001	***
Behavioural Flexibility	0.14	0.06	0.015	*
Consultation	0.15	0.05	0.008	**
Group Sociability	0.11	0.04	0.013	*
GenderM	0.07	0.05	0.150	
Career Orientation: GenderM	-0.09	0.09	0.311	
Routine: GenderM	0.06	0.07	0.368	
Behavioural Flexibility: GenderM	-0.03	0.09	0.689	
Consultation: GenderM	0.03	0.08	0.676	
Group Sociability: GenderM	0.00	0.07	0.913	

Note. GenderM–Males. The factors are the LASSO selected factors.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

Table 6-23

Comparison of Models of Desire for Involvement at Work With and Without Gender

	Model without Gender	Model with Gender Interaction effects
Residual Standard error	0.58	0.58
R-squared	0.631	0.638
Adjusted R-squared	0.627	0.631
p-value	<.001	<.001
F value	182.9 (5, 534)	84.2(11, 524)

Note. The details for the model without gender is shown in the previous section

Table 6-22 indicated no significant interaction effects. Gender ($\beta = 0.07$, $p = 0.150$) was not significant.

Table 6-23 indicates that adding the gender term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.627 to adjusted-R^2 = 0.631).

Conclusion

Except for interaction effects of gender on the relationship of persuasion with job satisfaction (main effect $\beta = 0.14$, interaction effect $\beta = -0.22$), persuasion with perceived reward at work (main effect $\beta = 0.15$, interaction effect $\beta = -0.23$), decisiveness with interpersonal fit at work (main effect $\beta = 0.05$, interaction effect $\beta = 0.16$) and autonomy with feeling of competence (main effect $\beta = 0.39$, interaction effect $\beta = -0.15$), there were no other noteworthy gender interaction effects on the regression between EdMAP and outcome variables. Comparing the models with and without interaction effects indicated that gender interaction terms did not notably add to the variance explained by the model. The interaction effect of gender in the predictive relationship between EdMAP and workplace outcomes is minimal.

Scientific psychology has been fascinated with the idea of psychological gender differences, with some arguing that these differences are both large and immutable, while others have argued for similarity. Wright et al. (2015) found gender differences in the predictors of job satisfaction in management employees. The above findings of minimal interaction effects can be viewed as a manifestation of Ashforth and Mael's (1989) social

identity theory, which points to teachers being a more uniform group than the general population, through similar individuals choosing to be teachers, the subsequent selection and training and the gravitation towards a strong common identity that gradually erodes inherent differences.

6.7 Age invariance of the EdMAP Prediction Models

Age has been extensively investigated for its influence on human behaviour. In addition to mean differences in the big five traits, Marsh et al. (2010) noted age-related differences in model behaviour such as differential item functioning in the big five traits. Marsh et al. (2013) found substantial nonlinear age effects and proposed the la dolce vita effect in old age. The following examines whether the above age-related differences extend to the predictive relationship between EdMAP and workplace outcomes (Table 6-24).

Table 6-24

Research Question Investigated

Number	Research Questions
S2-RQ-5 Age invariance of Prediction models	Are there differences in the regression coefficients between EdMAP attributes and job satisfaction, job self-concept and PWBW for different age groups?

Age invariance was examined by grouping the teacher sample into three age groups as shown in Table 6-25.

Table 6-25

Teachers Grouped by Age

Group	Age (years)	Number of Teachers
AgegrpA	34 and less	331
AgegrpB	35–49 inclusive	407
AgegrpC	50 and over	148

Note. The age ranges were chosen to balance the need for adequate sample size with the contextual significance of life span changes.

6.7.1 Job Satisfaction

Table 6-26 and Table 6-27 show the results for multiple regression, including interaction among the variables.

Table 6-26

Job Satisfaction and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.08	0.06	0.126	
Persuasion	0.11	0.09	0.211	
Emotional Control	0.21	0.08	0.005	**
Application	0.08	0.07	0.260	
Consultation	0.15	0.08	0.067	^
People Orientation	-0.16	0.08	0.030	*
Technical Orientation	-0.21	0.08	0.006	**
AgegrpB	0.13	0.07	0.078	^
AgegrpC	0.22	0.09	0.021	*
Persuasion:AgegrpB	0.03	0.11	0.787	
Persuasion:AgegrpC	-0.19	0.13	0.139	
Emotional Control:AgegrpB	-0.11	0.09	0.250	
Emotional Control:AgegrpC	-0.18	0.12	0.121	
Application:AgegrpB	-0.02	0.09	0.789	
Application:AgegrpC	0.12	0.11	0.285	
Consultation:AgegrpB	0.12	0.11	0.240	
Consultation:AgegrpC	0.21	0.13	0.116	
People Orientation:AgegrpB	0.06	0.09	0.548	
People Orientation:AgegrpC	0.21	0.12	0.069	.
Technical Orientation:AgegrpB	0.00	0.09	0.961	
Technical Orientation:AgegrpC	0.02	0.11	0.829	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-27

Comparison of Models for Job Satisfaction With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.709	0.705
R-squared	0.265	0.293
Adjusted R-squared	0.257	0.266
p-value	<.001	<.001
Value	32.08 (6, 533)	10.77 (20, 519)

Note. The details for the model without age are shown in the previous section.

Table 6-26 indicates that none of the interaction terms had a significant effect. The group over 50 years of age (AgegrpC, $\beta = 0.22$, $p = 0.021$) and the group between 35 and 49 years of age (AgegrpB, $\beta = 0.13$, $p = 0.078$) indicated a significant main effect.

Table 6-27 indicates that adding the age term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.257 to adjusted-R^2 = 0.266).

6.7.2 Self-Concept

Table 6-28 and Table 6-29 show the results for multiple regression, including interaction among the variables.

Table 6-28

Self-Concept and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	0.03	0.05	0.583	
Decisiveness	0.30	0.06	<.001	***
Persuasion	0.16	0.08	0.034	*
Leadership	0.30	0.08	<.001	***
Emotional Control	0.28	0.07	<.001	***
Routine	0.04	0.07	0.568	
AgegrpB	-0.07	0.06	0.284	
AgegrpC	0.03	0.09	0.762	
Decisiveness:AgegrpB	-0.14	0.08	0.100	
Decisiveness:AgegrpC	-0.05	0.10	0.602	
Persuasion:AgegrpB	0.07	0.09	0.440	
Persuasion:AgegrpC	0.09	0.12	0.423	
Leadership:AgegrpB	0.05	0.09	0.623	
Leadership:AgegrpC	-0.07	0.12	0.564	
Emotional Control:AgegrpB	-0.06	0.09	0.470	
Emotional Control:AgegrpC	0.01	0.11	0.918	
Routine:AgegrpB	0.05	0.09	0.584	
Routine:AgegrpC	-0.01	0.13	0.940	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$

Table 6-29

Comparison of Models for Self-Concept With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.644	0.646
R-squared	0.540	0.547
Adjusted R-squared	0.535	0.532
p-value	<.001	<.001
F value	125.50 (5, 534)	37.17 (17, 522)

Note. The details for the model without age are shown in the previous section.

Table 6-28 indicates that none of the interaction effects were significant. The main effects for the group between 35 and 49 years of age (AgegrpB, $\beta = -0.07$, $p = 0.284$) and the group over 50 years of age (AgegrpC, $\beta = 0.03$, $p = 0.762$) were not significant.

Table 6-29 indicates that adding the age term and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.535 to adjusted-R^2 = 0.532).

6.7.3 Interpersonal Fit at Work

Table 6-30 and Table 6-31 show the results for multiple regression, including interaction among the variables.

Table 6-30

Interpersonal Fit at Work and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.04	0.05	0.388	
Decisiveness	0.15	0.07	0.020	*
Routine	0.10	0.06	0.115	
Behavioural Flexibility	0.04	0.09	0.646	
Consultation	0.24	0.08	0.003	**
Group Sociability	0.32	0.07	6.76E-06	***
AgegrpB	0.00	0.07	0.972	
AgegrpC	0.21	0.09	0.016	^
Decisiveness:AgegrpB	-0.02	0.09	0.833	
Decisiveness:AgegrpC	-0.18	0.10	0.077	.
Routine:AgegrpB	0.06	0.08	0.454	
Routine:AgegrpC	0.04	0.10	0.680	
Behavioural Flexibility:AgegrpB	0.06	0.12	0.616	
Behavioural Flexibility:AgegrpC	0.16	0.14	0.257	
Consultation:AgegrpB	0.13	0.11	0.226	
Consultation:AgegrpC	0.32	0.13	0.014	^
Group Sociability:AgegrpB	-0.03	0.09	0.703	
Group Sociability:AgegrpC	-0.22	0.12	0.078	.

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-31

Predicting Interpersonal Fit at Work With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.661	0.653
R-squared	0.502	0.526
Adjusted R-squared	0.497	0.510
p-value	<0.001	<0.001
F value	107.80 (5,534)	34.08 (17, 522)

Note. The details for the model without age is shown in the previous section

Table 6-30 indicated that only the interaction effect for consultation-by-group over 50 years of age (Consultation:AgegrpC: β =0.32, p = 0.014) was significant. The main effect for the group over 50 years (AgegrpC: β = 0.21, p = 0.016) was also significant. This suggests that the relationship between interpersonal fit at work and consultation was different for the group over 50 years of age and was different from the other two age groups.

Table 6-31Table 6-31 indicates that adding the Agegroup and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.497 to adjusted-R^2 = 0.510).

6.7.4 Thriving at Work

Table 6-32 and Table 6-33 show the results for multiple regression, including interaction among the variables.

Table 6-32

Thriving at Work and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.03	0.05	0.484	
Decisiveness	0.34	0.06	<.001	***
Persuasion	0.10	0.07	0.193	
Career Orientation	0.45	0.08	<.001	***
Routine	0.35	0.06	<.001	***
People Orientation	0.00	0.07	0.968	
Consultation	0.15	0.07	0.042	*
AgegrpB	-0.04	0.06	0.519	
AgegrpC	0.14	0.08	0.079	^
Decisiveness:AgegrpB	-0.18	0.08	0.024	*
Decisiveness:AgegrpC	-0.27	0.10	0.005	**
Persuasion:AgegrpB	0.03	0.09	0.721	
Persuasion:AgegrpC	0.13	0.11	0.247	
Career Orientation:AgegrpB	0.00	0.10	0.979	
Career Orientation:AgegrpC	0.19	0.12	0.106	
Routine:AgegrpB	-0.01	0.08	0.856	
Routine:AgegrpC	0.02	0.10	0.824	
People Orientation:AgegrpB	-0.12	0.09	0.154	
People Orientation:AgegrpC	-0.25	0.11	0.018	*
Consultation:AgegrpB	0.11	0.10	0.238	
Consultation:AgegrpC	0.03	0.13	0.798	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-33

Predicting Thriving at Work With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.61	0.609
R-squared	0.612	0.620
Adjusted R-squared	0.608	0.610
p-value	p < 0.001	p < 0.001
F value	140.50 (6,533)	65.56 (13,522)

Note. The details for the model without age are shown in the previous section

Table 6-32 indicates that the interaction effects for decisiveness-by-group over 50 years of age (Decisiveness:AgegrpC: $\beta = -0.27$, $p = 0.005$) and decisiveness-by-group between 35 and 54 years of age (Decisiveness:AgegrpB: $\beta = -0.18$, $p = 0.042$) and people orientation-by-group with age over 50 years of age (People Orientation:AgegrpC: $\beta = -0.25$, $p = 0.018$) were significant.

Table 6-33 indicates that adding the Agegroup and its interaction effects caused only a minor change in the percentage of variance explained by the EdMAP factors (adjusted-R^2 = 0.608 to adjusted-R^2 = 0.617).

6.7.5 Feeling of Competence

Table 6-34 and table 6-35 show the results for multiple regression, including interaction among the variables.

Table 6-34

Feeling of Competence and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.09	0.06	0.120	
Decisiveness	0.19	0.08	0.015	*
Planning	0.11	0.08	0.177	
Application	0.17	0.07	0.016	*
Variety	-0.15	0.08	0.068	^
Autonomy	0.28	0.09	0.001	**
Consultation	0.38	0.09	3.97E-05	***
AgegrpB	0.07	0.08	0.343	
AgegrpC	0.30	0.10	0.004	**
Decisiveness:AgegrpB	0.06	0.10	0.557	
Decisiveness:AgegrpC	0.06	0.13	0.627	
Planning:AgegrpB	0.06	0.10	0.526	
Planning:AgegrpC	-0.13	0.13	0.316	
Application:AgegrpB	0.12	0.09	0.195	
Application:AgegrpC	0.14	0.12	0.250	
Variety:AgegrpB	-0.07	0.11	0.529	
Variety:AgegrpC	-0.11	0.14	0.456	
Autonomy:AgegrpB	0.02	0.11	0.832	
Autonomy:AgegrpC	0.08	0.13	0.516	
Consultation:AgegrpB	-0.04	0.11	0.745	
Consultation:AgegrpC	-0.02	0.14	0.895	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-35

Comparison of Models of Feeling of Competence With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.756	0.754
R-squared	0.355	0.375
Adjusted R-squared	0.347	0.351
p-value	p < 0.001	p < 0.001
F value	48.9(6, 533)	15.60 (20, 519)

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-35Table 6-35 indicates that adding the AgeGroup and its interaction effects caused only a small change in the percentage of variance explained by the EdMAP factors (adjusted-R2 = 0.347 to adjusted-R2 = 0.351).

6.7.6 Perceived Reward at Work

Table 6-36 and Table 6-37 show the results for multiple regression, including interaction among the variables.

Table 6-36

Perceived Reward at Work and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.06	0.06	0.321	
Persuasion	0.23	0.09	0.008	**
Variety	-0.13	0.09	0.134	
Routine	0.25	0.07	0.0006	***
Behavioural Flexibility	0.24	0.09	0.008	**
Group Sociability	0.26	0.08	0.001	**
AgegrpB	-0.05	0.07	0.502	
AgegrpC	0.20	0.09	0.0303	*
Persuasion:AgegrpB	0.00	0.11	0.978	
Persuasion:AgegrpC	-0.13	0.14	0.331	
Variety:AgegrpB	-0.10	0.11	0.383	
Variety:AgegrpC	0.11	0.15	0.459	
Routine:AgegrpB	-0.05	0.10	0.621	
Routine:AgegrpC	-0.23	0.13	0.076	.
Behavioural Flexibility:AgegrpB	0.08	0.13	0.539	
Behavioural Flexibility:AgegrpC	0.21	0.15	0.179	
Group Sociability:AgegrpB	-0.03	0.10	0.753	
Group Sociability:AgegrpC	-0.13	0.14	0.367	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '•' = $p < 0.1$

Table 6-37

Comparison of Models of Perceived Reward at Work With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.859	0.738
R-squared	0.165	0.357
Adjusted R-squared	0.157	0.336
p-value	p < 0.001	p < 0.001
F value	21.18 (5, 534)	17.11 (17, 522)

Note. The details for the model without age are shown in the previous section

Table 6-36 indicates that age had no significant interaction effects. The group over 50 years of age (AgegrpC: $\beta = 0.20$, $p = 0.03$) had a significant main effect. Table 6-37 indicates that adding the age group and its interaction effects caused a significant change in the level of variance explained by the EdMAP factors (adjusted-$R^2 = 0.157$ to adjusted-$R^2 = 0.336$).

6.7.7 Desire for Involvement at Work

Table 6-38 and Table 6-39 show the results for multiple regression, including interaction among the variables.

Table 6-38

Desire for Involvement at Work and Age Interaction Effects

	Estimate	Std. Error	pr > (t)	
(Intercept)	-0.05	0.04	0.232	
Career Orientation	0.54	0.08	<0.001	***
Routine	0.27	0.05	<0.001	***
Behavioural Flexibility	0.06	0.07	0.380	
Consultation	0.05	0.08	0.550	
Group Sociability	0.22	0.06	0.0002	***
AgegrpB	-0.01	0.06	0.801	
AgegrpC	0.11	0.07	0.118	
Career Orientation:AgegrpB	-0.10	0.10	0.339	
Career Orientation:AgegrpC	-0.20	0.12	0.097	^
Routine:AgegrpB	0.00	0.07	0.960	
Routine:AgegrpC	-0.12	0.09	0.191	
Behavioural Flexibility:AgegrpB	0.05	0.10	0.642	
Behavioural Flexibility:AgegrpC	0.17	0.13	0.189	
Consultation:AgegrpB	0.19	0.10	0.048	*
Consultation:AgegrpC	0.23	0.13	0.079	^
Group Sociability:AgegrpB	-0.20	0.08	0.015	*
Group Sociability:AgegrpC	-0.06	0.11	0.596	

Note. The factors are the LASSO selected factors from the previous section.

AgegrpA–less than 35 years, AgegrpB–between 35 and 49 years, AgegrpC–over 50 years.

Significance codes: *** = $p < 0.001$, ** = $p < 0.01$, * = $p < 0.05$, '^' = $p < 0.1$

Table 6-39

Predicting Desire for Involvement at Work With and Without Age

	Model without Age	Model with Age Interaction effects
Residual Standard error	0.58	0.57
R-squared	0.634	0.675
Adjusted R-squared	0.623	0.636
p-value	p < 0.001	p < 0.001
F value	182.9 (5, 534)	56.27 (17, 522)

Note. The details for the model without age are shown in the previous section.

Table 6-38 indicates that the interaction effects for consultation-by-group over 50 years of age (Consultation:AgegrpC, $\beta = 0.19$, $p = 0.048$) and group sociability-by-group over 50 years of age (Group Sociability:AgegrpB, $\beta = -0.20$, $p = 0.015$) were significant. Table 6-39 indicates that adding the AgeGroup and its interaction effects caused only a minor change (adjusted-R2 = 0.623 to adjusted-R2 = 0.636) in the percentage of variance explained by the EdMAP factors.

6.8 Conclusion

The predictive relationship between job satisfaction and its EdMAP predictors of persuasion, emotional control, application, consultation, people orientation and technical orientation showed no evidence of any interaction effects of age. Similarly, job self-concept, the perceived reward at work and desire for involvement at work indicated no interaction effects. The predictors for interpersonal fit at work, thriving at work and feeling of competence indicated significant interaction effects, with AgeGroupC (> 50 years) showing the most interaction effects. These results can be examined through the lens of the workplace life cycle of a teacher starting from novice/apprentice through professional to expert/emeritus or via the lens of an individual's life stages. However, the net results are a confluence of both dynamics. Teachers in different workplace life cycle phases have different expectations from their job, including expectations of leadership opportunities, financial rewards and recognition from peers (Reeves & Lowenhaupt, 2016). Similarly, the external requirements based on work-life balance change with age, with middle years having greater life demands, especially for females with children. Thus, the above finding of interaction effects is a reflection of the changing dynamics of the relationship between the workplace and the

individual with age and experience that manifests in the nexus between EdMAP attributes and workplace outcomes.

Chapter 7 Study 3: Person-Centred Analysis

7.1 Introduction

"Nature is so wisely constructed that you cannot take out one part and it anyway works" – Carl von Linne. Starting from the Greeks, the early psychologist took a holistic approach, classifying individuals to study behaviour. Since then, the advent of powerful statistical methods has enabled the decomposition of reality into different dimensions, and thereby to the development of the variable-centred approach that dominated subsequent research. However, the last few decades have seen the re-emergence of the holistic view of the individual (Bergman, 2014). Underpinned by the proposition that individual development is a dynamic, adaptive process involving the individual's mental, biological and behavioural factors interacting with social, cultural and physical factors (Bergman, 2014) and that every person is like every other person, like some other persons and like no other person, this chapter extends and complements the variable-centred analysis of the previous chapters with a person-centred investigation to identify latent groups. The research questions examined in this chapter are listed in Table 7-1.

Table 7-1

List of Research Questions Examined

Number	Research Questions
S3-RQ-1-A: EdMAP-Based Latent Profile Analysis	Will LPA find meaningful profiles of teachers based on the EdMAP set of attributes?
S3-RQ-1-B: EdMAP-Based Latent Profile Analysis Excluding Outliers	Will the exclusion of extreme individuals improve the classification and provide more theoretically relevant profiles?
S3-RQ-2: EdMAP-Based Latent Profile Analysis with Antecedent Covariates	Do the antecedent covariates of gender, age and grade taught predict the class into which an individual belongs?
S3-RQ-3: Workplace Outcome-Based Latent Profile Analysis	Will LPA find meaningful profiles of teachers based on the workplace outcomes of job satisfaction, job self-concept and PWBW?

Note: The research question S3-RQ-1 is examined in two parts, as the data indicated the need.

7.2 Methodology

Factors Used

The following analysis was conducted using a subset of EdMAP attributes identified as important in the predictive relationship between job satisfaction and job self-concept (Table 7-2).

Table 7-2

Attributes Used for the Person-Centred Analysis

EdMAP Attributes Used for Analysis	Outcome Attributes Used for Analysis	Antecedent Covariates Examined
Emotional Control (EMAT)	Job Satisfaction	Age
Career Orientation (CARI)	Self-Concept	Gender
Application (APPL)	Interpersonal Fit at Work	Grade Taught
Variety (VARI)	Thriving at Work	
Routine (ROUT)	Feeling of Competence	
Consultation (CONS)	Desire for Involvement at Work	
	Perceived Reward at Work	

Note. Gender and age are hypothesised as antecedent covariates.

LPA as implemented in the MPLUS package (Muthén & Muthén, 1998-2012) was used.

7.3 Results

7.3.1 S3-RQ-1-A: EdMAP-Based Latent Profile Analysis

The goodness of fit of the LPA models is listed in Table 7-3.

Table 7-3

Summary of LPA Model Fit Parameters for Two- to Seven-Class Models

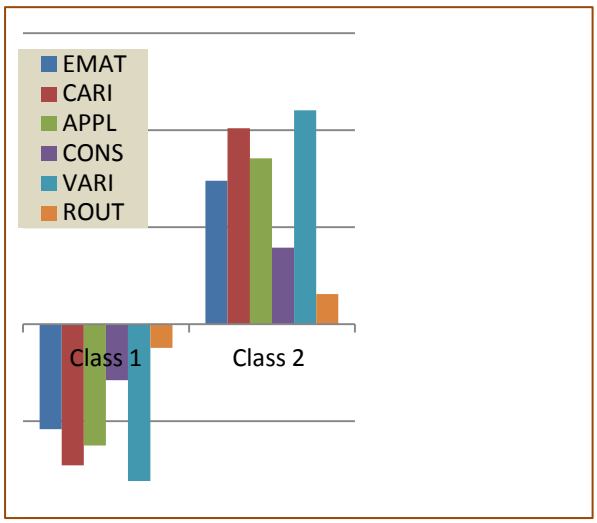
Classes	Parameters	Class size %	AIC	BIC	aBIC	Entropy
2	19	58, 41	13509.9	13600.8	13540.5	0.76
3	26	36, 19, 44	13321.6	13446.1	13363.5	0.71
4	33	32, 44, 21, 2	13190.6	13348.6	13243.8	0.76
5	40	2, 24, 45, 27, 2	13098.9	13290.4	13163.3	0.78
6	47	24, 2, 0, 1, 27, 43, 2	13009.4	13234.4	13085.1	0.81
7	54	2, 21, 25, 42, 2, 5, 3	12946.2	13204.6	13033.1	0.82

Note. AIC–Akaike information criterion, BIC–Bayesian information criterion, aBIC–Adjusted Bayesian information criterion.

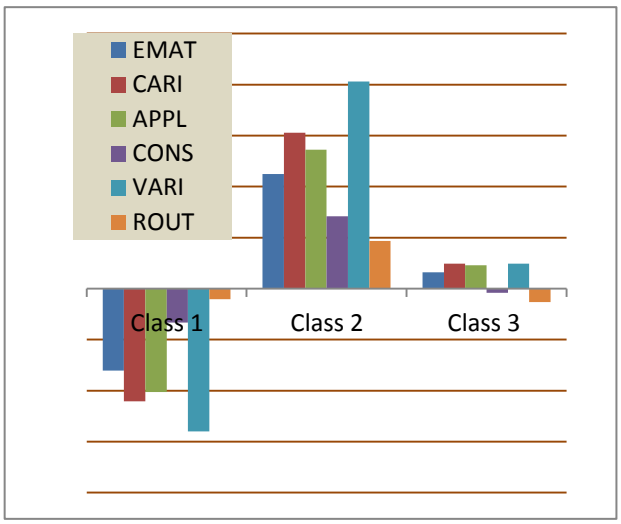
The corresponding means plots for the two- to five-class models are shown in Figure 7-1.

Figure 7-1

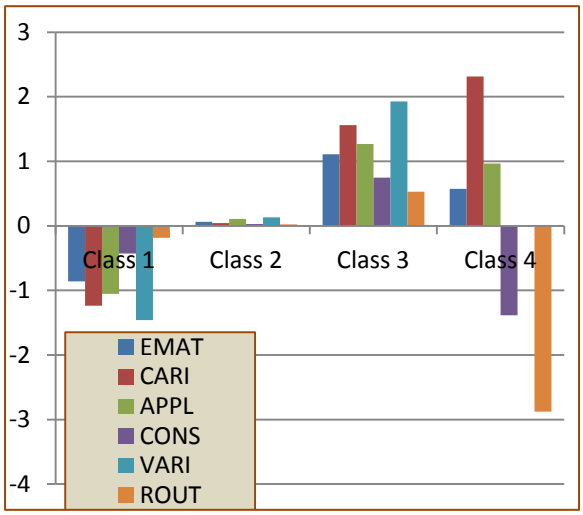
Means Plots for the Two- to Five-Class Models



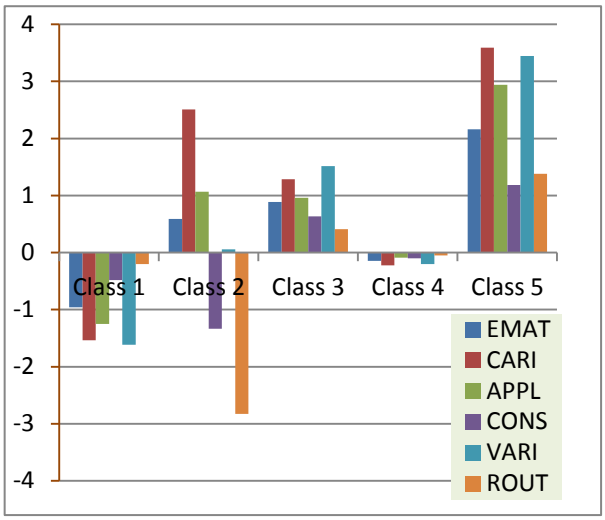
A. Two-Class LPA Model



B. Three-Class LPA Model



C. Four-Class LPA Model



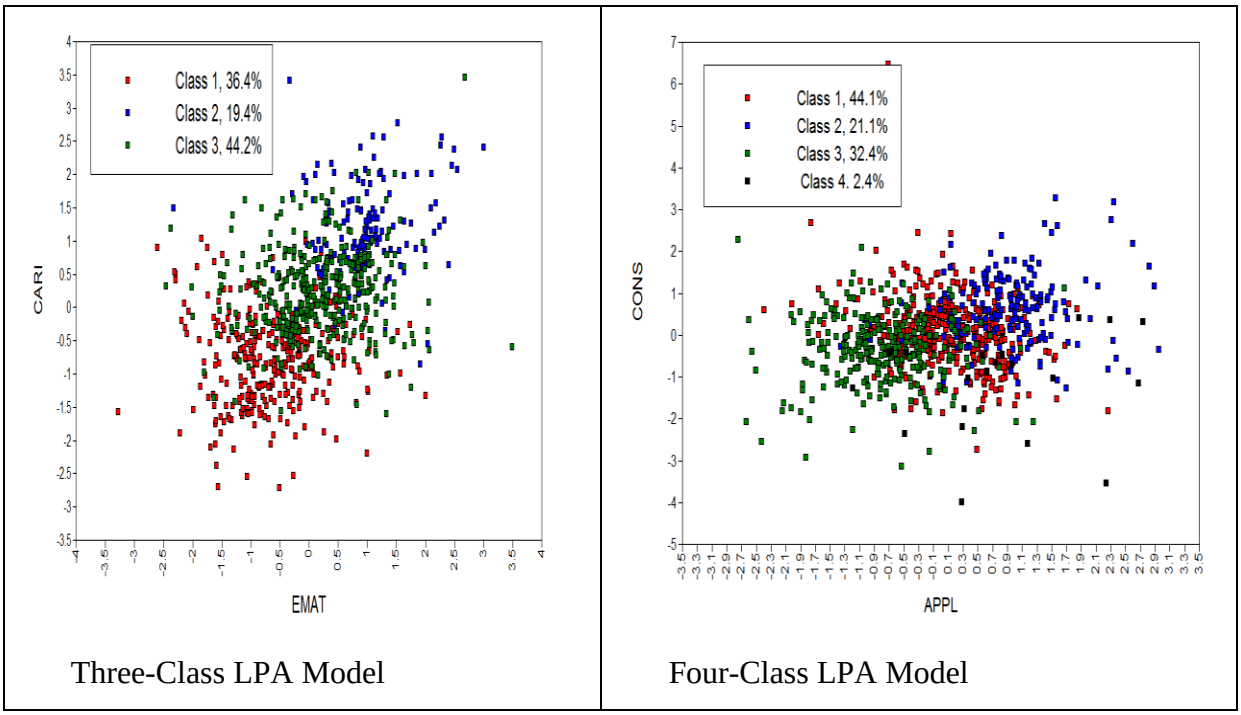
D. Five-Class LPA Model

Note. EMAT–Emotional control, CARI–Career orientation, APPL–Application, CONS–Consultation, VARI–Variety, ROUT–Routine.

A sample of scatter plots for the three and four-class models are shown in Figure 7-2.

Figure 7-2

Sample Scatter Plots for the Three- and Four-Class Models



Three-Class LPA Model | Four-Class LPA Model

Note. EMAT–Emotional control, CARI–Career orientation, APPL–Application, CONS–Consultation.

The values for the key criteria of AIC and BIC decreased as the number of classes increased, indicating that the fit improved with the increasing number of classes. This result was as expected, as these indicators are dependent on sample size. Marsh et al. (2009) postulated that information criteria will always favour the most complex and, therefore, the most saturated model. Entropy that indicates the accuracy of classification decreased from the two-class model to the three-class model before starting to increase from the four-class model onwards. As the number of classes increased, entropy increased, indicating that individuals were classified with greater confidence (Muthén, 2004).

Two-Class Model

The means plot in Figure 7-1 for the two-class model indicated level-based differentiation. Class 1 had high values for all attributes and Class 2 had correspondingly low values. With 48% and 52% of the population, the sample was evenly divided across the two classes.

Three-Class Model

The means plot in Figure 7-1 for the three-class model indicated level-based differentiation. Class 1 (36% of the population) was low-class with all attributes having low values, Class 2 (19%) was high-class for all the attributes and Class 3 (44%) was medium-class for all the attributes. The means plot shows that consultation and routine had a smaller contribution to the differentiation. The scatter plot in Figure 7-2 visually confirmed that the classes were less influenced by the level of consultation as each class contained the full range of consultation values. The mean of the factor routine was similar for the low- and medium-classes.

Four-Class Model

The four-class model in Figure **7-1** maintained the stability of the level-based differentiation of the three-class model with similar classes. Class 1 (32%) was low-class, Class 2 (43%) was medium-class and Class 3 (21%) was high-class with high values. However, Class 4 (2.3%) emerged as a mixed-class, revealing a different profile with a smaller sub-population. Class 4 had high means for emotional control, application, career orientation and variety, and very low values (lower than those of Class 1) for consultation and routine, identifying a group differentiated by the shape of the profile.

Five-Class Model

The five identified classes of the five-class model continued the stability of the level-based differentiation of the four-class model. Class 1 (24%) was low-class, Class 4 (43%) was medium-class and Class 3 (27%) was high-class. Class 2 (2.5%) with high means for emotional control, application, career orientation and variety, and very low values for consultation and routine, was the mixed-class similar to the four-class model. The individuals in the mixed-class subpopulations of the four- and five-class models were mostly the same. The new Class 5 (1.8%) with extremely high values indicated the existence of extreme individuals.

Six- and Seven-Class Models

In the six- and seven-class models, the three high, medium, and low classes differentiated by level remained well-defined and stable in size as the number of classes increased. Each of the additional classes had only a small percentage (< 5%) of the population and had extreme means.

In the absence of a theoretical need to acknowledge and investigate the existence of very small groups with different profiles, the LPA indicated the three-class model was the most plausible classification, capturing 95% of the population within the three main classes.

The extreme high and extreme low means of the additional classes in the five-, six- and seven-class models indicated extreme individuals. Bergman (1988) found that there can be a small number of unique individuals, not similar to any other subjects, whose inclusion may misdirect the results of the cluster analysis, and thus should not be forced into a cluster. Therefore, the following investigates whether the exclusion of extreme individuals would improve the classification.

7.3.2 S3-RQ-1-B: EdMAP-Based Latent Profile Analysis Excluding Outliers

As a precursor to this investigation, a simulation study was used to examine the influence of outliers on the ability of the MPLUS classification algorithm to identify latent classes. By using an aggregated sample population consisting of four distinct normal subpopulations, the study found that removing outliers enabled the algorithm to identify the true source-classes. The findings of the simulation study are summarised in the appendix D. The following analysis excludes outliers with attributes outside 2.6 standard deviations, retaining 94% of the population (Table 7-4).

Table 7-4

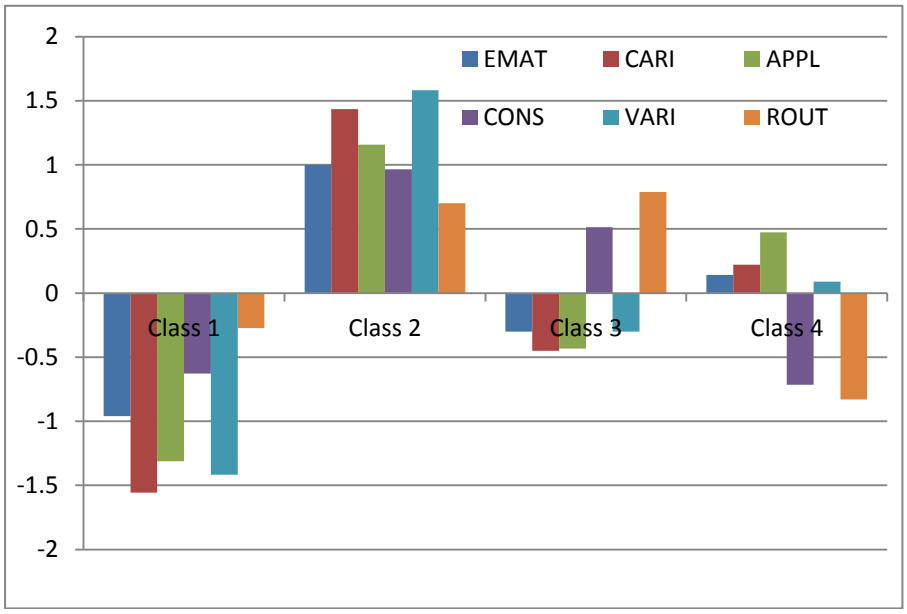
Summary of LPA Model Fit Parameters for Three- to Five-Class Models Excluding Outliers

Classes	Parameters	Class size (%)	AIC	BIC	aBIC	Entropy
3	26	43, 31, 25	9903.71	10024	9949	0.71
4	33	28, 27, 24, 19	9820.76	9974	9869	0.69
5	40	26, 26, 18, 23,6	9773.74	9959	9832	0.72

Note. AIC–Akaike information criterion, BIC–Bayesian information criterion, aBIC–Adjusted Bayesian information criterion.

Figure 7-3

Means Plots for the Four-Class Model Excluding Outliers



Four-class LPA model excluding outliers

Note. EMAT–Emotional control, CARI–Career orientation, APPL–Application, CONS–Consultation, VARI–Variety, ROUT–Routine

Three-Class Model Excluding Outliers

The three-class model excluding outliers had the same set of profiles as the three-class model with outliers. Class 1 (42%) was medium-class, Class 2 (31%) was low-class and Class 3 (24%) was high-class. There was no change in the model profiles, indicating a similar level-based differentiation as the previous analysis.

Four-Class Model Excluding Outliers

As seen from Figure 7-3, the four-class model excluding outliers produced a significantly different classification to the four-class model with outliers. The analysis identified two classes with a level-based differentiation and two classes with a profile-based differentiation. Each of the latter classes had a significant population.

The classes of the four-class model continued the stability of the high and low classes of the three-class model. Class 1 (28%) was low-class and Class 2 (27%) was high-class. However, Class 3 and Class 4 were two mixed medium-classes with different profiles. Class

3 (24%) had low means for emotional control, application, career orientation and variety and high values for consultation and routine. Class 4 (19%) had high means for emotional control, application, career orientation and variety and extremely low values (lower than the low-class) for consultation and routine. Thus, Class 4 can be viewed as populated by impatient "young Turks" with a low tolerance for routine and low propensity for consultation, but eager for variety, highly career oriented and dedicated to work (application).

Conclusion

The exclusion of outliers in the four-class model unearthed classes with shape-based differentiation and with a significant percentage of the population. From a methodological perspective, these results confirm the applicability of the simulation findings on the influence of outliers to EdMAP, and thus supports Bergman's (1988) recommendation to remove extreme unique individuals in the form of outliers to overcome the impact of multivariate outliers on the cluster analysis. From a theoretical perspective, it is a confirmation of the existence of a small percentage (a rare profile) of extreme individuals resulting from either one or both environmental conditions and genotypes (Bergman & Magnusson, 1997), who should subsequently be studied separately if practically warranted.

The following section investigates whether the probability of class membership can be predicted by the antecedent factors of gender, age and grades taught.

7.3.3 S3-RQ-2: EdMAP-Based Latent Profile Analysis with Covariates

While there are many ways to study the effect of covariates including a) analysing within-class variations, b) analysing the influence on the observed variables indirectly through latent continuous variables or c) analysing between-class variation (Lubke & Muthén, 2005), the following used a simplified evaluation within the MPLUS framework. Two parallel models of a) including the influence of the correlate in the classification and b) considering the correlate as an auxiliary variable were examined. Since including the correlate as auxiliary variable may influence the classification (Lubke & Muthén, 2005), the following shows both models.

The covariate analysis was conducted for both three-class and four-class models. However, in the four class models, the numbers of teachers in some groups were too small (the below 10, considered the rule of thumb minimum) to make any valid conclusions and therefore the covariate analysis for the four-class models are not presented.

Gender as a Covariate

Table 7-5 presents the three-class LPA model with age as a covariate.

Table 7-5

Three-Class Model Fit With Gender as a Covariate

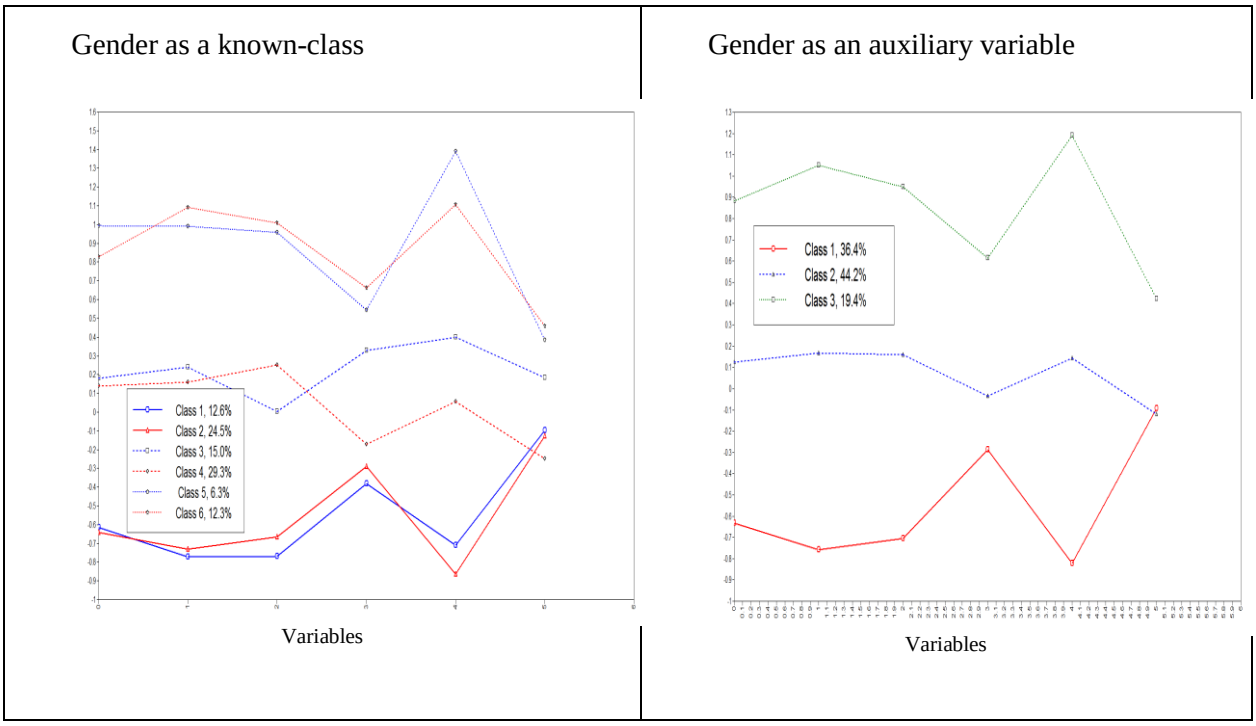
Classes	Parameters	Class size (%)	AIC	BIC	aBIC	Entropy
Three classes - Gender as a known-class	45	Males – 12, 15, 07 Females – 24, 30, 12	14331.51	14546.61	14403.70	0.83
Three classes - Gender as an auxiliary variable	26	36, 44, 19	13321.64	13446.09	13363.52	0.71

Note. AIC–Akaike information criterion, BIC–Bayesian information criterion, aBIC–Adjusted Bayesian information criterion.

The corresponding means plot for the three-class model is shown in Figure 7-4.

Figure 7-4

Means Plots for the Three-Class Model With Gender as a Covariate



Note. Blue–Males, Red–Females. Attributes: 0–Emotional control,1–Career orientation, 2–Application, 3–Consultation, 4–Variety, 5–Routine.

Comparing the patterns of the means for the three-class models (Table 7-5) showed that there was no significant difference between the patterns for the genders. Males and females, when considered separately, continued to display the three level-based classes and similar profiles. The entropy of the known-class model was 0.83, indicating improved classification. The four-class model provided a similar result with no visible difference between genders. Thus, separating the two genders had no significant effect on the class profiles.

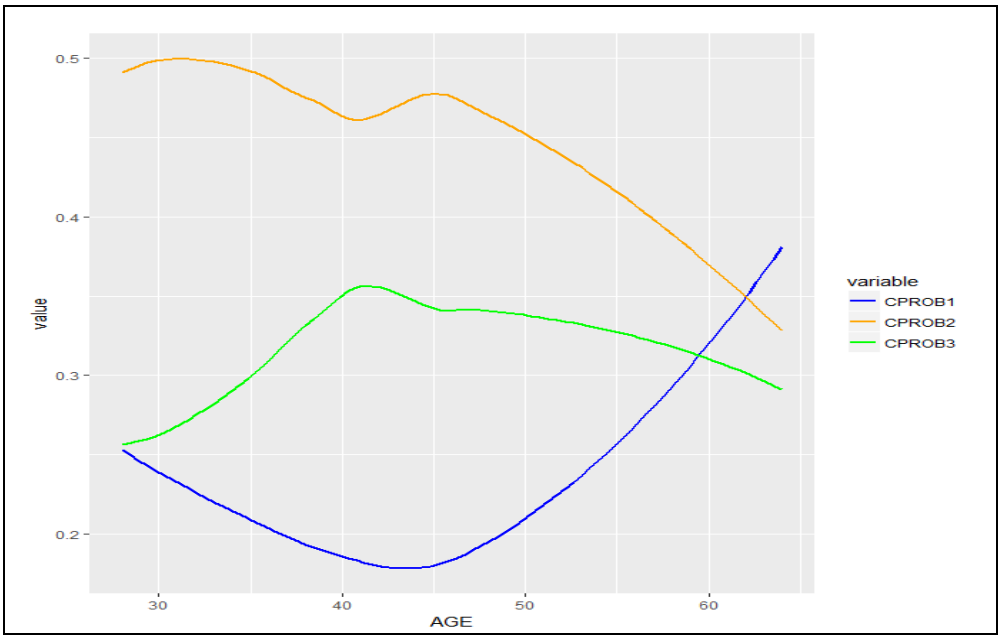
Marsh et al. (2009) investigating the influence of correlates postulated that while correlates can increase the accuracy of class proportions and profiles of classes, the classes should not change qualitatively unless the assumption that nominated correlates only affect the class probabilities is violated. Thus, there was no evidence of gender induced heterogeneity in this sample.

Age as a Covariate

Figure 7-5 presents the age vs. class probability for the three-class LPA model in section 7.3.1.

Figure 7-5

Class Probabilities With Age



Note. CPROB1–Probability of being in Class 1 (low-class), CPROB2–Probability of being in Class 2 (high-class), CPROB3–Probability of being in Class 3 (medium-class)

The three classes identified in the classical LPA were primarily level-based classes, with distinct high, medium, and low classes. The probability of being in the low-class (Class 1) was high for the younger age group and the probability decreased with age until the 40s and then increased. The probability of being in the medium-class (Class 3) started low in the 30s, increased until the mid-40s and then tapered very slowly. The probability of being in the high-class (Class 2) started high and tapered with age. Thus, age changed the probability of being in a specific level-based class.

Grades Taught as a Covariate

Table 7-6

Summary of LPA Model Fit with Grades Taught as a Covariate

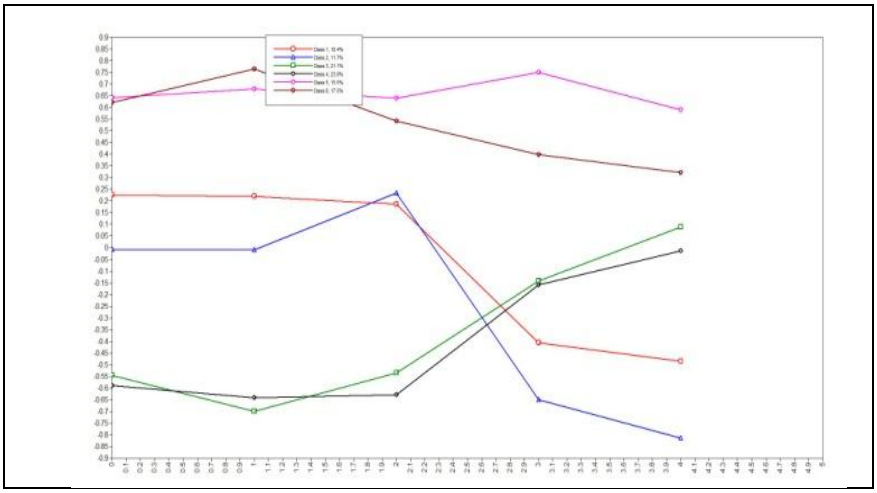
Classes	Parameters	% of Population	AIC	BIC	aBIC	Entropy
Three classes – Grade taught as a known-class	38	Primary teachers – 10, 22, 14 Secondary teachers– 11, 22, 18	10892.52	11071.75	10951.08	0.79
Three classes – Grade taught as an auxiliary variable	17	35, 45, 20	9928.36	10487.37	10243.04	0.73

Note. AIC–Akaike information criterion, BIC–Bayesian information criterion, aBIC–Adjusted Bayesian information criterion.

The corresponding means plot for the three-class model is shown in Figure 7-6.

Figure 7-6

Factor Means by Grade Taught



Note. 0–Emotional control, 1–Career orientation, 2–Application, 3–Consultation, 4–Variety, 5–Routine.

The profiles for the primary and secondary teachers were similar (Table 7-6). Thus, the contextual variable of grades taught did not show evidence of inducing heterogeneity in class membership.

7.3.4 S3-RQ-3: Workplace Outcome-Based Latent Profile Analysis

Table 7-7 presents the results for the three-class model for the workplace outcomes.

Table 7-7

Summary of LPA Profile-Based on Outcomes for Job Satisfaction, Job Self-Concept and Psychological Well-Being at Work

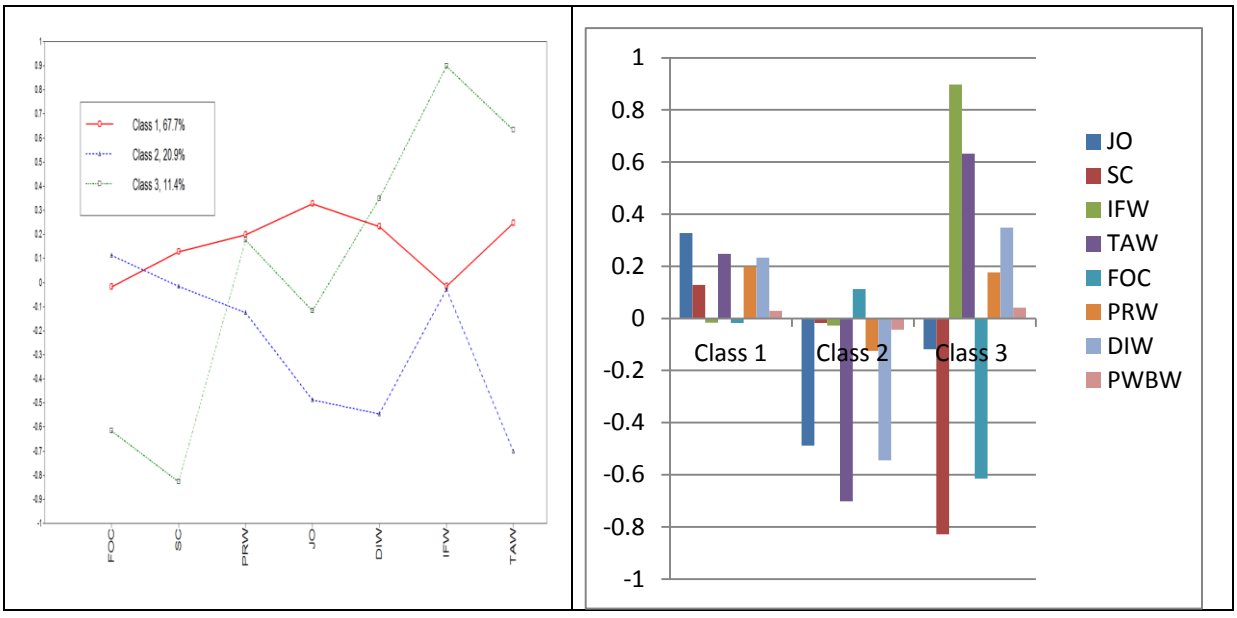
Classes	Parameters	% of Population	AIC	BIC	aBIC	Entropy
Three classes	38	67, 20, 11	13017.42	13176.10	13068.13	0.74
Four classes	47	65, 20, 11, 2	12873.43	12991.58	12852.42	0.71

Note. AIC–Akaike information criterion, BIC–Bayesian information criterion, aBIC–Adjusted Bayesian information criterion.

The corresponding means plot for the three-class model is shown in Figure 7-7.

Figure 7-7

Factor Means for Workplace Outcomes



Note. JO–Job satisfaction, SC–Self-concept, IFW–Interpersonal fit at work, TAW–Thriving at work, FOC–Feeling of competence, PRW–Perceived reward at work, DIW–Desire for involvement at work.

Class 1 with 67% of the population contained the majority and was mainly differentiated by level with higher values than Class 2. Class 2 with 20% of the population was mainly differentiated by level with lower values than Class 1 and Class 3.

Class 3 with 11% of the population was a mixed-class distinguished by a shape difference with very low values for the feeling of competence measured by "I feel confident at work" and job self-concept measured by "I feel that I am competent in my job", and very high values for interpersonal fit at work, desire for involvement at work and thriving at work. Considering the basic human need for competence and the need for the ability to master the environment (Ryan & Deci, 2000), this group can be conceptualised as having low self-esteem or self-worth in the job context. In contrast, they had a very high interpersonal fit at work, thriving at work and a high desire for involvement at work than the other teachers. It can be argued that high thriving at work and desire for involvement at work are related to intrinsic motivation, and thus this group is low on self-esteem and high on intrinsic motivation.

As an alternative conceptualisation, Crocker and Park (2004) proposed that people adopt goals to validate their capabilities and achievements and try to enhance self-worth in the costly pursuit of self-esteem via contingencies of self-worth. Consequently, striving for and achieving greater interpersonal fit at work and desire for involvement at work are good strategies for enhancing self-worth in the work context. Therefore, this group can be viewed as being low on self-esteem and engaged in the pursuit of self-esteem via strategies of achieving high interpersonal fit at work and seeking greater involvement at work.

Furthermore, Bandura (1997) found that teachers with high self-efficacy spend more classroom time in teaching-related tasks, pay more attention to student motivation and are less likely to be authoritative. Additionally, a higher self-efficacy of teachers predicts both teacher and student behaviours, including the use of innovative teaching strategies, teacher task persistence, teacher resilience and student achievement (Klassen et al., 2011). Consequently, this group with a low sense of self-worth and self-efficacy is a group of high practical interest.

7.4 Conclusion

This chapter focused on a person-centred investigation. Classical LPA indicated the three- and four-class models were the most plausible with a good model fit. While the three-class model was primarily a level-based differentiation, the four-class model found the fourth class with a different shaped profile. However, the sub-population was too small to make this class of practical value.

Excluding the outliers continued the stability of the subpopulations with high and low profiles. The four-class model excluding outliers found two “medium” classes with a shape difference and substantial subpopulations. One had higher emotional control, career orientation, application and variety and very low values for consultation and routine, indicating a substantial population of young Turks.

LPA using the outcomes of job satisfaction, job self-concept and facets of PWBW found an interesting sub-group pursuing self-esteem, with very low self-concept and feeling of competence, but with very high interpersonal fit at work and a strong desire for involvement at work.

Relating the classes to the covariates showed that gender played no statistically significant role in determining the EdMAP classes. However, there was a visible age-related pattern for the probability of being in a specific class. Grade taught showed no visible impact on the probability of being in a class.

An individual’s identity is a multifaceted concept, co-constructed from the individual’s attributes, the relationships with others and larger social groups, the technical and emotional aspects of teaching and the interaction between the personal experiences of the social, cultural and institutional environment (Day & Kington, 2008). However, individuals tend to adopt the identity of the group, causing the individual identity of the person to recede to the background (Korte, 2007). Thus, the level of standardisation was anticipated.

The teacher’s identity determines their personal involvement in a range of behaviours, including classroom management strategies and approaches to fostering collaborated learning and student creativity. As teachers are an influential co-constructor of student identity, their own profiles will have a significant impact on the students. An impatient young Turk with high career orientation, application and variety and low consultation and routine is likely to encourage similar attributes in a student. Individuals with a low profile in all attributes need to be investigated to identify strategies to improve their profiles. Similarly, individuals pursuing self-esteem need to be identified and their low self-esteem must be addressed to minimise the impact on teaching strategies and student interactions.

Chapter 8 Discussion and Conclusion

8.1 Introduction

The objective of this thesis was to investigate the motivation of teachers via the development of a set of individual motivational attributes that can successfully predict positive workplace outcomes. Three interrelated substantive methodological studies of Hong Kong teachers achieved the above objective. Study 1 established a psychometrically sound set of attributes, i.e., an EdMAP for teachers. Subsequently, Study 2 investigated the predictive relationship between the EdMAP and workplace outcomes of job satisfaction, job self-concept and PWBW. Finally, Study 3 used LPA to investigate practically relevant profiles of teachers based on EdMAP attributes. This chapter reviews the key findings of the above studies, analyses their strengths and weaknesses, examines the implication of the findings on educational policies and suggests some directions for future research. The EDMAP instrument contained 23 attributes and 115 items. However, some analysis was carried out with 22 attributes and 110 items due to convergence issue with the attribute tenacity.

8.2 Summary of Findings

The following presents a summary of the findings of the three studies.

8.2.1 Study 1–Psychometric Properties of the EdMAP Instrument

Researchers of motivation have sought to establish a set of individuals' attributes that can successfully predict workplace outcomes for the individual. Consequently, Study 1 examined 23 diverse attributes of the Hong Kong teacher sample by administering an adapted version of the 115 item EdMAP instrument that was previously validated for middle managers (Marsh & McInerney, 1991). The analysis found that the instrument reliably measured the constructs being studied.

When considered individually, each of the 23 attributes indicated an excellent fit. A total of 90% of the items had factor loadings above 0.60. Similarly, one-factor omega indicated high reliability with 22 of the 23 factors having $\omega > 0.80$. Thus, the EdMAP attributes were found to be well-defined and measured by the nominated indicator items.

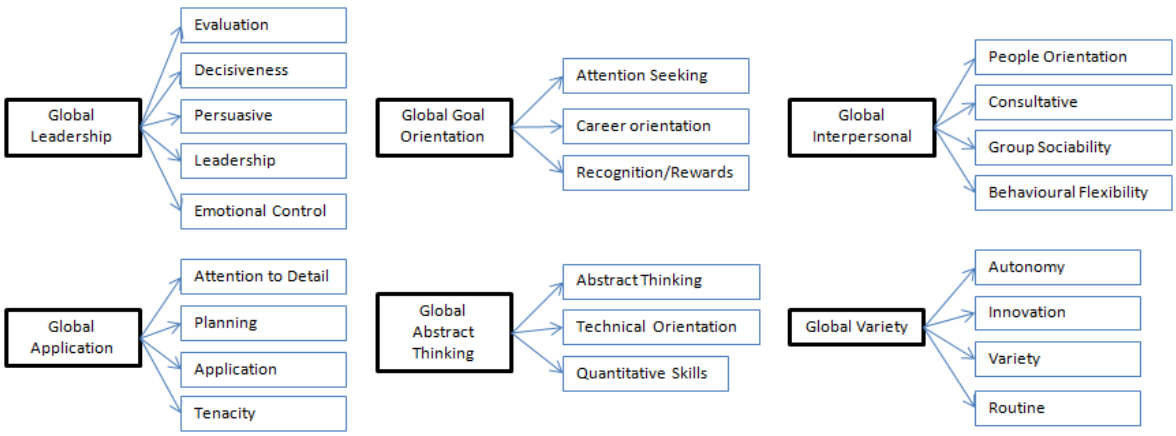
The consolidated multifactor congeneric model with all 23 attributes indicated a poor overall fit. However, most factor loadings remained above 0.60 and were consistent with the individual values of the one-factor congeneric model, thereby maintaining the plausible definition of the individual attributes.

The ESEM model with cross-loadings yielded an excellent fit. Furthermore, the ESEM model had lower cross-loadings and factor correlations than those of the CFA models. However, the factor loadings for the ESEM model followed a similar pattern to the CFA model, indicating a consistent model structure. Therefore, considering the reality that indicators are rarely, if ever, uniquely related to a single construct (Marsh et al., 2009) and the superior fit, the ESEM determined factors were chosen and used for the subsequent analysis.

The investigation into the second-order factors via CFA and ESEM found support for the a-priori second-order factors of global-leadership, global-goal orientation, global-interpersonal, global-application, global-abstract thinking, and global-variety initially hypothesised by Marsh and McInerney (1991). Figure 8-1 summarises the hypothesised structure.

Figure 8-1

Second-Order Factor Structure



Following from Marsh et al.'s (2014) proposition that confirming measurement invariance is fundamental to the evaluation of construct validity, the data was evaluated using a four-level nested model framework. Each of the models of configural invariance, weak measurement invariance, strong measurement invariance and strict measurement invariance confirmed that the factor structure, factor loadings and factor variances/covariances were

invariant across gender, age and grades taught. Thus, the instrument measured the same construct across the groups.

Mean Differences in EdMAP Attributes by Age and Gender

The majority of teachers were females, with the percentage of males increasing from 29% in the under-30 age group to 41% in the 51–55 age group (Table 5-41), demonstrating a predominance of females in the profession, a trend that is replicated in many other countries (Cruickshank, 2018). The study found significant differences in the means of EdMAP attributes by age and gender. As an example, for leadership and career orientation, the female teachers displayed a dip in mean values during their mid-30s, followed by a subsequent gradual increase with age (Figures 5-2 to 5-5). Male teachers displayed a different pattern, with a gradual decrease with age. Most other EdMAP attributes displayed variation with age and different patterns between males and females. The ramifications are discussed in subsequent sections.

8.2.2 Study 2–Prediction Power of EdMAP Items on Workplace Outcomes

Study 2 examined the structural relationship between the EdMAP attributes and the workplace outcomes via standardised β coefficients, examined predictive invariance by evaluating the interaction effects of gender, age and grades taught and evaluated the predictive accuracy of the relationship.

When considered individually, the majority of the EDMAP attributes showed strong regression (β) coefficients, predicting job satisfaction, job self-concept and PWBW (Table 6-2). Many attributes had β coefficients higher than 0.10 and significant p-values ($p < 0.001$). This result was expected because they were chosen on the basis that previous research had found them to be relevant to workplace outcomes.

Job Satisfaction

Job satisfaction measured by items such as “I am very satisfied with the work that I do” had the highest coefficient ($\beta = 0.37$) with career orientation, suggesting a substantial nexus between career orientation and job satisfaction. Similarly, high regression coefficients in the 0.20–0.30 range for the people-oriented attributes (e.g. emotional control and consultation) suggested that these were important attributes for predicting job satisfaction as a teacher.

Job Self-Concept

Job self-concept measured by items such as "I am good at what is expected of me" had the highest coefficient (β = 0.63) with career orientation, indicating that teachers who want to achieve their goals are good at what is expected of them. The similar high coefficient for leadership (β = 0.61) indicates that teachers who feel that they are good leaders also feel that they are good at doing what is expected of them, thus suggesting an important role for leadership.

Overall, the predictive effects on job self-concept were higher than those on job satisfaction, indicating that the EdMAP set of attributes had a stronger affinity to job self-concept than job satisfaction. Furthermore, the pattern of regression coefficients for job satisfaction was different from that for job self-concept, thereby indicating a different aetiology. This result can be attributed to the substantial influence of extrinsic influences, such as pay and work conditions that contribute to job satisfaction when compared to the intrinsic influences that contribute to job self-concept.

Interpersonal Fit at Work

Interpersonal fit at work, measured by "I enjoy working with the people at my job" had the highest regression coefficient (β = 0.64) for consultation and a similarly high coefficient (β = 0.62) for behavioural flexibility. The above nexus suggests that teachers who encourage others to contribute and can adjust their behaviour to the work context find that they can enjoy working with people at their job. Since interpersonal fit at work can be a measure of competence and contribute to both the basic human need for competence and relatedness (Deci & Ryan, 2008), the two adaptive attributes of consultation and behavioural flexibility can be a pathway for intrinsic motivation.

Thriving at Work

Thriving at work, measured by "I find my job exciting" had the highest regression coefficient (β = 0.68) with career orientation and a similarly high coefficient (β = 0.61) for leadership. The above suggests that career-oriented teachers and those who have a high perception of their leadership capability feel that they have an exciting job. Notably, this result is contradictory to the common stereotype that individuals with high ambition or leadership capabilities will not find teaching an exciting career. This aspect can be advertised to encourage more career-oriented individuals to join the profession.

Feeling of Competence

Feeling of competence, measured by "I feel confident at work", had the highest coefficient (β =0.47) for consultation and a high coefficient (β = 0.42) for autonomy. This result suggests a substantial nexus between encouraging the contribution of others and feeling confident at work.

This substantial nexus between the feeling of competence and autonomy can be interpreted as a positive of the school environment, such that individuals who like autonomy are encouraged and made to feel competent. This result also suggests that Reeve and Assor's (2011) assessment of the school as an autonomy promoting environment for students extends to teachers and may be the result of teacher behaviour.

Perceived Recognition at Work

Perceived recognition at work, measured by "I feel that my work is recognised" had the highest coefficient (β = 0.48) for behavioural flexibility, closely followed by a coefficient of (β = 0.47) for consultation. This result confirms the view that the classroom can be a challenging environment for the teacher. Consequently, the teacher's behavioural flexibility in adjusting to managing the demanding student behaviours and parent expectations plays a crucial role in classroom success and subsequently manifests as recognition at work. Conversely, the high β coefficient for consultation suggests that recognition at work may not only originate from superiors but also from co-workers and other stakeholders, including students and parents, whose contributions are canvassed via consultation. The stakeholders recognise and acknowledge the effort of consultation as a positive. Subsequently, the substantial nexus between consultation and recognition at work can be interpreted as a manifestation of the increasing push for democracy in the classroom and an increasing role of consultation in the school environment.

Desire for Involvement at Work

The desire for involvement at work measured by "I take the initiative at work" had the highest coefficient (β = 0.73) for career orientation, closely followed by consultation, leadership and variety, with each having a β value over 0.65. This finding suggests a multitude of reasons why a teacher may want additional involvement at work and can be used to educate planners to identify the different reasons for more involvement at work and harness the potential by the appropriate matching of opportunities. These teachers will

welcome thought leadership opportunities within the education system as well as within the broader society, successfully engage in broader consultation such as parent-teacher interactions and collegial interactions and search for variety via involvement in research and implementation of new teaching practices.

Overall, the five facets of PWBW had several attributes with β coefficients over 0.40 and $p < 0.001$, indicating a very high predictive value. Except for perceived recognition at work, the other facets had higher β coefficients than job satisfaction. This observation of higher affinity of EdMAP to the facets of PWBW such as thriving at work, when compared to job satisfaction, is evidence of Dagenais and Savoie's (2012) proposition that employees describe their PWBW primarily in eudemonic terms. The EdMAP items for predicting job self-concept were more aligned with thriving at work and interpersonal fit at work.

Ironically, technical orientation showed a negative β coefficient to both job satisfaction and job self-concept, a result that must be investigated in the future.

When the top 10 attributes across all outcomes were considered, leadership, emotional control, career orientation, behavioural flexibility, consultation and group sociability maintained strong β coefficients, indicating their pervasive impact in the workplace. The relationship-orientation of the above attributes (as opposed to the task-orientation of attributes such as attention to detail) is evidence to confirm Holland's (1997) categorisation of teaching as a "social" career.

Integrated Instrument

As shown in Table 6-3, when considered as an integrated instrument, the overall model for job satisfaction resulted in an adjusted-R^2 of 0.30. Similarly, the model for job self-concept resulted in an adjusted-R^2 of 0.66, indicating the strong predictive power of the integrated instrument. However, the individual β values were distorted by multicollinearity and cannot be interpreted, thus necessitating further statistical treatment.

Multicollinearity and the Important Factor Selection

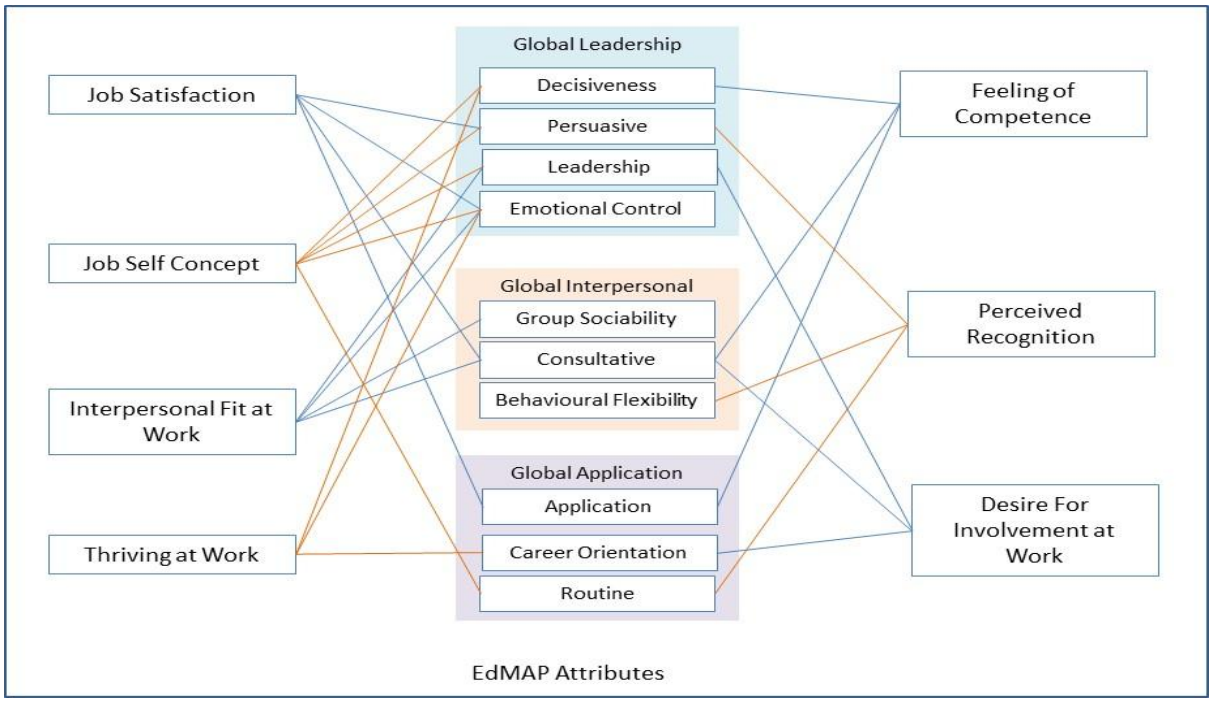
The LASSO technique was used to address multicollinearity and identify the "important factors" that predict workplace outcomes. The important factors with high predictive value are summarised below and in Figure 8-2:

- Job satisfaction is predicted by persuasiveness, emotional control, application, people orientation and consultation.

- Job self-concept is predicted by decisiveness, persuasiveness, leadership, emotional control and routine.
- Interpersonal fit at work is predicted by consultation, emotional control, leadership and group sociability.
- Thriving at work is predicted by decisiveness, emotional control and career orientation.
- Feeling of competence is predicted by decisiveness, application, consultation and autonomy.
- Perceived recognition at work is predicted by persuasiveness, behavioural flexibility and routine.
- The desire for involvement at work is predicted by leadership, career orientation and consultation.

Figure 8-2

Outcomes and LASSO Selected Important Factors



The prevalence of the "relationship-oriented" attributes that manifested when the individual attributes were examined was maintained in the LASSO selected factors.

Predictive Invariance

The examination of the interaction effects of gender and age on the regression relationship between EdMAP and outcomes found evidence of predictive non-invariance. This finding of different patterns of age and gender invariance for the different outcomes in their regression relationship with EdMAP has significant policy implications which are discussed later in this chapter.

8.2.3 Study 3–Person-Oriented Analysis

Study 3 investigated whether teachers can be categorised by qualitatively and quantitatively distinct profiles of EdMAP attributes. The profiles were then analysed to ascertain whether the antecedent covariates of gender, age and grade taught had any impact on the probability of an individual belonging to a specific class.

Emotional control, career orientation, application, consultation, variety and routine were used to evaluate EdMAP-based latent profiles. Similarly, job satisfaction, job self-concept and the five facets of PWBW were used to evaluate workplace outcome-based latent profiles.

EdMAP-Based on Latent Profiles

The three-class model with high, medium and low classes provided the least entropy. The four-class model identified three level-based high, medium and low classes and an additional shape-based class with high mean values for emotional control and career orientation, and low mean values for routine and consultation. However, the small population (< 5%) of this shape-based fourth class rendered it of limited practical relevance.

Latent Profiles Within the Main Cohort

The scatter plots of the six- and seven-class models indicated a strong influence of outliers with a small proportion of the population. Considering Bergman and Anderson's (2010) suggestion that some multivariate outliers are best excluded, the main cohort after excluding the outliers was analysed.

The four-class model excluding outliers unearthed two substantial shape-based subpopulations. This result suggests that the main cohort that appeared as the medium-class containing approximately 40% of the population consisted of two latent subgroups with shape-based profile differences. One sub-group with 21% of the population had low means for emotional control, application, career orientation and variety and high means for

consultation and routine. The other sub-group with 19% of the population with very low values for consultation (“I like to consult and reach consensus”) and routine (“I like repetitive work”) and very high values for emotional control (“I control my emotions in all circumstances”), application (“I am hard-working”), career orientation (“I am ambitious about my career”) and variety (“I am happier with frequent changes of activity”) resembles young Turks within the teacher population.

Impact of Covariates on Latent Profiles

When the impact of the covariates was investigated using the “auxiliary” variable approach of MPLUS, the study found that:

- There was no evidence that gender had any antecedent impact on the classification.
- When age was nominated as an auxiliary variable, the subsequent probability of being in a specific class showed evidence of age-related changes. As age increased, the probability of being in the higher class decreased.

Workplace Outcome-Based Profiles

The LPA using the workplace outcomes of job satisfaction, job self-concept and the five facets of PWBW provided noteworthy results.

The three-class model indicated a dominant medium-class with 67% of the population and a low-class with 20% of the population. The third class with 11% of the population was a “low self-esteem” class, differentiated by a shape-based profile, which had very low values for job self-concept and feeling of competence and very high values for interpersonal fit at work and thriving at work.

From a teacher’s perspective, this mixed-class has practical significance. Using William James’ (1890) definition of self-esteem as a sense of one's worth, this group can be conceptualised as being low on self-esteem and with a low sense of self-efficacy. Teachers with high self-efficacy spend more classroom time in teaching-related tasks, pay more attention to student motivation, and are less likely to be authoritative (Bandura, 1997). Thus, this group is of high interest to policymakers because of its repercussion on student achievement.

In summary, Study 3 identified several ways of classifying the data to unearth practically relevant groupings that can provide valuable insights for future research, intervention design and policy analysis.

8.3 Contribution

As a substantive methodological study, the findings of this thesis make several contributions to the current knowledge on teacher motivation and the application of statistical methodologies in psychological research. Additionally, the findings offer several insights to future researchers and educational policymakers.

As seen from the literature review in Chapter 2, and aptly summarised by McInerney et al. (2018), from many perspectives a teacher is a jack-of-all-trades and must bring to bear a broad range of professional and individual attributes both inside and outside the classroom. Furthermore, the many theories of motivation examined indicate that workplace motivation and PWBW are not singular constructs, but rather the result of multiple, context determined dynamics where a broad range of professional and personal attributes come into play. Therefore, by examining a broad range of attributes and establishing their relevance to teachers' workplace outcomes, this thesis comprising three studies adds the following to the current body-of-knowledge on teacher motivation.

Study 1 presented the broad 23-attribute EdMAP instrument as a valid instrument measuring the conceptualised individual attributes for the Hong Kong teachers. After considering the instrument's previous successful use on middle management, it can now be generalised and extended to similar professions and used for future research on motivation. Furthermore, in presenting the attribute profile of a teacher population from a country placed high in the PISA rankings and with a comparatively low rate of teacher attrition, the study presents a worthy benchmark for comparison in future studies of teachers.

Additionally, Study 1 endorsed the second-order factor structure initially identified by Marsh and McInerney (1991) as applicable to teachers. This second-order factor structure provides a parsimonious interpretation of the EdMAP and a manageable proxy for the broad range of attributes, which can be used for future studies. By ascertaining a similarity with middle managers, the study confirmed the relevance of these aspects of middle manager motivation to teacher motivation. Thus, other constructs found for managers can now be investigated for relevance to teachers.

Study 2 presented the professional and personal attributes of EdMAP as strong predictors of workplace outcomes, adding to the current literature on motivation by a) confirming Marsh and McInerney's (1991) assessment of the original instrument as a suitable tool for investigating motivation, b) confirming the strong nexus that exists between EdMAP

attributes and job satisfaction, and thus, adding them as co-contributors to job satisfaction together with the well-researched external conditions such as pay and physical work conditions and c) confirming the strong nexus that exists between EdMAP and the job self-concept and PWBW and the relevance of examining a holistic set of attributes. Thus, this study highlights the need for the endemic and adaptive attributes of individuals to be considered in any comprehensive evaluation of workplace outcomes.

The predictors of job satisfaction have been extensively studied. Notwithstanding the importance of teachers' self-concept in teacher behaviour such as in encouraging choice of student-centred teaching strategies, and the contributing role of self-concept on teachers' intention to quit the profession, there is a dearth of literature on teachers' self-concept (McInerney et al., 2018). In identifying attributes that predict teachers' self-concept, this study lays a foundation for further analysis and investigation into strategies that improve teachers' self-concept. Similarly, the establishment of the close nexus between EdMAP attributes and the many facets of PWBW as identified by Dagenais-Desmarais and Savoie (2012), Study 2 adds to the literature on teachers' PWB and reinforces the multi-dimensionality of the motivational constructs.

By unearthing and presenting shape-based latent profiles of teachers, Study 3 contributed a complementary and alternative view of the sample population. The shape-based classes of the motivational attributes, especially the group with very low values for consultation and routine and high values for emotional control, application, career orientation and variety add an insight to guide further person-centred research and intervention analysis.

From a methodological perspective, this thesis adds to the expanding literature on ESEM as a complementary tool to CFA. The results are evidence that ESEM successfully addresses the reality that psychological constructs are rarely, if ever, independent and addresses the fallibility of considering measured items as perfect indicators of a single construct (Morin et al., 2014).

Similarly, Study 2 extended the LASSO method to address the pervasive challenge of multicollinearity in psychology research. Moreover, the study used the technique of evaluating the predictive accuracy by applying the model to test data. Future studies in motivation should incorporate confirming the predictive accuracy of the model by the application of the model to a test dataset.

Millsap (2007) noted that predictive invariance is rarely studied. Study 2 addressed this lack of research and found meaningful predictive non-invariance. Future research is required to investigate the findings of the different dynamics at play among different genders and age groups for its ramifications for practitioners.

8.4 Implications

This thesis investigated a broad set of an individual's motivational attributes, their relationship to workplace outcomes and the interaction effects of age, gender and grades taught. The finding of EdMAP attributes as strong predictors of job satisfaction, job self-concept and PWWB, together with the identification of mean differences in EdMAP attributes by gender and age mandate them as significant considerations for planners and educators. Furthermore, as noted by McInerney et al. (2018), these motivational attributes can be adaptive. Thus, the findings suggest that workplace outcomes may be improved through interventions such as encouraging collegial interactions, targeted professional development, increased participation in decision making, an increased sense of autonomy and better leadership opportunities. However, the mean differences in attributes, together with the observed interaction effects in the predictive relationships by age and gender, suggest that the interventions may need to be adjusted for the influence of gender and age. Additionally, the wide variety of factors that predict positive outcomes suggest that there are many aspects of the workplace that need to be concurrently considered. Interventions need to target both task-oriented and relationship-oriented outcomes. Key practical implications for the strong predictor attributes are summarised below:

- **Leadership**: Leadership predicts job self-concept, interpersonal fit at work, and desire for involvement at work. Thus, the finding of significant mean differences in leadership by age and gender has policy implications. Previous research indicates that while 48% of teachers choose their profession for personal fulfilment, 21% choose it for practical considerations (e.g. combining career and family) (Howes & Goodman-Delahunty, 2015). However, family considerations apply more to female teachers who have or intended to have school-aged children than to male teachers. Thus, male teachers with high leadership potential are likely to move out of the profession. In contrast, female teachers remain in the profession and begin to show increased leadership capability with age. While not commonly acknowledged, teachers have a range of leadership opportunities

within the education system, including vertical career changes, taking roles within the school, district-level movement and opportunities in curriculum planning (Reeves & Lowenhaupt, 2016). Therefore, to achieve the best outcomes, policymakers must facilitate matching the needs of teachers with the available leadership opportunities and participation in the decision-making process within the education system. This can be encouraged by implementing policies on shared governance, and participation in student evaluation/remediation processes and curriculum reform.

- **Career orientation:** Career orientation predicts many positive outcomes. The pattern of career orientation for female teachers with a trough in the mid-30s, followed by a gradual rise validates the current understanding of social dynamics and family responsibilities. As discussed above, females in the 30–40 age group, will attempt to stay in the profession and seek to refocus on the career after escaping "relationship or family traps". Crow (1988) identified this as a growth opportunity for female teachers. Therefore, this subsequent refocus on the career must be supported by suitable opportunities for professional development and harnessed via policies that create career enhancement paths for female teachers.
- **Group Sociability:** Group sociability predicts job self-concept, interpersonal fit at work and desire for involvement at work. Group sociability with a dip in value in the mid-30s to mid-40s, followed by a gradual increase had a similar pattern for both males and females. Increased group sociability improves teacher-teacher interaction, encourages mentoring and peer support, encourages feedback and satisfies the innate need for relatedness. Similarly, teachers who converse about teaching (reflective dialogue) with other teachers have been found to have higher self-efficacy. Findings by McInerney et al. (2018) on Hong Kong teachers, support previous research that teachers benefit from interpersonal relationships with colleagues. Thus, while continuing to improve core teaching skills, professional development for teachers should also target group sociability. Additionally, the opportunities for improving collegial interactions, such as communities of interest, mentor relationships and outside-school teacher social interactions need to be encouraged. Other initiatives such as teachers rest area design and pupil free days can be mobilised to encourage interaction. Consequently, school principals must be encouraged to create such opportunities

for sharing of ideas and building interdependence among teachers. At the same time, professional development must educate teachers to the benefits of improved collegial interactions to ensure that the opportunities are adequately utilised. By creating professional learning communities within the school or in school clusters, principals can encourage group sociability and concurrently validate the efforts of the younger or more innovative teachers. However, van Petegem et al. (2005) reported behavioural differences in group sociability between males and females with children, thus highlighting the influence of other contextual variables. Therefore, interventions must account for other contextual variables, such as marital status.

- **Emotional Control:** Emotional Control predicts job satisfaction, job self-concept, interpersonal fit at work and thriving at work. Males and females follow different patterns of emotional control with age, with younger teachers and mostly younger females showing lower values for emotional control measured by "I remain calm when emergencies occur". While it can be argued that such control comes with experience, these findings indicate an addressable gap in the younger teachers. Thus, there is an opportunity to target this adaptive attribute required to handle classroom situations via teacher training, ongoing professional development and the mentoring role of more experienced teachers.

Many studies (Arens & Morin, 2006; McInerney et al., 2018) have documented that teachers who are psychologically well are more likely to stay in the profession, less likely to burn out and are likely to provide an environment for students to achieve better results. Therefore, this finding of attributes that can predict PWB has significant implications for educators. Considering that most EdMAP attributes had a strong predictive relationship and are also adaptive, any interventions need to take a holistic approach.

The negative predictive relationship between technical orientation measured by "I enjoy mastering new equipment and techniques" and workplace outcomes needs further investigation for its cause. Considering this finding in the context of the Hong Kong Education Bureau's promotion of electronic teaching in schools and investment in technology, this finding can be plausibly attributed to teachers applying a comparison process with the opportunities in the industrial sectors. Thus, there is an opportunity for improving teacher well-being (concurrently with student achievement) by further improving the application of technology to the levels seen in other sectors.

Study 3 identified practically useful latent profiles of teachers that enables researchers and policymakers to focus on groups of teachers, rather than on individual motivational dimensions. Since the low-class in EdMAP attributes also predicts low workplace outcomes, further research is required to confirm causality. Subsequently, the improved understanding and additional insights into teachers' motivational profiles will help in guiding policies aimed at improving teacher well-being.

The fourth class of "young Turks" in the four-class model, with low values for consultation and routine and high values for emotional control, application and career orientation, is of theoretical interest and practical significance as they are likely to be more progressive, amenable to change and willing to try out new ideas. They are a potential source of change champions that school principals can mobilise.

Similarly, the "low self-esteem" class with low values for job self-concept and feeling of competence and high values for interpersonal fit at work and thriving at work is a challenge for policymakers. Viewing this mixed-class from the perspective of SDT's psychological needs sub-theory (Deci & Ryan, 2004), this group would be low on the satisfaction of the need for competence, but high on the satisfaction of the need for relatedness. Since low self-esteem has been found to impact the teacher's PWB, influence the choice of teaching strategies, increase the probability of leaving the profession and increase feelings of burnout (Hong, 2012), this group is a priority for interventions and professional development. Since teachers' self-concept is a determinant of the adoption of student-centred approaches to learning, improving teacher self-concept will have a significant impact on students.

In summary, the EdMAP attributes and their predictive relationship with workplace outcomes can be used for informing and guiding interventions aimed at improving workplace outcomes and for assessing other interventions for their impact on the relevant outcomes.

8.5 Strengths of the Thesis

Focus on a Broad Range of Endemic Qualities of Teachers

The most salient strength of this study is its focus on a broad set of attributes that can be considered endemic to the personal qualities of a teacher. As discussed in Chapter 2, the chosen attributes relate to teacher functions both inside and outside the classroom. Furthermore, the 23 attributes contain task-oriented attributes such as application and relationship-oriented attributes such as group sociability, which encompass the multifaceted nature of workplace motivation. Most attributes are adaptive, and thus can be targeted through training, professional development and specific interventions.

While many studies look at a narrow range of constructs, the 23-factor EMAP instrument from which the EdMAP was derived was one of the first to look at a diverse range of attributes (Marsh, 1991). The EdMAP maintained the same diverse set of attributes to leverage the strength of the EMAP. The appropriateness of this approach was subsequently confirmed by Study 2, which found that most of the attributes had strong predictive relationships with desirable workplace outcomes and the EdMAP instrument could explain a significant percentage of the variance in the outcomes.

Appropriateness of the Sample Population

Hong Kong education is centrally managed, suggesting uniformity in the environment compared to decentralised systems. Furthermore, Hong Kong students have been consistently at the top of the PISA rankings. Thus, any attribute profiles and predictive relationships, while educative in themselves, are a worthy baseline to compare in future studies. This suitability as a baseline is further supported by the comparatively low attrition among Hong Kong teachers.

Sound Psychometric Properties of the Instrument

The 23 factors demonstrated internal validity when considered as individual factors and maintained factorial integrity when considered as a complete instrument. There was support for the second-order global factor model. Invariance analysis indicated that the operationalisation of the constructs via the items was valid and measured the same constructs across gender, age and grade taught. Thus, the study was based on a psychometrically sound instrument.

Use of Multiple Complementary Models

The thesis supplemented the results of CFA with ESEMs to develop factor scores and investigate the second-order factor structure. The results from the two approaches were complementary and confirmed each other. The superior ESEM generated factor scores were adopted, benefiting subsequent analysis.

Comprehensive Approach to Evaluating the Prediction Models

The regression relation was comprehensively analysed. This study looked at individual factor regression and regression as an integrated instrument and addressed multicollinearity via the LASSO technique to develop a subset of the "most important factors". The results were confirmed by evaluating the model results against a test dataset derived from the sample to ratify the predictive accuracy of the models and their utility.

Overcoming the Impact of Outliers

Classification algorithms are sensitive to outliers. Furthermore, when there are equally strong shape and level effects, the identification of qualitative differences can become harder because strong level effects can make equally strong quantitative differences between the profiles (Masyn et al., 2010). However, unless clear shape differences are identified, the value of person-centred analysis is limited (Bauer & Curran, 2004). Notably, this study has met the above challenges and successfully used a different approach of excluding outliers. By explicitly recognising the presence of a small group (< 5%) of extreme individuals (a class of outliers) and separating them, the classification algorithm was empowered to focus on the central cohort and, therefore, successfully unearthed the shape differences in the main cohort.

Support from Other Research Findings

As discussed in the relevant results sections, most results were aligned to findings from other similar research. Notably, the findings in Table 6.12, where "social" attributes such as emotional control and leadership showed a dominant influence on job self-concept and job satisfaction are well supported by the expectations from Holland's (2012) nomination of teaching as a social profession.

Relationship-oriented attributes have a stronger predictive influence on the facets of PWB. Thus, the results for the PWBW are supported by Dagenais and Savoie's (2011) proposition that employees describe their PWBW primarily in eudemonic terms.

8.6 Limitations and Future Research

The study has several weaknesses and areas for improvement. The weaknesses stemming from the nature of data collection, which flow on to all three studies, will be detailed first, followed by items specific to each study.

Hong Kong Sample

The Hong Kong education system is managed by the Ministry of Education of the special administrative region and is considered a highly centralised operation. Thus, some of the results may not be relevant to a more decentralised context. Similarly, the Hong Kong teacher population has a relatively low drop-out rate, and thus may not be extendable to other contexts.

Future research should consider decentralised education systems together with the contextual variables that are likely to change from school to school. Replicating this study across multiple school environments is required to confirm consistency and global applicability of the findings.

Sample Selection Method

The survey was optional. Thus, there was potential for participant bias where only well-motivated teachers or extremely disgruntled teachers would be motivated to complete the survey. However, the items when plotted did not display a bimodal pattern indicative of such bias.

Self-Reporting and Sociability Bias in Responses

Data were collected by self-reported measures. Therefore, the results and conclusions may suffer from social desirability bias (Leite & Cooper, 2010). Notably, responses for factors such as leadership and group sociability are based on self-perception, and thus are more susceptible to bias. Even though it can be argued that teachers know their own attributes, future research should supplement the core data with additional data sources (e.g. peer-rating or supervisor-rating) for better objectivity. Additionally, colleagues and students may have different perceptions. Thus, it would be valuable to extend the EdMAP survey to include longitudinal data and extend respondents to include a 360-degree view including superiors, student and peers.

Future research should address social desirability bias using developing techniques such as factor mixture models (Lubke & Muthén, 2005) and appropriate experimental designs incorporating responses from a randomly assigned group of individuals providing what they believe are socially desirable responses (Leite & Cooper, 2010).

Limitations of the Cross-Sectional Design of Data

A major limitation of the thesis is that the instrument was administered at one point in time. This cross-sectional design of the study makes it unsuitable for investigating or inferring any causal relationships in subsequent analysis. The potential reverse causality/reciprocity between the outcome variables and EdMAP attributes call for future longitudinal studies or appropriate experimental designs. Consequently, future studies should investigate causality and reciprocity through initiatives that can change the adaptive EdMAP attributes and measure the impact of the change on workplace outcomes.

Additionally, future research should explore whether such profiles are stable, across age and other contextual variables (e.g. different schools).

Similarly, the capturing of EdMAP profiles of those entering the teacher training programs, those finishing the programs and those who are exiting the profession will offer valuable insights into the pattern of adaptation during the professional life cycle including entry and exit.

Limitations of the Sample Size

Overall, there were smaller number of male teachers in the primary schools, with a predominance of female teachers. Thus, it was not possible to analyse variances of motivation related attributes by grades taught as gender differences will bias results and there was insufficient data to analyse by gender and grades taught.

Limitations of ESEM

Due to its exploratory component, ESEM is sometimes criticised as being a data-driven approach, where small cross-loading can taint the factors. However, Asparouhov and Muthén (2009) have shown via simulation studies that the true population values for factor correlations remain unbiased when there are small cross-loadings. Furthermore, small cross-loadings reflect the influence of the factor on construct relevant indicators (Morin et al.,

2016). Thus, despite its exploratory nature, ESEM generated factors are a better representation of reality.

Marsh et al. (2014) noted that different rotation strategies result in different ESEM solutions and that all models fit the data equally well (rotational indeterminacy). Thus, even though the target rotation used in the present study provided a more robust basis for testing a-priori structure, other alternatives such as ESEM within CFA must be investigated to establish best practice.

Limitations of the LASSO Technique

While acknowledging that LASSO is a valuable tool for model fitting and feature extraction, Zou and Hastie (2005) noted some relevant criticisms, including the a) random selection of only one from a group of variables that have high pairwise correlations, b) empirically observed inferior performance to ridge regression when there are high correlations between predictors (Tibshirani, 1996) and c) assumption of linear regression. However, the selected factors were mostly supported by previous research and the number of chosen factors was relatively small. Furthermore, the subsequent investigation into the predictive accuracy of the LASSO identified factors (via a test dataset) showed acceptable predictive accuracy. Therefore, considering the key success criteria of the accuracy of prediction, interpretability of the model and parsimony, the limitations of the LASSO technique had a minimal negative impact on the results.

The analysis in chapter 5 provided evidence of the existence of higher order-factors. However, the predictive analysis on chapter 6 focused on the individual attributes, and found the pervasive impact of collinearity, which was addressed via LASSOO technique. Future studies can compare the LASSOO results with the predictive analysis using the higher order factors, which indirectly address multicollinearity.

In Study 3 the covariate analysis was limited to the 3 class model due to the sample size. When the 4 class model was used some groups has less than 10 participants, rendering any conclusions invalid. Future research must strive for a larger sample.

The regression analysis in chapter 6, indicate that teachers with high values of the relevant EDMAP attributes would also have high workplace outcomes. This result predicts that the teachers in the high, medium and low classes of the 3-class model will have similar high, medium and low values for workplace. The supplemental analysis in table 7-7 indicated a similar pattern for most outcome variables. Future research can investigate the validity of this prediction, using a larger sample and the 4-class model.

8.7 Conclusion

The primary aim of this thesis was to contribute to the knowledge of the motivation of teachers. Recognising that motivation is a multidimensional, multifaceted construct, the study focused on identifying a broad set of attributes (EdMAP) to predict workplace outcomes for a sample teacher population from Hong Kong.

This study found that the 23-attribute instrument validly and reliably measured a broad set of task-oriented and relationship-oriented attributes of the sample population. As suggested by the previous research that supported the choice of attributes, the majority of the attributes had a strong predictive relationship with job satisfaction, job self-concept and PWBW. Thus, EdMAP is a tool that is suitable for use in future investigation of the motivation of teachers and similar occupations.

The strong predictive relationship between EdMAP attributes and workplace outcomes suggest that interventions aimed at these potentially adaptive attributes of teachers may be used to guide policy and interventions aimed at improving the measured workplace outcomes. However, since this was a cross-sectional study, and due to the possibility of reciprocal relationships between the EdMAP attributes and workplace outcomes, further research is required to confirm causality.

The unearthing of shape-based profiles of teachers using EdMAP attributes and outcomes complement the findings of the variable-centred approach and provide an insight into the existence of latent groups who need to be considered in designing interventions and mapping training and development opportunities.

In conclusion, this thesis is an exercise in the substantive methodological approach in the study of teacher motivation. It presents the EdMAP as a tool for further research on teachers, establishes the value of ESEM, presents a set of attributes that can predict positive workplace outcomes and provides insights into teacher motivation that can be used for evaluating policy and intervention impacts. The findings underscore the potentially powerful impact of teachers' individual attributes in determining workplace outcomes. If school administrators want to attract and retain good teachers, they need to invest in holistic measures to sustain teachers' job satisfaction, self-concept and PWB.

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Appendices

Appendix A – EdMAP instrument

	Code	Question
1	AU1	I like to have freedom to act in my own area.
2	AU2	I need freedom to do my own thing.
3	AU3	I need freedom to choose my own method of working.
4	AU4	I like to make my own rules.
5	AU5	I am comfortable "doing my own thing".
6	IN1	I think creatively and imaginatively.
	IN2	I like opportunities to be creative.
8	IN3	I work best in creative situation.
9	IN4	I like to use creative and innovative responses.
10	IN5	I like to create new ideas, programs, etc.
11	VA1	I enjoy the chance to do different things.
12	VA2	Prefers to do many different things.
13	VA3	I prefer work responsibilities to change frequently.
14	VA4	I like to work on new tasks and projects.
15	VA5	I am happier with frequent changes of activity.
16	BE1	I cope with frequent changes to situations.
17	BE2	I adapt my behaviour to suit the situation.
18	BE3	I can change my approach to achieve a goal.
19	BE4	I change my behaviour as circumstances demand.
20	BE5	I readily adapt my personal approach to the situation.
21	DET1	I prefer to work with considerable attention to detail.
22	DET2	I like tasks that require careful detailed attention.
23	DET3	I pay attention to detail in my work.
24	DET4	I enjoy detailed work.
25	DET5	I show a high concern for details.
26	AB1	I prefer working with complex theoretical questions.
27	AB2	I have a theoretical orientation to problem solving.
28	AB3	I enjoy taking conceptual or theoretical approaches.
29	AB4	I like operating from a theoretical base.
30	AB5	I prefer working with complex theoretical questions.
31	TEC1	I enjoy mastering new equipment and techniques.
32	TEC2	I enjoy using equipment and technical procedures.
33	TEC3	I like to learn new technology and approaches.
34	TEC4	I stay abreast of technical changes.
35	TEC5	I am comfortable working with scientific information.
36	PL1	I like to plan and work with schedules.
37	PL2	I use a structured approach to tasks.
38	PL3	I am forward looking and anticipate problems.
39	PL4	I like to be prepared ahead of time.
40	PL5	I have a planned approach to activities.
41	EV1	I am not prepared to accept things at face value.

42	EV2	I like to question the validity of assumption.
43	EV3	I look for flaws in arguments.
44	EV4	I review information critically.
45	EV5	I critically evaluate and interpret data.
46	QU1	I take a numerical approach to solving problems.
47	QU2	I use facts and figures in problem solving.
48	QU3	I take a quantitative approach.
49	QU4	I am comfortable with statistical reasoning
50	QU5	I define problems quantitatively.
51	DEC1	I can readily take decisions.
52	DEC2	I am able to make decisions easily.
53	DEC3	I assess situations quickly and decisively.
54	DEC4	I make up my mind quickly on major issues.
55	DEC5	I like making decisions with high impact.
56	AP1	I can handle a lot of work.
57	AP2	I am hard working.
58	AP3	I place high value on hard work.
59	AP4	I sustain effort over a long period of time.
60	AP5	I put in long hours when required.
61	TEN1	I finish what I start.
62	TEN2	I persist in completing a task.
63	TEN3	Once I take on a job I stick with it.
64	TEN4	I keep working at a task until it is finished.
65	TEN5	I never leave a job incomplete.
66	CA1	I want to achieve career goal.
67	CA2	I am ambitious about my career.
68	CA3	I have a vision for my career.
69	CA4	I want to keep progressing in my career.
70	CA5	I have a well-defined set of personal career goals.
71	PER1	I can convince others with my argument.
72	PER2	I can argue persuasively for my point of view.
73	PER3	I am skilful arguing a point of view.
74	PER4	I can express an argument convincingly.
75	PER5	I like to make my point of view heard.
76	LE1	I can keep a group working together as a team.
77	LE2	I am seen as an effective leader.
78	LE3	I am confident directing the activities of others.
79	LE4	I like to have leadership responsibility.
80	LE5	I confidently approach leadership tasks.
81	AT1	need to be noticed.
82	AT2	I enjoy being the centre of attention.
83	AT3	I like to be the centre of attention.
84	AT4	I adopt a high profile.
85	AT5	I attract the attention of others.
86	GR1	I make friends easily.
87	GR2	I like to develop close friendships.
88	GR3	I am a highly sociable, gregarious person.
89	GR4	I enjoy my social networks.

90	GR5	I establish personal friendships and social relationships.
91	CO1	I support and encourage the contribution of others.
92	CO2	I like to consult and reach consensus.
93	CO3	I like to resolve issues by consensus.
94	CO4	I seek consensus on group decisions.
95	CO5	I consider different views in reaching consensus.
96	PEO1	I analyse people's behaviour.
97	PEO2	I am interested in understanding people's behaviour.
98	PEO3	I analyse body language.
99	PEO4	I seek out motives behind people’s behaviour.
100	PEO5	I look for reasons for people’s behaviour.
101	RE1	I seek reward for work well done.
102	RE2	I desire recognition for my work.
103	RE3	I expect praise for doing a good job.
104	RE4	I seek recognition from superiors in works or actions.
105	RE5	32. I desire recognition and reward.
106	EM1	30. I remain calm when emergencies occur.
107	EM2	31.I stay calm under pressure.
108	EM3	32. I control my emotions in all circumstances.
109	EM4	33. I am firmly in control of my emotion.
110	EM5	I am unflappable regardless of the situation.
111	RO1	I like repetitive work.
112	RO2	I am comfortable with routine work.
113	RO3	I see routine work as important.
114	RO4	I like working with detailed clerical procedures.
115	RO5	I find routine work interesting.
116	JO1	I am very satisfied with the kind of work that I do.
117	JO2	I am well satisfied with my job.
118	JO3	I pay attention to detail in my work.
119	JO4	I feel personal satisfaction doing my job.
120	JO5	I am satisfied with the work I do.
121	SC1	I am good at what is expected of me in my job.
122	SC2	I feel that I am competent in my job.
123	SC3	I am competent in the work I do.
124	SC4	I feel that I can do my job effectively.
125	SC5	I am self-confident about my work.

Appendix B - ESEM Model

ESEM model – All factors as a single cluster

```
Model
  AUTO  BY          AU1-AU4~1    IN1-RO5~0 (*1);
 INNO  BY AU1-AU4~0   IN1-IN4~1    VA1-RO5~0 (*1);
  VARI  BY AU1-IN4~0   VA1-VA5~1    BE1-RO5~0 (*1);
  BEHA  BY AU1-VA5~0   BE1-BE5~1    DET1-RO5~0 (*1);
  DETE  BY AU1-BE5~0   DET1-DET4~1   AB1-RO5~0 (*1);
  ABST  BY AU1-DET4~0   AB1-AB5~1    TEC1-RO5~0 (*1);
  TECH  BY AU1-AB5~0   TEC1-TEC5~1   PL1-RO5~0 (*1);
  PLAN  BY AU1-TEC5~0   PL1-PL5~1    EV2-RO5~0 (*1);
  EVAL  BY AU1-PL5~0   EV2-EV5~1    QU1-RO5~0 (*1);
  QUAL  BY AU1-EV5~0   QU1-QU5~1    DEI1-RO5~0 (*1);
  DECI  BY AU1-QU5~0   DEI1-DEI4~1   AP2-RO5~0 (*1);
  APPL  BY AU1-DEI4~0   AP2-AP5~1    TEN1-RO5~0 (*1);
  TENA  BY AU1-AP5~0   TEN1-TEN5    CA1-RO5~0 (*1);
  CARI  BY AU1-TEN5~0   CA1-CA5~1    PER1-RO5~0 (*1);
  PERS  BY AU1-CA5~0   PER1-PER5~1   LE1-RO5~0 (*1);
  LEAD  BY AU1-PER5~0   LE1-LE5~1    AT2-RO5~0 (*1);
  ATTN  BY AU1-LE5~0   AT2-AT5~1    GR1-RO5~0 (*1);
  GROU  BY AU1-AT5~0   GR1-GR5~1    CO1-RO5~0 (*1);
  CONS  BY AU1-GR5~0   CO1-CO5~1    PEO1-RO5~0 (*1);
  PEOP  BY AU1-CO5~0   PEO1-PEO5~1   RE1-RO5~0 (*1);
  REWA  BY AU1-PEO5~0   RE1-RE5~1    EM2-RO5~0 (*1);
  EMAT  BY AU1-RE5~0   EM2-EM5~1    RO1-RO5~0 (*1);
  ROUT  BY AU1-EM5~0   RO1-RO5~1   (*1);
```

Appendix C – Factor Loadings for CFA Models

Column "Single Factor at a time" – shows the result of analysis for S1-HY-1: Individual Factors.

Column "Congeneric - All factors together" shows the result of analysis for S1-HY-2: Multifactor Congeneric Model with all five items

Item	Description	Single factor at a time	Congeneric - All factors together				
EVAL			EVAL	DECI	PERS	LEAD	EMAT
EV1	I am not prepared to accept things at face value.	0.33	0.39				
EV2	I like to question validity of assumption.	0.63	0.61				
EV3	I look for flaws in arguments.	0.72	0.73				
EV4	I review information critically.	0.78	0.76				
EV5	I critically evaluate and interpret data.	0.79	0.78				
DECI							
DEI1	I can readily take decisions.	0.69		0.63			
DEI2	I am able to make decisions easily.	0.78		0.74			
DEI3	I assess situations quickly and decisively.	0.81		0.84			
DEI4	I make up my mind quickly on issues.	0.79		0.70			
DEI5	I like making decisions with high impact	0.67		0.81			
PERS							
PER1	I can convince others with my argument	0.72			0.67		
PER2	I can argue persuasively my point of view	0.76			0.77		
PER3	I am skilful arguing a point of view	0.82			0.76		
PER4	I can express an argument convincingly	0.78			0.77		
PER5	I like to make my point of view heard	0.55			0.66		
LEAD							
LE1	I can keep a group working together as a team	0.70				0.72	
LE2	I am seen as an effective leader	0.68				0.65	
LE3	I am confident directing the activities of others	0.80				0.80	
LE4	I like to have leadership responsibility	0.78				0.81	
LE5	I confidently approach leadership tasks	0.85				0.82	
EMAT							
EM1	I remain calm when emergencies occur	0.75					0.83
EM2	I stay calm under pressure	0.76					0.82
EM3	I control my emotions in all circumstances	0.83					0.74
EM4	I am firmly in control of my emotion	0.86					0.78
EM5	I am unflappable regardless of the situation	0.88					0.87

Item	Description	Single factor at a time	Congeneric - All factors together				
CARE			CARE	ATTS	RECO	PLAN	APPL
CA1	I want to achieve career goal	0.85	0.79				
CA2	I am ambitious about my career	0.68	0.73				
CA3	I have a vision for my career	0.82	0.83				
CA4	I want to keep progressing in my career	0.79	0.75				
CA5	I have a well defined set of personal career goals	0.78	0.83				
ATTN							
AT1	I need to be noticed	0.50		0.55			
AT2	I enjoy being the centre of attention	0.77		0.79			
AT3	I like to be the center of attention	0.90		0.72			
AT4	I adopt a high profile	0.65		0.75			
AT5	I attract the attention of others	0.75		0.75			
RECO							
RE1	I seek reward for work well done	0.76			0.82		
RE2	I desire recognition for my work	0.63			0.56		
RE3	I expect praise for doing a good job	0.62			0.70		
RE4	I seek recognition from superiors in works or actions	0.73			0.71		
RE5	I desire recognition and reward	0.82			0.72		
PLAN							
PL1	I like to plan and work with schedules.	0.58				0.69	
PL2	I use a structured approach to tasks.	0.74				0.62	
PL3	I am forward looking and anticipate problems.	0.56				0.73	
PL4	I like to be prepared ahead of time.	0.66				0.49	
PL5	I have a planned approach to activities.	0.81				0.74	
APPL							
AP1	I can handle a lot of work	0.55					0.74
AP2	I am hard working	0.71					0.58
AP3	I place high value on hard work	0.57					0.60
AP4	I sustain effort over a long period of time	0.82					0.71
AP5	I put in long hours when required	0.61					0.59

Item	Description	Single factor at a time	Congeneric - All factors together				
ATTN			ATTN	VARI	INNO	AUTO	ROUT
DET1	I prefer to work with considerable attention to detail.	0.78	0.64				
DET2	I like tasks that require careful detailed attention.	0.76	0.90				
DET3	I pay attention to detail in my work.	0.83	0.79				
DET4	I enjoy detailed work.	0.81	0.85				
DET5	I show a high concern for details.	0.81	0.79				
VARI							
VA1	I enjoy the chance to do different things.	0.71		0.80			
VA2	Prefers to do many different things.	0.75		0.77			
VA3	I prefer work responsibilities to change frequently.	0.71		0.61			
VA4	I like to work on new tasks and projects.	0.86		0.87			
VA5	I am happier with frequent changes of activity.	0.74		0.72			
INNO							
IN1	I think creatively and imaginatively.	0.72			0.69		
IN2	I like opportunities to be creative.	0.83			0.78		
IN3	I work best in creative situation.	0.78			0.78		
IN4	I like to use creative and innovative responses.	0.73			0.66		
IN5	I like to create new ideas, programs, etc.	0.74			0.87		
AUTO							
AU1	I like to have freedom to act in my own area.	0.41				0.23	
AU2	I need freedom to do my own thing.	0.57				0.60	
AU3	I need freedom to choose my own method of working.	0.42				0.58	
AU4	I like to make my own rules.	0.57				0.44	
AU5	I am comfortable "doing my own thing".	0.74				0.75	
ROUT							
RO1	I like repetitive work	0.60					0.42
RO2	I am comfortable with routine work	0.72					0.48
RO3	I see routine work as important	0.72					0.54
RO4	I like working with detailed clerical procedures	0.51					0.74
RO5	I find routine work interesting	0.38					0.62

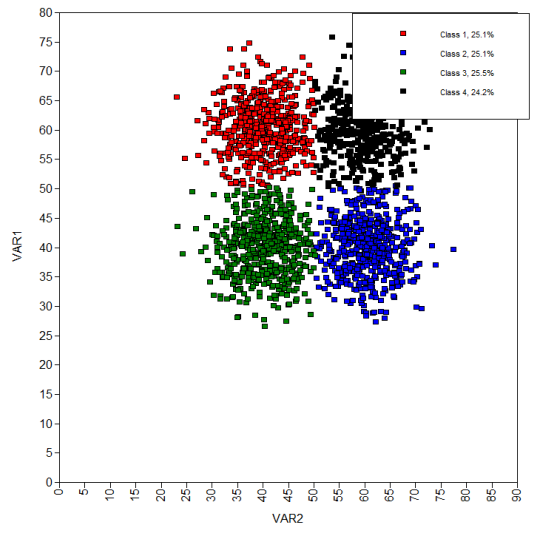
Item	Description	Single factor at a time	Congeneric - All factors together				
ABST			ABST	TECH	QUAN	BEHA	CONS
AB1	I prefer working with complex theoretical questions.	0.67	0.70				
AB2	I have a theoretical orientation to problem solving.	0.71	0.70				
AB3	I enjoy taking conceptual or theoretical approaches.	0.86	0.85				
AB4	I like operating from a theoretical base.	0.83	0.86				
AB5	I prefer working with complex theoretical questions.	0.66	0.61				
TECH							
TEC1	I enjoy mastering new equipment and techniques.	0.78		0.76			
TEC2	I enjoy using equipment and technical procedures.	0.76		0.73			
TEC3	I like to learn new technology and approaches.	0.79		0.82			
TEC4	I stay abreast of technical changes.	0.81		0.77			
TEC5	I am comfortable working with scientific information.	0.71		0.77			
QUAN							
QU1	I take a numerical approach to solving problems.	0.76			0.74		
QU2	I use facts and figures in problem solving.	0.78			0.86		
QU3	I take a quantitative approach.	0.82			0.79		
QU4	I am comfortable with statistical reasoning	0.72			0.76		
QU5	I define problems quantitatively.	0.88			0.79		
BEHA							
BE1	I cope with frequent changes to situations.	0.65				0.82	
BE2	I adapt my behaviour to suit the situation.	0.66				0.65	
BE3	I can change my approach to achieve a goal.	0.70				0.68	
BE4	I change my behaviour as circumstances demand.	0.77				0.68	
BE5	I readily adapt my personal approach to situations	0.78				0.72	
CONS							
CO1	I support and encourage the contribution of others	0.51					0.62
CO2	I like to consult and reach consensus	0.67					0.59
CO3	I like to resolve issues by consensus	0.65					0.57
CO4	I seek consensus on group decisions	0.79					0.66
CO5	I consider different views in reaching consensus	0.66					0.78

Item	Description	Single factor at a time	Congeneric - All factors together				
PEOP			PEOP	GROU			
PEO1	I analyze people's behavior	0.76	0.73				
PEO2	I am interested in understanding people's behaviour	0.75	0.80				
PEO3	I analyze body language	0.71	0.75				
PEO4	I seek out motives behind people's behaviour	0.81	0.81				
PEO5	I look for reasons for people's behaviour	0.87	0.77				
GROU							
GR1	I make friends easily	0.74		0.70			
GR2	I like to develop close friendships	0.67		0.70			
GR3	I am a highly sociable, gregarious person	0.70		0.75			
GR4	I enjoy my social networks	0.80		0.82			
GR5	I establish personal friendships and social relationships	0.88		0.80			

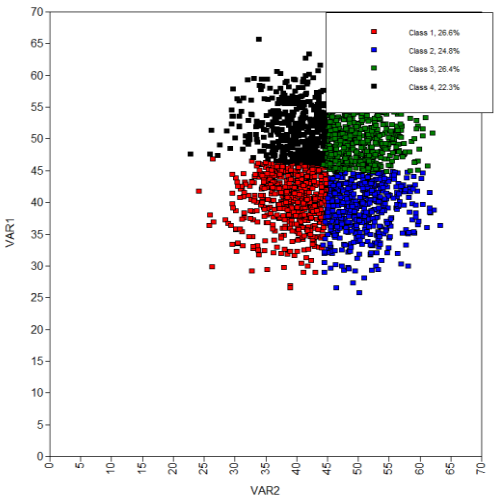
Note . The diagonal values are set to zero and not shown for better readability.

Appendix D – LPA simulation results

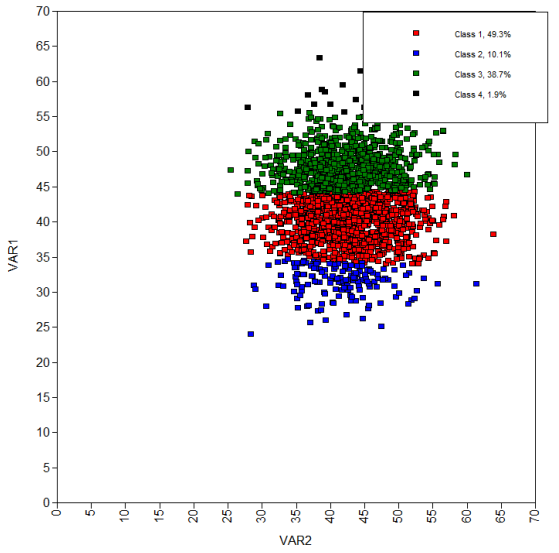
Scatter Plots for the Simulated data – Four-Class Model



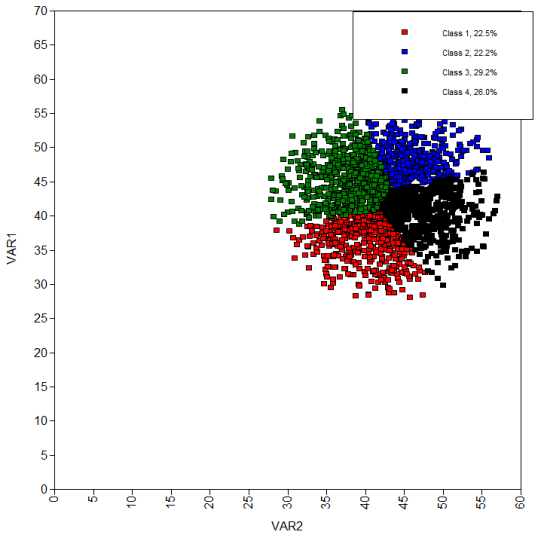
A. Four-class model with 2-standard deviations separation



B. Four-class model with 1-standard deviations separation



C. Four-class model with 1-standard deviations separation



D. Four-class model with 1-standard deviations separation, excluding outliers 2.96 Euclidian distance

Appendix E – Examples of Significant Interaction Effects of Gender and Age

Table E-1

Examples of Significant Interaction Effects of Gender and Age

Outcome	Interaction effect	β coefficient	*p-value*
Gender			
Job Satisfaction	Persuasiveness X GenderMale	0.23	0.033 *
Interpersonal Fit at Work	Decisiveness X GenderMale	0.16	0.036 *
Age			
Thriving at Work	Decisiveness X AgeGroupB	-0.18	0.024 *
	Decisiveness X AgeGroupC	-0.27	0.005 **
Perceived Reward at Work	Consultation X AgeGroupB	0.19	0.048 *
	Group Sociability X AgeGroupB	-0.20	0.015 *

Appendix F – Self Determination Continuum