THE PSYCHOMETRIC PROPERTIES OF MEASUREMENT OF THE MATHEMATICS TEACHERS' PROFESSIONAL IDENTITY IN SAUDI ARABIA

ALGHAMDI HAMAD ABDULLAH J

UNIVERSITI SAINS MALAYSIA

2021

THE PSYCHOMETRIC PROPERTIES OF MEASUREMENT OF THE MATHEMATICS TEACHERS' PROFESSIONAL IDENTITY IN SAUDI ARABIA

by

ALGHAMDI HAMAD ABDULLAH J

**Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy**

February 2021

ACKNOWLEDGEMENT

I thank God for numerous blessings granted onto this research. I give thanks to God for continuous grace. I thank God for the divine mercy that was showered upon this research. I thank God for being a divine guide throughout this study. I acknowledge God's faithfulness over this research. I acknowledge God's steadfast love in this research. I give praises to God for allowing this research to achieve a worthy milestone of divine fulfilment.

I would like to express my deep and genuine gratitude to my supervisor, Associate Professor Dr Mohd Ali Samsudin for his big support of my PhD study and related research, for his kindness, patience, motivation and knowledge. His inspiration and guidance helped me finish my research and write this thesis. I could not imagine having a better advisor and mentor for my PhD Study. He guided me back on track in many times whenever I got lost. I would also like to convey my sincere appreciation to my Co-Supervisor and also as a Dean of School of Educational Studies which is Associate Professor Dr Shaik Abdul Malik Mohamed Ismail for the support, kindness, motivation and knowledge. Thank you and again, thank you. My sincere thanks are extended to all PPIP USM staff who are really helpful and for their kindness.

In particular, I would like to express my gratitude to my beloved wife, families, friends, colleagues and who ever contribute directly or indirectly during my PhD journey.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

1PL	One-Parameter Logistic
2PL	Two-Parameter Logistic
3PL	Three-Parameter Logistic
CAT	Computerized Adaptive Testing
CCT	Classical Test Theory
CRC	Category Response Curve
CWEQ	Conditions of Work Effectiveness Questionnaire
DIF	Differential Item Function
GRM	Graded Response Model
GSS	Gudjonsson Suggestibility Scales
IIF	Item Information Function
IRC	Item Response Curve
IRF	Item Response Function
IRT	Item Response Theory
OPQ	Occupational Personality Questionnaire
PCM	Partial Credit Model
RSM	Rating Scale Model
SIF	Scale Information Function
TPI	Teacher Professional Identity
TRF	Threshold Response Functions

LIST OF APPENDICES

CIRI-CIRI PSIKOMETRIK PENGUKURAN IDENTITI

PROFESIONALISME GURU MATEMATIK DI ARAB SAUDI

ABSTRAK

Tujuan utama kajian ini adalah untuk mentaksir ciri-ciri psikometrik pengukuran identiti profesionalisme guru Matematik di negara Arab Saudi. Pendekatan deskriptif digunakan dalam kajian ini. Saiz sampel kajian ini adalah seramai 600 orang guru Matematik sekolah menengah. Kajian ini menggunakan soal selidik yang diadaptasi daripada Albaqi'i (2014) untuk mengukur identiti profesionalisme guru Matematik sampel kajian ini. Walaupun kajian ini memberi fokus kepada kajian kuantitatif, namun demikian, proses kesahan dijalankan menerusi dua peringkat. Peringkat pertama, melibatkan teknik Delphi yang dijalankan dalam tiga pusingan bagi mengumpul pandangan daripada pakar tentang kesesuaian soal selidik Identiti Profesionalisme Guru Matematik digunakan dalam konteks negara Arab Saudi. Berbanding menggunakan pandangan pakar pada teknik Delphi peringkat pertama, teknik Delphi pada peringkat kedua melibatkan guru-guru Matematik yang mempunyai latar belakang yang berbeza yang bagi menentusahkan item agar tidak mempunyai dengan item keterfungsian berbeza. Keputusan analisis model Rasch menunjukkan bukti psikometrik yang kuat dari segi kebolehpercayaan item dan responden, kepolaran item, analisis keserasian item dan responden, keunidimensionalan tanpa wujud isu Item Keterfungsian Berbeza. Akhir sekali, analisis profil menunjukkan Identiti Profesionalisme guru Matematik dipengaruhi oleh faktor pengalaman mengajar dan tahap kelulusan, namun tidak dipengaruhi oleh jantina. Dapatan analisis profil memberi implikasi tentang kefahaman bagaimana

identiti profesionalisme guru berkembang dalam kalangan guru Matematik di negara Arab Saudi menerusi pembelajaran yang berlaku secara sosial menerusi pengaruh pengalaman mengajar dan pengembangan professional yang diwakili oleh tahap kelulusan mereka. Dapatan ini juga memberi maklumat bahawa guru Matematik lelaki dan perempuan tidak mempunyai perbezaan pandangan terhadap identiti profesionalisme mereka yang mencadangkan budaya di Arab Saudi membenarkan penyertaan yang sama adil dalam pembinaan identiti profesionalisme mereka. Oleh itu, dapat disimpulkan bahawa kajian ini berjaya menghasilkan struktur kategori skala Likert yang baik berdasarkan Analisis Model Rasch dan kajian ini juga telah menunjukkan bahawa tiada perbezaan yang signifikan dalam Matematik TPI dalam aspek jantina, tetapi terdapat perbezaan yang signifikan Matematik TPI berdasarkan pengalaman mengajar dan kelayakan di kalangan guru Matematik di negara Saudi Arabia.

THE PSYCHOMETRIC PROPERTIES OF MEASUREMENT OF THE MATHEMATICS TEACHERS' PROFESSIONAL IDENTITY IN SAUDI ARABIA

ABSTRACT

The primary purposes of the study are to assess the psychometric properties of the professional identity measure of Mathematics teachers and to explore the profile of the professional identity of Mathematics teachers in the Kingdom of Saudi Arabia. The descriptive approach is used in this study. The sample size of this study is 600 secondary Mathematics teachers. This study used an adapted version of the questionnaire designed by Albaqi'i (2014) to measure the Mathematics Teachers' Professional Identity (TPI) of the participants. Although this study focuses on the quantitative findings for the psychometric properties of Mathematics version TPI questionnaire, nevertheless, a validation process has been undertaken at two stages. At the first stage, a Delphi technique has been done in three rounds in order to gather opinion from experts about the suitability of Mathematics TPI questionnaire to be used in the Kingdom of Saudi Arabia context. Instead of using expert opinion at the first stage of Delphi study, the Delphi study in the second stage uses Mathematics teachers with different background to validate the items without DIF issues. The results of the Rasch model analysis showed robust psychometric evidence in term of the item reliability, and person reliability, item polarity, and item and person fit analysis, unidimensional without any Differential Item Functioning issue. Finally, the profile analysis revealed that TPI of Mathematics teachers is influenced by teaching experiences and qualifications, but not by gender. The finding of the profile analysis gives some implications to understand how TPI is evolved among Mathematics

teachers in the Kingdom of Saudi Arabia through the influences of teaching experience and professional development, which represent by their qualifications. The findings also informed that male and female Mathematics teachers did not perceive their professional identity differently, which suggest that Saudi Arabia culture permit equal participation in building their professional identity. Thus, it can be concluded that this study produce a good Likert Scale category structure properties based on Rasch Model Analysis, and this study showed that there is no significant difference of Mathematics TPI in gender wise, but there is significant differences of Mathematics TPI based on teaching experiences and qualifications among the Mathematics teachers in Kingdom of Saudi Arabia.

CHAPTER 1

INTRODUCTION

1.1   Introduction

Literature on teaching emphasizes the importance of identity in teacher development, understanding identity and the issues related to it can be a challenging endeavour as stated in Beauchamp and Thomas (2009). Previous researches, such as, Freese (2006), Hoban (2007), Korthagen (2001), Olsen (2008) and Sachs (2005) studied the importance of identity in teacher development. Beauchamp and Thomas (2009) also reported that further identity shifts may occur throughout a teacher's career as a result of interactions within schools and in broader communities. Yet the concept of identity is a complex one, and even a cursory examination of the literature reveals that there is much to understand if one is to appreciate the importance of identity in teacher development.

To understand the growing literature on Teacher Professional Identity (TPI), the identity in teaching has been explored in a variety of very different ways; such as, (i) in terms of the constant 'reinventing' of themselves that teachers undergo as studied by Mitchell and Weber (1999), (ii) in terms of the narratives that teachers create to explain themselves and their teaching lives as studied by Connelley and Clandinin (1999) and Sfard and Prusak (2005), (iii) and the variety of discourses teachers participate in and produce as studied by Alsup (2006), (iv) in terms of the metaphors that may guide or result from a teacher's understanding of the role as studied by Hunt (2006), and Leavy, McSorley, and Boté (2007), (v) in terms of the influence of a wide range of contextual factors on teachers and their practice as studied by Chevrier, Gohier, Anadon, and Godbout (2007) and Flores and Day (2006). Reaching a full

understanding of the important aspects of identity and the ways in which they are related can be challenging.

One must struggle to comprehend the close connection between identity and the self, the role of emotion in shaping identity, the power of stories and discourse in understanding identity, the role of reflection in shaping identity, the link between identity and agency, and the contextual factors that promote or hinder the construction of identity, to create opportunities for the exploration of new and developing teacher identities. The challenge of reaching a full understanding of identity as a concept, realizing that it has been explored across different disciplines in addition to education for example, in philosophy (Taylor, 1989), in psychology (Erickson, 1959), in anthropology (Holland, Lachicotte, Skinner, & Cain, 1998) and that notions of identity thus range across approaches from these disciplines.

In a study of research on TPI, Beijaard, Meijer and Verloop (2004) noted that the absence of a definition in several works. The result of their systematic investigation of literature about TPI from 1998–2000 is the articulation of four features of professional identity stemming from the works studied. It determines that identity is an ongoing process, and therefore that identity is dynamic rather than stable, a constantly evolving phenomenon. It involves both a person and a context: within a context teacher learn professional characteristics that are adopted by individuals in unique ways. Within a teacher's professional identity are sub-identities, which may be more or less central to the overall identity and must be balanced to avoid conflict across them. Professional identity comprises the notion of agency, or the active pursuit of professional development and learning in accordance with a teacher's goals. TPI stands at the core of the teaching profession. It provides a framework for teachers to construct their own ideas of 'how to be', 'how to act' and 'how to understand' their

work and their place in society. Importantly, teacher identity is not something that is fixed nor is it imposed; rather it is negotiated through experience and the sense that is made of that experience (Sachs, 2005).

The aim of this study is to use the modern theory of measurement which is known as the Rasch model framework in forming the standards of the TPI as well as the importance of highlighting the concept of the professional identity of the teacher. In accordance with that, this chapter is designed in a way that highlight the elements that form this study. The chapter started with a background in which the TPI is defined and highlighted. The Rasch model usefulness in evaluating the measurements is well introduced and discussed accordingly. The chapter then presents the problem statement and the objectives of the study. The chapter then presents the research questions and hypotheses. The significant of the study is also discussed in this chapter. Next to that, the chapter introduces the operational definition used in this study. Finally, the chapter is summarized.

1.2   Background of the Study

Identity formation is an important dimension of the human personality (Erikson, 1968). It determines the individual's behaviour pattern, system of management, self-evaluation, and to use his energies and abilities effectively to achieve his goals. This creates a sense of self-efficacy and positive appreciation for the individual that helps him to adapt with his psychological and social environment. Psychology researchers were interested in the concept of identity and due to this growing interest and research on this concept, it has been divided into several forms; (i) psychological identity, (ii) cultural identity, (iii) social identity and (iv) professional identity. The details on each identity were explained, as below:

(i) Psychological identity: Also known as personal identity. Neimeyer and April (1994) psychological identity relates to self-concept, self-image (a person's mental model of him or herself), self-esteem and individuation.

(ii) Cultural identity: Taylor (1999) defines cultural identity "as one's understanding of the multi layered, interdependent, and nonsynchronous interaction of social status, language, race, ethnicity, values, and behaviours that permeate and influence nearly all aspects of our lives".

(iii) Social identity: Hogg (2000) defines social identity to how we identify ourselves in relation to others according to what we have in common. Social identity can provide people with a sense of self-esteem and a framework for socializing, and it can influence their behaviour. The institutions of social formation play a vital role in forming and developing the identity in its various forms among individuals.

(iv) Professional identity: Professional identity conceptualized as the result of an interaction between the personal experiences of teachers and the social, cultural, and institutional environment in which they function on a daily basis as stated in Van den Berg (2002). In fact, professional identity linked to a personal interpretation of factors within the professional environment. Professional identity has been described as an interaction between the personal and the professional. In such an interaction there is the possibility of the one influencing the other.

The concept of professional identity has attracted the interest of researchers in various medical, legal and educational fields. But the focus of recent studies on the TPI was higher in the educational field, specifically on the extent of teachers' sense of perception their identity and how to develop it, and on the factors affecting the

formation of that identity, such as the work conditions as reported in Schepens, Aelterman, and Vlerick (2009).

The Arab world consists of 22 countries spread from the Atlantic Ocean to the Persian-Arabian Gulf, with an estimated population of 363 million (Economic and Social Commission for Western Asia, 2013). The 22 countries, as defined by membership in the League of Arab States, comprise Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates (UAE), and Yemen. The population of the Arab world is similar in size to that of the U.S. or of the European Union.

The Arab world is diverse, with people from different ethnic, religious, and cultural backgrounds. Skin colour ranges from white to black, with sometimes wide variations seen within the same country. While specific and rigorous estimates are difficult to find, the majority of individuals in the Arab countries are Arab and Muslim (including both Sunni and Shi`a Muslims). However, there are notable populations of ethnic and religious minorities. For example, about 20 million individuals (40% of Moroccans and 20–25% of Algerians) identify themselves as belonging to the Berber-Amazigh ethnic minority (International Crisis Group, 2003), and more than five million ethnic Kurds live in Syria and Iraq (Aziz, 2011). Furthermore, about 13 million identify themselves as Christians, and make up significant portions of nationals in some countries, including 38.3% in Lebanon, 14.5% in Bahrain and 14.3% in Kuwait (Pew Research Center, 2011). While formal and semi-formal Arabic are shared across the Arab region and dominate written communication, colloquial Arabic and dialects are region specific and dominate verbal communication. Additionally, French and English languages are widely used in nations where a strong colonial past existed.

Each culture possesses cultural difference with the other culture. According to Ali and Azim (1996) stated that individual's national culture is likely to influence their perception and reaction to the world. This is also applicable to Arab and non-Arab countries (especially Western country). Two very different cultures will be compared to help illustrate how different cultures influence on their behaviour and ways of thinking. In scientific studies, relations between the Arabic and Western world are usually examined from a political, economic, defence and security, or education perspective (Manshur, 2019).

In the last decade, a series of studies have investigated the impact of culture on different societies, focusing mainly on the United States as a symbol of the West. However, little attention has been given to the Arab World in order to understand the influence of culture in the Arab society (El Sherif, 2012). Islam is influential upon Muslims' life-style and ways of thinking. Abu-Raiya and Pargament's (2011) comprehensive review of empirical Islamic psychology underscores the relevance of Islam to Muslims' lives and well-being, and the need for greater attention to the Islamic religion when dealing with Muslim populations. Failure to do so could lead to an incomplete and perhaps distorted picture of Muslims.

Ali, Taqi, and Krishnan (2010) claimed that in a collective culture decision styles that maintain and reinforce consensus, such as consultative style, is valued and emphasised. On the other hand, research shows that, decision styles that are serving an individual's interest are embraced in individualistic cultures (Ali, Taqi, & Krishnan, 2010). Furthermore, Arabs in general tend to be more collectivist due to Islamic teaching and Arab traditions that has group loyalty, respect for family members, and remaining humble while interacting with others as a paramount (Ali, Taqi, & Krishnan, 2010). Arabs were found to emphasise consultation and they demand humility when

dealing with others (Ali, Taqi, & Krishnan, 2010). Scholars have previously mentioned that due to different values, customs, language, and religion non-Arab find socializing really difficult (Atiyyah, 1996). Ali, Taqi, and Krishnan (2010) argue that if Arabs were to be treated with arrogance in any context, it could damage the relationships immensely if not end it completely. A previous research has found that foreign workers in Arab country struggle with subjective problems, such as personal relationships being more important than professional relationships (Ali & Azim, 1996).

In sum, the Arab world offers a culturally rich and socially complex set of dynamics that await robust and systematic exploration. In contrast to monolithic perceptions about Arabs, in actuality the region is diverse in terms of histories, ethnicities, religions, and even languages. At the same time, there is also unity in some of the socio-political and economic challenges affecting the region. Research has also begun to identify some of the key values that are shared across the region and how they may contrast with values in other parts of the world. Findings converge in describing the Arab peoples as rather conservative and hierarchically organized. Tradition, morality, generosity, and concern for the group seem to be primary motivators for many. However, much of this research has been marred by methodological flaws that should be remedied in future research. While the absence of substantial financial and human resources may hinder a robust program of investigation, continued interest in the region, and the graduation of a new generation of Arab psychologists from local and Western universities, is promising a more informed and better-researched future.

While the study of identities helps increase understanding of how Arab peoples define themselves, the study of cultural values allows for a deeper understanding of the goals that motivate them. The study of values has been essential to the

understanding of cultural differences and similarities. Values are beliefs or concepts that pertain to desirable behaviours or end states; they transcend specific situations and guide the selection or evaluation of events and behaviour (Schwartz, 1994). The central role values play in everyday life and the different profiles that emerge across different ecosystems has placed values at the core of cross-cultural research (Smith, Fischer, Vignoles, and Bond, 2013).

Researching on the formation of TPI is very important in understanding how teachers feel towards their changing roles in today's schools; because many educational issues are changing rapidly, forcing teacher to deal and control differently with these changes and how facing them (Beijaard, Meijer, & Verloop, 2004). The development of the TPI has received more attention from decision makers and researchers and based on the fact that reform of the education system set new requirements and standards for quality related to the TPI. This means increasing the teacher's awareness of teaching profession in terms of: how the teacher will work? How the performance could be improved and how the professional growth occurs? (Živković, 2013).

TPI is defined as the sense of the teacher in his / her own role through the roles he / she performs inside and outside the school, and through the knowledge, skills and learning competencies, and the commitment to the values and ethics of his profession (Albaqi'i, 2014). While others defined professional identity as the group of attitudes, beliefs and hobbies that individual has in matters and attitudes related to the profession that the individual seeks to achieve (Alzubaidi & Al-Kahali, 2014). According to Goldin, Hannula, Heyd, Jansen, Kaasila, Lutovac and Pantziara (2016) reported that professional identity is the way in which the individual is associated with a specific society and participate within it, and it is a dynamic structure changes over time. In

8

general, the TPI is best described as the teacher's own vision as an expert in the academic content of the subject, an expert in teaching, and an educational expert. A number of factors influence the forming of the TPI, including the context and environment of the teaching, the teaching experience, and the curriculum vitae. The TPI is a continuous process of integration between subjective and professional aspects.

TPI derives through the way they view themselves as educational experts, through effective classroom management, organizing and facilitating learning, or emphasizing that learning is more than just conveying knowledge to learners, as they are more profound and understanding of different subjects (Beijaard, Verloop, & Vermunt, 2000). TPI determines how teachers look at themselves, how they constantly interact with their learning environment, how they interpret and perceive the roles they perform. The TPI is not formed by completing the teacher's rehabilitation and training, but is gradually formed through effective participation, direction and targeting by the teacher inside and outside of the school (Canrinus, Helms-Lorenz, Beijaard, Buitink, & Hofman, 2011).

The professional nature of teachers is shaped by the interaction of three dimensions: the personal dimension that refers to the teachers' life outside the school, the professional dimension that refers to the political and social expectations of the educated and qualified teachers in educational ideas, and the dimension related to the work that shows how the teacher adapts to the school environment (Day, Kington, Stobart, & Sammons, 2006). The clear TPI helps teachers to think about enriching and modifying the curriculum, planning for goal setting, implementing educational procedures, continuously evaluating performance, and activating cooperation between the school community and the local community (Woods & Jeffrey, 2002; Bolívar & Domingo, 2006).

The subject of the construction of standards occupies an important place in the educational and psychological literature as it has been studied with great attention by psychologists and educators. Despite the rich pedagogical literature in describing the different methods and procedures to build psychological standards according to the models of Item Response Theory (IRT) especially in Rasch model framework, but it did not receive great attention at the level of Arab studies and research (Dabous, 2016; Hamadneh, 2015; Sabah, 2017). The researcher found that the majority of psychological standards used in the Arab studies were built according to the concepts of the Classical Test Theory (CCT) (Abdulwahab, 2010; Ali, 2012; AL-Zayla'I, 2014; Hamadneh, 2009; Ithawi, 2009). De Gruijter and van der Kamp (2001) stated that the modern theory of measurement, the IRT, is a new and close scientific framework in the selection of items at present. It deals with many educational and psychological issues more effectively than traditional theory. Thus, it is meaningful if any Item Response Theory research can be incorporated into researches in Mathematics education.

In the context of Mathematics education and learning, Goldin et al. (2016) reviewed a number of studies and research focused on identity and Mathematics, and noticed there is increased in interest in the subject of identity, reflecting the interest in social, cultural and political aspects in the teaching and learning of Mathematics. It also noticed that these studies were divided into two directions; (i) examined the identity of the student, and (ii) second focused on the identity of the teacher. Moreover, Goldin et al. (2016) reported that most of the studies that investigated identity, whether for students or teachers, linked between identity and attitudes, beliefs, self-efficacy and motivation towards Mathematics education and learning (Goldin et al., 2016).

According to Graven and Lerman (2014), most of the literature in Mathematics education consider the identity of the Mathematics teacher as the ways in which the individual becomes a teacher of Mathematics and belongs to the profession of education including paths of professional growth in narrative and discursive terms. Research literature indicates that the identity of the teacher is an alternative means of determining teacher learning and not necessarily a global perspective. Research is still needed to gain a broad understanding of the concept of teacher's identity. At the same time, research literature showed that the concept of identity exists intensively in social sciences, and researchers in Mathematics teaching need to determine how the term is used, identify sources and references of their views, and the relevance and relevance of teaching and learning Mathematics as reported in Graven and Lerman (2014).

Lace (2014) claims that professional identity is based on three components – awareness of one's personality as a representative of a certain profession. Another important factor is searching for meaning in the respective profession which leads to the third component which is professional ambitions one has. Previous and current experiences play a great role into forming beliefs, professional images, knowledge and skills. It can all be developed and challenged during university studies as well as respective field practice. Moreover, van Huizen, van Oers, and Wubbels (2005) claimed that from the Vygostkian perspective, the overall aim of a teacher education program is best conceived as the development of TPI. Thus, pre-service teacher education should provide meaningful contextualised support through guided reflection to facilitate this development. A teacher with a strong and positive TPI will be an effective teacher who will be self-directed to acquire knowledge and skills necessary for teaching throughout their life. Lifelong learning has become the necessity to be an effective teacher.

There is no unified definition of the concept professional identity. Discussing the challenges of defining the concept of TPI, Beijaard et al. (2004) state that TPI as an ongoing process of integration of the 'personal' and the 'professional' sides of becoming and being a teacher. They stress the combination of personal and professional aspects which should be challenged throughout university studies. Chang-Kredl and Kingsley (2014) also emphasise the dynamic nature of professional identity; it is a continuous process in which identity is formed, built, and shaped. Positive TPI is very important as it might help students cope with critical moments of their career. Dillabough (1999) also points out that profession identity is not fixed but is formed through interpretations, ascribing meaning and everyday practice in various contexts. This only highlights the importance of learning and reflection as significant attributes of a modern 21st century teacher.

The measurement of the Mathematics TPI should be expanded from Classical Theory to current and modern theory in measurement which is called Item Response Theory. The IRT assumes that the performance of the examinees can be predicted, or their performance can be interpreted in a psychological or educational test. IRT is based in the light of a characteristic of this performance called (Trait) and it is difficult to observe this attribute directly; therefore, it must be estimated or inferred from the performance of the examinee that can be observed on a set of measurement or test paragraphs (Hambleton, Swaminathan, & Rogers, 1991).

Different models of modern measurement theories have been developed known as Latent Trait Models (LTM) and it is generally aiming to determine the relationships between the performance of the individual in the test and the attribute that underlies this performance and its interpretation. Some models of the IRT are based on basic

assumptions which are Unidimensionality, Local Independence and Item Characteristic Curve (De Gruijter & van der Kamp, 2001).

IRT is an extension of classical testing theory with mathematical roots which deeply penetrated in psychology and the mathematical basis of Item Response Theory has been embedded in the psychological measurement (Ostini & Nering, 2006). Some controversial issues, however, exist in defining the concept of measurement in human science and psychology. Rasch model is mathematically equivalent to the one-Parameter Logistic (1PL) IRT model, but they developed separately (DeMars, 2010). Controversy surrounds the Rasch model; some specialists believed that the Rasch model and IRT models are structurally different and are used very differently. It is claimed that IRT models are used to "describe and fit data; when fit is poor, the model is adapted or discarded in favour of another model". IRT models are exploratory models aiming to describe the variance in the data. Researchers seem to be divided on the preference of one over another. In contrast, the Rasch model is more prescriptive. The data are required to fit the model and when they do not, items that show misfit are discarded until a satisfactory fit is obtained. Rasch analysis is, is a special case of IRT model, is a confirmatory model where the data has to meet the Rasch model requirement to form a valid measurement scale. Hambleton et. al (1991) claimed that Rasch model is one of the most commonly used models of the IRT. One of particular characteristic of this model is that when the data correspond to this model, the parameters of the items, which are their degree of difficulty, can be estimated separately from the sample used, and the capabilities of individuals can be estimated independently of the degree of difficulty of the items (Hambleton et al., 1991).

Several models have emerged from the Rasch model, each suited to a particular type of data, including the Dichotomous Model, the Partial Credit and Rating Scale Model, which is used in data derived from estimation scales, and was first developed by Andrich (Andrich, as cited in Wright & Masters, 1982). The idea on which the estimation model is based is that each item carries a total psychological charge that expresses the direction of the individual in accordance with its estimate of that item. The model estimates this charge for each item according to the probability situation

Based on Rasch model framework, it is believed that any instrument should produce interval-scale measures for items and persons (with error terms) on an interval-level scale that remain invariant across the intended uses of that instrument. Moreover, the construction of those measures is a necessary prerequisite for meaningful statistical analyses. This principle is aligned with the standard for scientific measurement, which has been the servant of the physical sciences. It is argued that this measurement principle can be approximated in the human sciences via probabilistic conjoint measurement. According to Bond and Fox (2015), the Rasch model is the only model that is focused on providing for the construction of measures meeting these criteria.

Using the Rasch model framework for the construction of invariant measures does not replace statistical analysis; it precedes it. This study will demonstrate how Rasch Model is able to enhance the quality of inferential statistics during the process of profiling Mathematics TPI. This is done by fulfilling the two assumptions, which are; (i) the conversion of ordinal data from Likert scale Mathematics TPI questionnaire to Rasch-based Logit unit which is interval mathematically, and, (ii) the measurement is invariance. In the Rasch model framework, the property of invariance is achieved by freeing the estimates of person achievement from item's difficulty and freeing the

estimates of item difficulty from the effects of person's achievement (Wright & Stone, 1979).

The persons are not individually parameterized as in the Rasch model. This has important implications for the concept of measurement invariance, because other IRT models are not person–distribution free (Wu & Adams, 2007). For examples, the two parameter IRT model includes a parameter for item discrimination, and the three-parameter IRT model adds parameters for both item discrimination and guessing. It is criticized that although proponents of the two- and three-parameter models contend that data fit generally improves when these techniques are used, the values of the second and the third parameters of these models are introduced or manipulated expressly for that purpose: to maximize the fit of the model to the data. The Rasch model, however, is used for another purpose: the construction of fundamental measures (Wu & Adams, 2007). This is distinctly different from other IRT models, where the observed data have primacy and the results of the analyses are descriptive of those data. As mentioned previously, in general, other IRT models are exploratory and descriptive models; whereas, Rasch model is confirmatory and predictive. Exploratory models must account for all the data; a confirmatory model requires the data to fit that model. In this context, ensuring fit to the model, by focusing on the size and structure of the residuals, indicates where the principles of probabilistic conjoint measurement have been sufficiently realized in practice to justify the claim that the results can be used as a measurement scale with invariant, interval measurement properties (Wu & Adams, 2007).

By taking consideration of the output from many previous researches, this study will assess the psychometric properties of Mathematics TPI questionnaire based on Rasch model framework. The following subtopics, will address specifically the

main issue concerning the status of Mathematics TPI in the Kingdom of Saudi Arabia context.

1.3 Problem Statement

Many factors contribute in forming the TPI (Bolívar & Domingo, 2006; Graven & Lerman, 2014), such as the major development in the teacher work and the educational challenges that affect the teacher's performance (Coldron & Smith, 1999). Due to that, it was necessary to measure the TPI, especially since this topic has not been widely addressed in the Arab environment. Few previous researchs only tried to highlight the important aspect of the TPI in the educational process as reported in Hussein (2017), Abdulghani and Abulnaeem (2016) and Albagi'i (2014). Thus, this field is highly needed to be addressed in the Arab environment due to the complex environment and culture in this area.

Furthermore, few researches like Lerman (2014) and Graven (2004) had argued that there are many aspects of the TPI that are integrally connected to the particular nature of the subject Mathematics. TPI differs only with regard to beliefs about and views of the subject itself, which plays a significant role among Mathematics TPI. However, many researchers have argued that researchers working with the notion of Mathematics teacher's identity have not clearly defined and operationalized the notion as reported in Graven & Lerman (2014). Moreover, despite the importance that has been highlights in the literature for studying the Mathematics TPI, only few and inadequate body of research has been performed in the Arab environment.

This view is supported by the argument that the contribution of Mathematics to scientific and technological development has influenced Mathematics itself, and has become a tool for developing thinking and achieving relationships in an integrated framework in the individual after viewing it as merely acquiring normal mathematical skills. Traditional Mathematics teaching methods is no longer acceptable today. Ball (2003) had reported that teaching subject like Mathematics requires the necessary skills that must be exercised by the teacher who is able to work effectively, whether it is related to the objectives of teaching Mathematics, or how to prepare, implement and evaluate. The complexity of Mathematics teachers to develop the necessary skills can be varied depending on their interpretations of their ongoing interaction with their context (Beijaard et al., 2004). Kelchtermans (2009) stated that teachers develop an interpretative framework during their careers and that this framework is formed and restructured through interaction between individual teachers and social, cultural and structural working conditions in the context of their work. The measurement of this interpretive framework is called professional which relates to how teachers perceive themselves as teachers, based on their interpretations of their ongoing interaction with their context (Beijaard et al., 2004).

As well as Dabous (2016) and Hussein (2017) highlighted the need for a precise measurement tool to measure the TPI that fit to the criteria for objective measurement and the culture in the Arab environment. This led to the importance of test the validity and the reliability of the measurement based on the modern measurement theories such as the IRT. This is what motivated the researcher to prepare an objective measure of the TPI in the context of Kingdom of Saudi Arabia.

Furthermore, Saudi Arabia had significant transformed in the educational process. Several conferences were held to support the development of the teachers and

the education in the Kingdom of Saudi Arabia and the first conference was in held in the year of 1973, the second conference was in the year of 1995 and the third one in the year of 1999. All of these conferences were held to prepare the teacher of public education in the Kingdom of Saudi Arabia. Recently the education in the Kingdom of Saudi Arabia gain a great attention form the government in the country which led to the important of perform this research in the country. Furthermore,by providing a well-tested tool to measure the Mathematics TPI will provide a trusted profile of the teachers and these profiles will contribute on the evaluation of the teachers in Saudi Arabia and their roles in the educational process in the country.

Hence, this study aims to form the TPI in a sample of Mathematics teachers in the Kingdom of Saudi Arabia according to the IRT, taking into account the scientific trends related to the construction of psychological standards according to the Rasch model framework.

1.4   Research Objectives

The objectives of this study are as follow:

1.   To adapt the measurement of Mathematics TPI in the context of Kingdom of Saudi Arabia.

2.   To assess the psychometric properties of the professional identity measure of Mathematics teachers in the Kingdom of Saudi Arabia.

3.   To compare TPI based on gender, teaching experience and qualification in the Kingdom of Saudi Arabia.

1.5 Research Questions

The research questions of this study are as follows:

1. How is the TPI measurement is adapted to fit the context of Mathematics Teachers in the Kingdom of Saudi Arabia?

2. What are the psychometric properties of Mathematics TPI measure in the Kingdom of Saudi Arabia?

3. To compare Mathematics TPI based on gender, teaching experience and qualification in the Kingdom of Saudi Arabia.

1.6 Research Hypothesis

In this study, Research Question 1 is answered by using a Delphi study whereas Research Question 2 is answered through descriptive analysis by using Rasch model data analysis technique. Therefore, only Research Question 3 is answered by testing the following three hypothesis which are:

H_{01}: There is no significant difference on gender in Mathematics TPI in the Kingdom of Saudi Arabia.

H_{02}: There is no significant difference on teaching experience in Mathematics TPI in the Kingdom of Saudi Arabia.

H_{03}: There is no significant difference on qualification in Mathematics TPI in the Kingdom of Saudi Arabia.

1.7   The Significance of the Study

The main significance of this study is to identify the level of Mathematics TPI recognition among in the Kingdom of Saudi Arabia. By conducting this study, it will enable the researcher to highlight one of the most important factors affecting the teachers' performance. The results of this study can provide indicators of the reality of the TPI, especially in the light of the lack of Middle East and local studies in this issue and can contribute to improve the reality of the teachers themselves and become more aware of their job identity, which enables them to perform their roles more effectively. Moreover, this study aims to build an objective measuring instrument for measuring the TPI, making for this measurement an educational value that can be utilized in subsequent studies.

This study aims to explore Mathematics TPI formation in the context of Kingdom of Saudi Arabia. The findings from this study will have many implications for Saudi Arabia's development of current and upcoming teacher, especially in special focus will be given among Mathematics teachers. Ministry of Kingdom of Saudi Arabia will benefit by this study finding from TPI, because in contrast it will have impact in the process of teaching and learning and also best in preparing Mathematics curriculum and context by the Mathematics teachers. Ministry of Kingdom of Saudi Arabia gain benefit from this study because the ministry will encourage more researchers to conduct research among the teachers in difficult and critical courses, such as, Science teachers. When a country gives priority in the development in critical areas, such as, Science, Technology, Engineering, and Mathematics, it allows the country to thrive in an increasingly competitive global economic development.

It is expected that the procedures of this study will benefit the designers of the scales and those interested in the construction of psychological measures by means of an objective measurement tool according to the Rasch model framework. This is done by freeing the measurement tools from the characteristics of the measured objects, and freeing the measurement of objects from the characteristics of the measuring instruments, which provides this measure a special educational value to meet the needs of many interested about the TPI.

In addition, measuring and developing the TPI has a significant impact on the process of education (Ambusaidi, Alhashmi, & Al-Rawahi, 2014). Teacher identity has been viewed as a conceptual tool that is critical to understanding teacher education (King, 2015). However, it has been mentioned earlier that most of the previous research that has been conducted on TPI and its measurements has been conducted in Western countries contexts while limited research seems to have been conducted in the Arab countries in general and Saudi Arabia in particular (Abdulghani & Abulnaeem, 2016). This means that our understanding of the construct of TPI and its measurements are significantly shaped by the findings and revelations of Western theories and their studies. This is not to say that such findings are of no use to education field in the Kingdom of Saudi Arabia. However, these findings and revelations may not provide a deep understanding of the construct of TPI and the way it should be measured and developed in the Saudi context considering the consensus among researchers and practitioners on the idea that cultural differences between individuals from different countries influence their behavior and ways of thinking (Hofstede, 2003). Thus, and due to the lack of research on TPI and its measurements in the Kingdom of Saudi Arabia context, it is expected that the findings of this study would be of a great use to the body of research on TPI and its measurements as such findings

could provide a cross-cultural understanding of how TPI is understood and developed across cultures and countries in the Middle East educational context in general and the in the context of the Kingdom of Arab Saudi education in particular.

Furthermore, the findings of this study are expected to be significant to the educational authorities in the Kingdom of Saudi Arabia in designing and conducting a professional development programs that helps teachers to develop their professional identity in general and Mathematics TPI in particular as stated in Sabancıogullari and Dogan (2015). Such programs are significant in developing the entire educational activities in educational field in Saudi Arabia. Further, providing a well-tested tool to measure the TPI will provide a trusted profile of the teachers and these profiles will contribute on the evaluation of the Mathematics teachers in the Kingdom of Saudi Arabia and their roles in the educational process in the country.

1.8   Limitation of the Study

This dissertation, and the revised version of the Mathematics TPI scale, can be conceived of as a starting point in the ongoing cycle of re-calibration, optimization, re-evaluation, and maintenance of this and other TPI scales (Hattie, Jaeger, & Bond, 1999). Although the benefits and implications of this study, and the psychometrically sound scale, are noteworthy, this study is not exempt from limitations. These must be considered when drawing conclusions.

The sample used in this study was based on respondents who answered survey questions online in the year of 2019. It is possible that had a different sample frame, or a different time period, been chosen the results might have changed. Related to this limitation is the concept of generalizability. While steps were taken to delimit the

sample to be representative of a broad range of teachers in the Kingdom of Saudi Arabia, the actual generalizability of findings to the broader Saudi Arabia. population is unknown. As such, readers should use caution when extrapolating results to groups that do not match the sample characteristics. The sample group is from three cities in the Kingdom of Saudi Arabia. The number of the Mathematics teachers is limited. It demonstrates the results related to the Mathematics teachers working in only three cities in the Kingdom of Saudi Arabia, which are the Tabuk, Hail and Sakaka.

Furthermore, the study only uses Rasch model framework to evaluate the proposed measurement. The understanding on the construction of TPI in this study is based on the Social Learning Theory and Gender Schema Theory. Therefore, the working definition of Mathematics TPI probably will not be the same if different theories used in this study. This data of this study is limited to quantitative data in order to evaluate the psychometric properties of the instrument and to profile the Mathematics TPI in the Kingdom of Saudi Arabia. This study relies on the honesty of the respondents to response to the Mathematics TPI questionnaire administered to them. This study has an assumption that teachers may have different opinion about their TPI, but the items which are provided in the questionnaire are sufficient enough to represent their Mathematics TPI, as will be proven by the result of Delphi techniques and psychometric properties analysis which will be presented at the Chapter 3 and 4 of this thesis.

Another limitation is that differential item functioning was not performed in this study. Thus, little is known if different items are functioning optimally across different groups. Unlike CTT's perspective where all items contribute to the scale and function across groups equally, a Rasch analysis allows for item bias tests across groups via differential item functioning. This undoubtedly should be a future research

study as a way to determine the objectivity and fairness with which items in the scale measure substantially different groups.

A further limitation is that there was no attempt to qualitatively pre-test each item via focus groups, nor was cognitive interviewing done. This study relied on the fact that the scale has been widely used, and that previous psychometric work supports the validity and reliability of the scale. Nonetheless, a future endeavour should include an in-depth qualitative assessment of the items retained in this scale that could include further review of the already revised categories with functioning problems in the scale. Similarly, the evidence of validity provided in the study was limited to construct validity via the evaluation of construct irrelevance and construct underrepresentation in the scale. The notion of consequential validity, an integral part of the "Messickian" conceptualization of validity, was not examined in this study.

1.9   Definitions of terms

1.9.1   Psychometric Properties

Psychometric is the construction and validation of measurement instruments and assessing if these instruments are reliable and valid forms of measurement. According to Ginty (2013), measurement usually takes place in the form of a questionnaire, and questionnaires must be evaluated extensively before being able to state that they have excellent psychometric properties, meaning scale is both reliable and valid. IRT was used in several empirical studies to assess the psychometric properties of the questionnaire.