

ASSESSMENT OF SOCIAL PERCEPTION AND MATHEMATICAL THINKING
AMONGST JORDANIAN STUDENTS IN HIGHER EDUCATION

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This Thesis is especially dedicated to the soul of my father

To my mother and my wife

Whose love, kindness, patience and prayer have brought me this far

To my children

To the soul of my friends: Majdi and Abdelrahman

To all of my friends, specially Alaa AbuZaiter

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ABSTRACT

Mathematics is important in the human life. Despite the efforts for the development of mathematics education, it did not reach an acceptable level, because of low level in mathematical thinking and social perception of mathematics. This study aimed to examine the relationship between mathematical thinking and social perception of mathematics in Jordan higher education. This study used a quantitative survey approach. The sample of this study comprised of 338 male and 362 female first year students at Jordan universities. Two instruments were developed: a mathematical thinking test to measure students' mathematical thinking and social perceptions of mathematics questionnaire to measure the students' perception of mathematics. The results showed that there were statistically significant differences in whole mathematical thinking test depending on gender in favor of male, residence in favor of rural areas and interaction between gender and residence in favor of females in rural areas. The results showed that the performance of males in urban areas was better than females in urban areas and the performance of females in rural areas was better than males in rural areas. There were no significant differences in social perception towards mathematics due to gender, residence and their interactions. The results showed that the relationship between mathematical thinking and social perception of mathematics was significant and social perception of mathematics has an influence on mathematical thinking. An increase in social perception of mathematics may lead to an increase of mathematical thinking. The two instruments developed can be used as measurement scales for mathematical thinking skills and social perception of mathematics and opening the way for researchers to address issues and weaknesses related to mathematics education.

ABSTRAK

Matematik adalah penting dalam kehidupan manusia. Walaupun pelbagai usaha untuk membangunkan pendidikan matematik, ia belum sampai ke tahap yang boleh dibanggakan disebabkan oleh tahap pemikiran matematik dan persepsi sosial bagi ilmu matematik yang masih rendah. Kajian ini bertujuan untuk mengkaji hubungan antara pemikiran matematik dan persepsi sosial bagi ilmu matematik di pusat pengajian tinggi Jordan. Kajian ini menggunakan pendekatan kajian tinjauan kuantitatif. Sampel kajian ini terdiri daripada 338 orang lelaki dan 362 orang perempuan pelajar tahun pertama di universiti-universiti Jordan. Dua instrumen telah dibangunkan : ujian pemikiran matematik untuk mengukur pemikiran matematik pelajar, dan soal selidik persepsi sosial bagi ilmu matematik untuk mengukur persepsi pelajar terhadap matematik. Hasil kajian menunjukkan bahawa terdapat perbezaan yang signifikan dalam ujian keseluruhan pemikiran matematik bergantung kepada jantina yang memihak kepada lelaki, kediaman pula yang memihak kepada kawasan luar bandar dan interaksi antara jantina serta kediaman memihak kepada wanita di kawasan luar bandar. Hasil kajian menunjukkan bahawa prestasi lelaki di kawasan bandar adalah lebih baik daripada perempuan di kawasan bandar dan prestasi wanita di kawasan luar bandar adalah lebih baik daripada lelaki di luar bandar. Tiada perbezaan yang signifikan dalam persepsi sosial terhadap matematik berdasarkan jantina, kediaman dan interaksi mereka. Keputusan juga menunjukkan bahawa hubungan antara pemikiran matematik dan persepsi sosial matematik adalah signifikan dan persepsi sosial matematik mempunyai pengaruh ke atas pemikiran matematik. Peningkatan dalam persepsi sosial matematik boleh membawa kepada peningkatan kepada pemikiran matematik. Kedua-dua instrumen yang dibangunkan boleh digunakan sebagai skala pengukuran untuk kemahiran pemikiran matematik dan persepsi sosial matematik dan membuka jalan bagi penyelidik untuk menangani isu-isu dan kelemahan yang berkaitan dengan pendidikan matematik.

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LIST OF ABBREVIATIONS

NCERT	-	National Council of Educational Research and Training
NCTM	-	National Council of Teachers of Mathematics
NCRD	-	National Center for Resources Development
TIMSS	-	Trends in International Mathematics and Science Study
MTT	-	Mathematical Thinking Test
SPMQ	-	Social Perceptions of Mathematics
ANOVA	-	Analysis of Variance
C1-C24	-	Test Questions
B1-B36	-	Questionnaire Items
AV1	-	The Mean of Difficulty of Mathematics Items
AV2	-	The Mean of Nature of Mathematics Items
AV3	-	The Mean of Usefulness of Mathematics Items
AV4	-	The Mean of Anxiety of Mathematics Items
AV5	-	The Mean of Enjoyment of Mathematics Items
AV6	-	The Mean of Teacher Role Items
AVT1	-	The Mean of Total of AV1-AV6
AV7	-	The Mean of Induction Items
AV8	-	The Mean of Induction Items
AV9	-	The Mean of Induction Items
AV10	-	The Mean of Induction Items
AV11	-	The Mean of Induction Items
AV12	-	The Mean of Induction Items
AVT2	-	The Mean of Total of AV7-AV12
MNSQ	-	The Mean Square
PTMEA	-	Point Measure Correlation

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Measurement and assessment play an important role in the instructional program. They provide information that can be used in a variety of educational decision. Assessment of students learning requires the use of number of techniques for measuring student achievement. But assessment is more than a collection of techniques. It is a process, a systematic one, that plays a significant role in effective teaching. It begins with the identification of learning goals and ends with a judgment concerning the extent to which those goals have been attained (Miller et al., 2013; Kizlik, 2011).

Mathematics plays an important role in the development of human civilization. Human need mathematics in their lives, for accounts, data processing, communication with others, problem solving, and decision-making. Mathematics occupies a privileged position between science and various fields of knowledge and it is considered the mother of science, because it is applied in various fields of life. Mathematics is a good field to train students and develop thinking skills and such mathematics accompany the students throughout their lives. Thinking and mathematical thinking are an educational necessity. Learning how to think mathematically is an extremely important issue in mathematics education.

The recent advancement and advent of technology in almost all walks of life has increased the importance of mathematics education and research in mathematics teaching. The value of mathematics in this technological age was stressed by the Alkhateeb & Ababneh (2011) as an essential tool for dealing with individuals in their lives in order to help them identify problems and solve them. The same importance was emphasized by NCERT (2006) as mathematics as an essential and compulsory topic in education and the provision of quality mathematics education was a necessary requirement for every child. Mathematics contributed to the development of thinking processes among students. That is the reason that made almost all countries in the world developing a curriculum that focuses on the development of deep understanding of mathematical concepts. The National Council of Teachers of Mathematics (NCTM, 1989, 2000) emphasized on the development of mathematical, critical, proof, inductive and deductive thinking. Further, NCTM emphasized mathematical teaching on Algebraic, reasoning and problem solving in a broader perspective (Schielack et al., 2000; NCTM, 1989, 2000).

Jordan is located in the Middle East, a population of 6,388,000, within an area of 89,318 km² (Department of Statistics, 2012). Approximately 98 percent of the people are Muslims. The education system of Jordan has improved consistently since the middle of the twentieth century. Education system played a big role in transforming Jordan from a country predominantly agricultural to industrial nation. In addition, the education system in Jordan was ranked first in the Arab world, and was one of the best educational systems in the region (Ministry of Education Jordan, 2005). The main objectives of the educational system in Jordan were to achieve the followings;

- i. Using mathematical thinking, numerical systems and mathematical relationships in the fields of science and public life.
- ii. Data collection, then storage and processed, produced and used in the interpretation of the phenomena, also predicted the different possibilities of events and decision-making in various fields.
- iii. The substantive critical thinking and follow the scientific method in research and problem solving.
- iv. Using Arabic language in self-expression and communication with others. (Ministry of Education Jordan, 2000, p.30).

The structure of the educational system consisted of a two-years pre-school education (kindergarten) from age 4-6 years, a ten years of compulsory basic education from age 6-16 years, and two years of a secondary academic or vocational education from age 16-18 years.

The Ministry of Education has developed curricula to conform with the development plans based on the knowledge economy. These curricula aim to achieve learning outcomes consistent with the requirements of the knowledge economy by providing students with the knowledge, experience, skills, attitudes and values necessary, make the human as the center of the knowledge economy (Ministry of Education Jordan, 2005). The objectives of mathematics curriculum become characterized by inclusiveness, interest in the cognitive dimension and emotive by focusing on the value of mathematics. It also develops logical thinking, accuracy of expression, understanding the nature of mathematics, and its important applications in everyday life, and role in the progress of life (Ababneh, 1995). Mathematics curriculum content was largely consistent with the content of the global mathematics curriculum, proposed by the National Council of Teachers of Mathematics in America (NCTM, 2000). There is a lake of instruments to measure mathematical thinking skills and also to measure students' social perception toward mathematics in higher education.

There are 29 universities in Jordan, 10 public universities, and 19 private universities (Ministry of higher education Jordan, 2013). Most universities of Jordan follow the American and English education system. The duration of study for a basic bachelor degree program is 4 years, while for dentistry, pharmacy and engineering takes five years, as for the medical six years.

1.2 Background of Problem

The current reality of scientific and technological progress and the spread of knowledge must prepare students to keep up with the social, economic, scientific and technological changes. Students should acquire thinking skills, because teaching thinking provides the individuals with the tools they need to be able to face many changes. The development of thinking became important because knowledge and facts acquisition by students depends on the development of their ability to think properly. Thus the success of education depends on the principle of teaching students on how to learn and how to think (Houssart et al., 2005; Paul, 1993; Wilson, 1993; Marzano et al., 1988). Badawi (2008) pointed out that the teaching of mathematics is necessary for teaching the basic skills that students learn to a logical way of thinking, and the use of mathematical thinking. Thinking is the most complex of human behavior. It comes at the highest level of mental activity and distinguishes human from another. Human existence is related to his mental activity, and its ability to deal intelligently with things. Human learns more by thinking, because thinking is always related to problems solving.

The effective mathematics education relies on an understanding of the process of students' mathematics learning by providing a rich learning environment and comprehensive experience. Teachers being the supporter and mentor have the responsibility to educate experiences in a way that makes learning active and they can carry out this prime task through a deep understanding on students' educational experiences and underlying key factors and process. Furthermore, successful teachers deliver knowledge to students' according to their age and past educational experiences (Abu Zainah, 2010).

Turner and Rossman (1997) indicated the importance of mathematics curriculum in order to make students' as mathematical thinkers, through the development of the students' abilities in solving problems, reasoning, logical thinking, and enjoying mathematical topics. The emphasis is on the importance of its role in the learning of mathematics by adopting the student centered perspective in the teaching learning situations and fostering in students ability to reflect about what they have

learned in through their own perspectives. Martin (1996) characterized the effective mathematics curriculum as having coherent mathematical topics aimed to help students to understand the link between various mathematical topics, and a grasp the relationships between to another and same subject, and ensuring an opportunity for students to use math in their daily lives. In Jordan, mathematics curriculum is compatible with the directions and recommendations of the first Conference on Educational Development in 1987, in term of the emphasis on developing students' mathematical thinking and solving mathematical problems (MOE, 1988, p75).

Mathematical education contributes to the development of students' thinking as its main objectives by imparting basic skills in the logic and use of mathematical skills in life routines. The document of the NCTM (2000) included the set of detailed goals for mathematical thinking in line with different developmental ages. The standard of Mathematics and thinking in NCTM is usage of models, facts, properties and relationships to explain ideas, justify answers and procedures that will leads to solutions because of mathematical logical operations as expected by the goals of teaching mathematics.

The NCTM (2000) also issued a set of standards for mathematics curriculum. One of these standards is logical thinking and proof. Based on this standard should be that students acquire the following skills and knowledge;

- i. Develop and evaluate mathematical arguments and evidence.
- ii. Recognize logical thinking and proof as essential aspects of mathematics.
- iii. Building mathematical guesses and verified.
- iv. Select and use different styles of logical thinking and methods of proof.

Different orientations of schools of thought has made the identification and nature of mathematical thinking not clear and complicated. Mathematicians viewed mathematical thinking differently from psychologists. This prevails in different education levels. It was evident even in primary and secondary school teachers. The concept of mathematical thinking seems to be related to individuals' professional academic level and experience (Lutfiyya, 1998; Carpenter, 1985). In spite of attempts to define mathematical thinking, mathematical skills and styles, there is a lapse in the

development of a clear framework that explains all the styles and mathematical thinking skills. In this regard, many researchers have tried to determine the mathematical thinking skills (Barham and Alkhateeb, 2012; Schurter, 2002).

Mathematics curriculum aims to impart mathematical thinking skills, by guiding students to be able to collect evidences, and build arguments to support mathematical ideas. Mathematical thinking and ability to proof encompasses mathematical understanding that will lead students to understand various phenomena and interpret these mathematically. Mathematical thinking and proofs are a part of the student's experience at all academic levels. It developed through continuous work in situations that require the use of mathematical thinking styles in several contexts (NCTM, 2000).

Assessment as stated in the document of the National Council of Teachers of Mathematics in America represents the process of collecting evidence for the student's knowledge and ability to use mathematical knowledge and social perception towards mathematics, and draw judgments. Therefore, assessment includes all of the tests and measurement (NCTM, 1995).

The tests are considered important in measuring methods and evaluation of students' abilities, knowing their level of achievement, on the other hand is to achieve the behavioral objectives, or educational outcomes, and what the teacher provided from different educational activities that help to raise the skills achievement among students. Supervisors and educators emphasized that these tests are highly efficient in the measurement and evaluation process.

Mathematical thinking is a skill, develop with training, mental growth and constructive experiences. It does not happen by chance, but is achieved by putting the learner in educational activities and situations which aim to develop different thinking levels among individuals. This leads to the development of mathematics curriculum and educational materials. In addition, new methods for teaching and evaluation will provide educational opportunities for students' to develop their mathematical thinking

skills. (NCTM, 2000; Greenwood, 1993; Lutfiyya, 1998; Coben, 2002; Breyfogle and Herbel-Eisenmann, 2004; Barham and Alkhateeb, 2012).

Mathematical Thinking is the ability of an individual to solve routine encountered mathematical problems. It is a process of seeking out meaning from a situation in its mathematical context as numbers, symbols, shapes or mathematical concepts (Abed & Abu Zainah, 2012). It is different from other types of thinking. In general, it includes clear concepts, such as the relationship between numbers, symbols, and concepts that can be represented by drawing, or other forms. Mathematical thinking emphasizes the mental activity and methods used in the teaching of mathematics. It also focuses on clear procedures to reach the desired result. Using of the right methods to verify hypotheses and induction in the formation of relationships (Kousa, 2001). Mathematical thinking test is a method of assessment to reveal the strengths and weaknesses of the students. Based on that will be improve and develop the educational process.

Jordan has made efforts to develop education to the desired level and improve outcomes. However the learning outcomes in mathematics did not reach an acceptable level. This is revealed by the Ministry of Education and the National Center for Human Resources Development in Jordan. The results of the studies revealed that the level of students' mathematical thinking were less than the acceptable level and the level of Jordanian students in mathematics was low (National Center for Human Resources Development, 2001). Also, the mathematics teachers in Jordan didn't emphasis on mathematical thinking in the teaching of mathematics (Abu Zainah, 1986, Nasr, 1988; Yunis, 1991; Alkhateeb, 2004). The scheme of the Jordanian mathematics curriculum included objectives that emphasize interest to mathematical thinking (Ministry of Education in Jordan, 1991).

In higher education, there is general mathematics and mathematics for the disciplines such as engineering Maths, Busines Maths etc. Mathematical thinking helps to develop intellectual capability among students and develop their mental skills. Mathematics teachers noticed that majority of students in general education and university hence a significant weakness in the basic mathematical principles. This was

confirmed by the National Center for Assessment in Higher Education. The center states that students results in the aptitude test, (which largely focuses on the basics of math) – was not good. Although aptitude tests are simple but it needs logical thinking and knowledge of some mathematical skills that are supposed to be familiar with the student (Namrawi, 2014; Al-shara, 2011).

Mathematics is the style of thinking based on understanding and perception of relationship. Teaching of mathematics contributes to the development of students' thinking processes, problem-solving and skills. It's also necessary to teach the basic skills that students learn through a logical manner. Knowing the relationship between achievement in math and thinking skills contribute to an increased interest in the teaching of mathematics, and focus on the mental processes. Badawy (2008) indicated that thinking is one of the distinctive attributes of mathematics, because it employs the structural organization that connects parts of mathematics together. The teaching thinking process is done through asking questions, opinions and ideas (Badawy, 2008). However, they must be valid and reliable instrument to measure mathematical thinking.

The importance and benefits of mathematics was discussed for everyday life. However students' interest did not reach the required level. There was distrust in mathematics. It is assumed that social perception form the cognitive domain in the learning processes for students in whole nature of mathematics, the learning of mathematics and problem solving determines the strategy and methods dealing with the problems (Zuhair, 2008).

Emotional variables such as perceptions, beliefs and attitudes towards mathematics influence the practice of teaching which helps them understand the mechanisms and strategies for student learning (Wagner et al., 1999). The studies of these variables represent an approach to the development of teaching practices and may be maximize outputs. Making required changes in the processes of teaching and learning of mathematics begins from the nature of the students' perception towards mathematics (Rayyan, 2010).

Social perception is a process of understanding others. The available information is interpreted for others to accurately understanding their behaviour. It includes observing and understanding existing information and drawing conclusions. It also helps individuals to simplify, solve problems and contradictions, and help them to accept situations (Jussim, 2012). Most studies about social perception of mathematics emphasized to the need for a theoretical framework for affect in mathematics education (Zan et al., 2006). So this led to identify some critical issues in research such as need for instruments consistent with the research problem and with the chosen definition of social perception, and capable of capturing the deep interaction between affect and cognition. In particular several scholars question the possibility of 'measuring' social perception through questionnaires. Most studies about social perception of mathematics do not provide a clear definition of the construct itself. Attitude tends rather to be defined implicitly and a posteriori through the instruments used to measure it (Zan, 2008).

Social perception towards learning topic and its nature influence on topic learning. Consequently pupils form perceptions towards mathematics, and what mathematics meant to them. The formation of perceptions on themselves as learners of mathematics will lead to an effective role in the formation of the curriculum. The impact of social perceptions on individuals plays an important role in their lives. It directs the behavior to describe phenomenon through social, psychological and biological framework. Social perceptions represent systems thinking about certain subjects which differ from the opinions and attitudes, so that individuals remain connected to the community. Social perception may have an impact on mathematical thinking because it directs the learner's response towards learning mathematics. Literature built both mathematical thinking and social perception of mathematics may differ according to background. Only two instruments important when gender and residence because higher education was different by gender and location in higher education institution. The other was assumed not to be of significant. Research on social perception has been judged to be particularly contradictory and confusing, due to the fact that it has given more emphasis to creating measurement instruments rather than elaborating on a theoretical framework (McLeod, 1992; Ruffell, Mason & Allen, 1998).

1.3 Statement of Problem

Mathematics is important for the human life, in terms of accounting, data processing, communicating, problem solving, and decision-making. Students' need it for the study of other scientific courses. It is largely an abstract science, so it needs thinking skills. Student should possess it to address mathematics problems and related issues (Al Qayam, 2008). Mathematical thinking is the cornerstone in the development of mathematics. So that they can recognize abstract mathematical relationships and understand mathematical applications. The growth of students' mathematical abilities depends on the development of mathematical thinking skills (Nejem, 2012; Mubarak, 2005). Efforts to develop learning outcomes in mathematics did not reach an acceptable level. There are many problems which included low scientific achievement, failure to process and analysis data, wrong interpretations, and unable to solve problems (NCRD, 2007). The results of International Study of Mathematics and Science TIMSS for the year 2011 showed that Jordan decline in mathematics from position 31 in 2007 to 35 in 2011. The average score of Mathematics was 427 in 2007 and fell to 406 in 2011 (TIMSS, 2011). The results for Jordan in the Programme for International Student Assessment PISA for the year 2012 showed that Jordan decline in mathematics from position 55 in 2009 to 61 in 2012 (OECD, 2010; PISA, 2012). Mathematics teachers noticed that majority of students in general education and university hence a significant weakness in the basic mathematical principles. This was confirmed by the National Center for Assessment in Higher Education. The results of many studies showed that a general weakness in the ability to mathematical thinking (Barham and Alkhateeb, 2012; Abu Zainah & Ababneh, 2007; Abed & Abu Zainah, 2012).

The purpose of social perception study is the interpretation and predicts behavior and then modifies it, to fit the interests of the individuals. This applies to the measure of social perception of mathematics, to know its existence and its degree of strength. It form the cognitive domain in the learning processes for students. Social perception about the nature of mathematics, learning of mathematics and problem solving determines the strategy and methods to deal with the problems. This will lead

to effective role in influencing the curriculum and the progress of the educational processes. It consists of observing and understanding existing information and draw conclusions. It also helps individuals to simplify and solve problems and contradictions, and help them to accept the environment. So many researchers and educators believe that the main reasons for the failure of students in mathematics due to negative perception towards mathematics. An instrument should be available to measure mathematical thinking and social perception of mathematics. Other instruments not complete for Jordan higher education. Measuring learning outcomes and evaluation in the emotional domain has still a little interest when compared with the cognitive domain. In previous work (Di Martino & Zan, 2001, 2002, 2003; Zan & Di Martino, 2003) underlined the lack of theoretical clarity that characterizes research on social perception and the inadequacy of most measurement instruments.

1.4 Research Objectives

This study examined the relationships between mathematical thinking and social perception of mathematics in Jordan higher education through the use of quantitative data. This study aimed to achieve the following objectives:

- i. To develop an instrument of mathematical thinking skills (MTT) among first year students at Jordanian Universities.
- ii. To develop an instrument of social perceptions of mathematics (SPMQ) among first year students at Jordanian Universities.
- iii. To identify the profiling trend of varied students' grouping based on the developed MTT instrument.
- iv. To identify the similarity and differences of social perception of mathematics between first year students in Jordan.
- v. To assess the relationship between mathematical thinking skills (MTT) and social perception of mathematics (SPMQ) among first year students at Jordanian universities.

1.5 Research Questions

To achieve the above objectives this study attempts to answer the following questions:

- i. What is the validity and reliability of the MTT instrument?
- ii. What is the validity and reliability of the SPMQ instrument?
- iii. Is there any significant difference in the level of mathematical thinking among Jordanian students due to gender, residence and their interaction?
- iv. Is there any significant difference in the social perception of mathematics among Jordanian students due to gender, residence and their interaction?
- v(a). Is there any correlation between mathematical thinking skills and social perception of mathematics among Jordanian first year university students?
- v(b). Is there any significant influence of social perception on mathematical thinking among Jordanian first year university students?

1.6 Research Hypothesis

The following research hypotheses were formed according to the research objectives and questions.

- Ho1: There is no significant difference of mathematical thinking skills among Jordanian students based on gender and residence.
- Ho2: There is no significant difference in the social perception of mathematics among Jordanian students based on gender and residence.
- Ho3: There is no significant difference among students in Jordan on based on both mathematical thinking skills and social perception of mathematics.
- Ho4: There is no significant relationship between mathematical thinking skills and social perception of mathematics of Jordanian students.

1.7 Significance of the Study

The results of this study would provide information on students' strengths and weaknesses in mathematical thinking skills. It can be used to guide educationist to use suitable teaching strategies in order to develop thinking skills among students. It can also guide mathematicians and specialists to implement educational activities and teaching programs in the treatment of weaknesses for students and development mathematical thinking skills.

This study will also provide emphasis on the teaching-learning process, and how conformity can be made to the preferred learning styles of students. It is necessary to provide opportunities for students to practice activities that develop their thinking skills which help them make right decision to face various situations. Mathematical thinking test is important because it can be used to determine students' strength and weakness in their mathematical thinking styles.

Perceptions occupied a substantial site within the social and psychological research. Most of the topics were on psychological and educational content, but were studying attitudes and opinions. The topic of social perceptions is comprehensive it contribute to knowledge in social psychology. It is important to measure social perception of mathematics for the possibility of identifying and trying to modify the negative aspect. It can be used to configure positive social perception of mathematics, so that students like to study mathematics (Amer, 2011).

Social perceptions help to classify and organize explanations from others through experiences and interactions. It also helps people how their association with other people or other subjects and allows them to predict and modify behaviors. The importance of social perception is to know the thoughts, beliefs, feelings, intentions and desires, as well as it can be read internal individuals issues based on their behavior and their words. Modified on these readings, people can make the right decision on how to behave socially. Social perception is an important component of social efficiency and social success, because it is social rules knowledge roles. In turn helps in decision-making and confidence in social interaction (Haj Sheikh, 2012).

1.8 Limitation of the Study

This study only investigated the variables mathematical thinking and social perception of mathematics. This study only used a quantitative survey approach. Only two instruments were used in the study. First, mathematical thinking skills test that consist of only six aspects that was; induction, deduction, mathematical proof, logical thinking, symbolism, and generalization. Second, social perception of mathematics dimensions questionnaire that consisted of only six dimensions which were; difficulty of mathematics, nature of mathematics, anxiety of mathematics, enjoyment of mathematics, role of teachers, and usefulness of mathematics.

The sample of study consisted of only first-year students at three universities which are Yarmouk University, AL-Hussein Bin Talal University and The Hashemite University because they need to master the skills and development of mathematical thinking to help them to solve problems, make the appropriate decisions that face, and raise their achievement. The researcher analyzed the result by using Analysis of Variance (ANOVA), Person Correlation Coefficient, Rasch model and Amos. The results can only be generalized to Jordan first year university students.

1.9 Theoretical Framework

The understanding on the theories about how people learn, and the ability to apply these theories in the teaching of mathematics are the primary requirements for effective teaching of mathematics. Many scientists studied the mental growth and the nature of learning resulted in the variety of learning theories. Learning theories are a set of ideas or opinions logically consistent. It introduces the concept of psychological theoretical that can be applied to educational problems (Driscoll 1994; Zghoul, 2003;

Olson & Hergenhahn, 2009). This is the theoretical basis for social perception. Learning theories provide the framework for understanding the nature of learning, behavioral patterns in diverse conditions, interpretation of the causes, and predictions (Schunk, 2008). This study adopted the Cognitive learning and constructive learning theory.

Cognitive learning theory is the interaction of mental processes, knowledge and direct and indirect experiences. It focuses on the internal processes of the individual, such as thinking, planning and decision-making that is on the external environment or clear responses (Qutami & Qutami, 1998). Driscoll (1994) indicated the fundamental principle underlying the cognitive theory was that most behavior including learning was controlled by the internal cognitive processes. According to this theory, learning is a mental process represented in the use of memory, thinking and motivation (Anderson and Elloumi, 2004). Bower & Hilgard (1981); Olson & Hergenhahn (2009); Anderson and Elloumi (2004); Qutami & Qutami (1998) and Zghoul (2003) confirmed that cognitive learning was characterized by the followings;

- i. A change in the case of perception and knowledge.
- ii. Realized knowledge which is as a mental activity requires coding and internal mental structure of the learner.
- iii. Learner as an active participant in the learning process.
- iv. Focusing on building templates of knowledge.
- v. Focusing on the construction, organization and arrangement to facilitate optimal treatment for information.
- vi. Focusing on how to remember, retrieval, and storage of information in memory.
- vii. Learning as an active process carried out by the learner, which can be affected by the learner.
- viii. Learning outcomes depend on what the teacher provided, and what the learner's did for information processing.

Constructive learning theory is defined as to how the individual builds self-knowledge in his mind depending on his experience and not a negative reception from others. Constructivism is characterized by its emphasis on the employment of learning

through real context and focuses on the importance of the social dimension in the occurrence learning. It also emphasized that the individual interprets the information and the world around him according to his personal views (Duffy & Cunningham, 1996; Schunk, 2008; Olson & Hergenhahn, 2009). Learning was done through observation, processing and interpretation and adapting the information based on the individual's cognitive environment. The learner is the center of the learning process. The teacher is the supervisor of the learning process. The learner builds up knowledge. Schunk (2008); Zghoul (2003); Olson & Hergenhahn (2009); Duffy & Cunningham (1996) confirmed that the principles of constructivist theory of learning are the followings;

- i. The learning is an active process. The learner uses sensory input and constructs meaning through it.
- ii. The individual learns how to learn. Learning includes both the construction of meaning and construction of systems of meaning.
- iii. The activities and scientific experiments are necessary for learning.
- iv. learning is a social activity associated with an individual connection with others such as; the teacher , peers , family , and friends.
- v. Knowledge is essential for learning to happen.
- vi. Learning takes time, and the occurrence of actual learning needs of the individual review of his ideas, which leads to meditation and testing that leads to learning.
- vii. Motivation is the main component of learning. Learning use this knowledge through motivation not only earned.

Many scientists and specialists relied on theories of learning in building instruments and standard tests in many areas. The main investigation in this study was the relationship between social perception of mathematics and mathematical thinking. There are many studies on mathematical thinking such as by Lutfiyya (1998), Barham and Alkhateeb (2012), Zaman (2011), Mubark (2005), and Alkhateeb (2006). There are also many studies on social perception such as by Alkhateeb (2011), Alkhateeb & Ababneh (2011), Abed & Asha (2009), Abed & Saedi (2002), Kloosterman & stage (1992) and others. Most studies about social perception of mathematics emphasized to the need for a theoretical framework for affect in mathematics education (Zan et al., 2006). So this led to identify some critical issues in research such as need for instruments consistent with the research problem and with the chosen definition of

social perception, and capable of capturing the deep interaction between affect and cognition. In particular several scholars question the possibility of ‘measuring’ social perception through questionnaires

Mathematical thinking is thus mental processes carried out by the students to develop ideas related by situations, mathematical experiences or solve a specific problem in mathematics. It related to cognition development and cognitive theory. Also these abilities were developed through learning and its environment which relates to constructive theory. students’ perception towards mathematics is theoretically based on social constructivism.

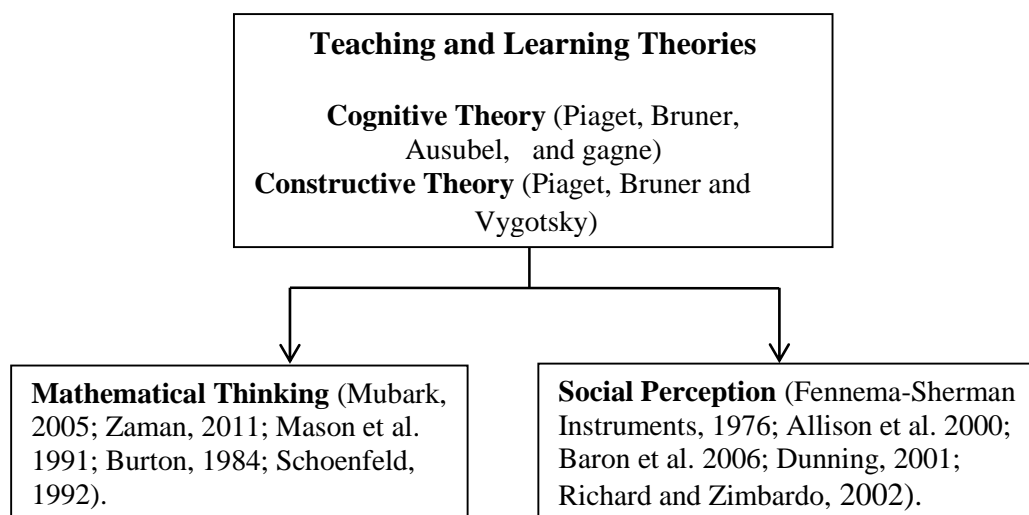


Figure 1.1 Theoretical Framework

1.10 Conceptual Framework

There are many studies dealing with aspects of mathematical thinking. After reviewing the past studies and was considering the opinions of a group of mathematics specialists at Jordanian universities, the researcher chose six aspects, and they were induction, deduction, generalization, symbolism, logical thinking, mathematical proof (Mubark, 2005). This was based on past studies by Mubark (2011); Barham & Alkhateeb (2012); Zaman (2011); Abu Zainah & Ababneh (2007); Mubark (2005); Lutfiyya (1998); Badawy (2008) proposed inductive thinking. Mubark (2011); Barham & Alkhateeb (2012); Zaman (2011); Abu Zainah & Ababneh (2007); Mubark (2005); Lutfiyya (1998); Badawy (2008); Schielack et al. (2000); Mustafah (2002)

suggested Deductive thinking. Mubark (2011); Barham & Alkhateeb (2012); Badawy (2008); Mubark (2005); Dehance & Spelke (1999) indicated Algebraic thinking (Symbolism). Mubark (2011); Barham & Alkhateeb (2012); Zaman (2011); Badawy (2008); Mubark (2005); Petocz & Petocz (1997) suggested mathematical proof. Abed & Abu Zainah (2012); Zaman (2011); Nejem (2010); Mubark (2005) proposed Generalization. Lastly, Barham & Alkhateeb (2012); Mubark (2011); Nejem (2012); Abu Zainah (2012); Alkhateeb & Ababneh (2011); Zaman (2011); Mubark (2005) proposed Logical Thinking.

Social perception is the process of understanding others, which is the process of integrating and interpreting information available for others to get to a more precise understanding of their behavior. It determines an individual's ability to create a rule for others, because it consists by observing and understanding of existing information on the individual and to extraction findings. After reviewing the studies that dealt dimensions of social perception, the researcher choose the most important dimensions based on the original Fennema-Sherman Instruments (1976). From previous studies, Alkhateeb (2011); Alkhateeb & Ababneh (2011); Abed & Asha (2009) proposed difficulty of mathematics as one of this dimensions. Kloosterman & stage (1992); Lazim et al. (2004); Ababneh (1997), Alkhateeb & Ababneh (2011) suggested usefulness of mathematics. Tapia (1996); Nooriafshar & Maraseni (2005), Abed & Asha (2009) proposed enjoyable of mathematics. Mclemore (2004); Yeo, (2004); Cemen (1987); Kirk (2001); Trujillo & Hadfield (1999) proposed anxiety of mathematics. Alkhateeb & Ababneh (2011); Lazim et al. (2004); Abed & Saedi (2002); McLeod (1992); Barkatsas & Malone (2005) proposed that nature of mathematics. Lastly, Alkhateeb (2011); Abed & Saedi (2002) proposed role of teacher. The Figure 1.1 showed the theoretical framework for this study.

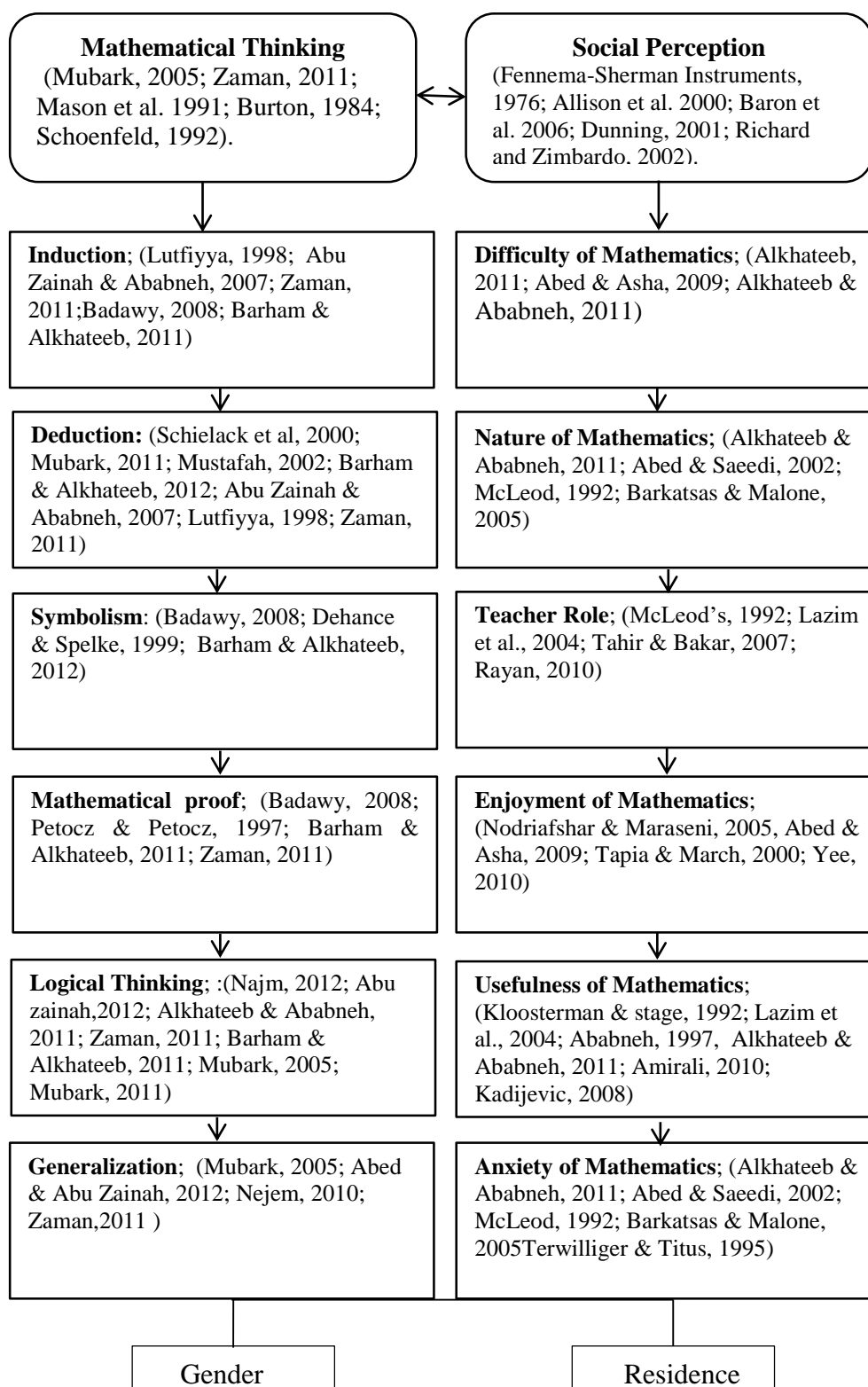


Figure 1.2 Conceptual Framework

1.11 Definition of Terms

These were the definition of terms for this study;

1.11.1 Mathematical Thinking

According to Mason et al. (1991), Mathematical thinking was defined as “A dynamic process which, by enabling us to increase the complexity of ideas we can handle, expands our understanding” (p.158).

“Mathematical thinking is the development of a mathematical point of view valuing the process of mathematization and abstraction and having the predilection to apply them; and the development of competence with tools of the trade and using those tools in the service of the goal of understanding structure” (Schoenfeld, 1992, p.335).

According to Burton (1984), “Mathematical thinking is mathematical not because it is thinking about mathematics but because the operations on which it relies are mathematical operations. Furthermore, the key to recognizing and using mathematical thinking lies in creating an atmosphere that builds the confidence to question, challenge, and reflect” (P. 36, 48).

According to Zaman (2011) “Mathematical thinking in this thesis is defined as the abstraction and generalization of mathematical idea. It is dynamic process which, by enabling us to increase the complexity of ideas we can handle, expands our understanding”.

From the previous definitions and others, this study defined mathematical thinking as mental processes and skills carried out by the individual learner to develop ideas related to situations and mathematical experiences, or to discuss a particular topic

in math, to judge the reality of something, or solve a specific problem in mathematics. Mathematical thinking measured by a score that obtained by the students when answering a mathematical thinking test that prepared for the purposes of the study, and determined by the following aspects: induction, deduction, mathematical proof, logical thinking, generalization, symbolism.

1.11.2 Social Perception

According to Allison et al. (2000), social perception denotes to preliminary steps in the processing of information that concludes in the exact analysis of the dispositions and intentions of other persons. According Baron et al., (2006) social perception is the method through which are to define many of the characteristics and behaviors of ourselves and others. Social perception is defined as the processes through which individuals interpret information about others, extract interpretations about them, and development mental demonstrations of them (Bernstein et al., 2006; Richard and Zimbardo, 2002).

According to Dunning (2001) social perception is, in psychology and other cognitive sciences, that part of perception that allows people to understand the individuals and groups of their social world, while social perceptions can be flawed, they help people to form impressions of others by making the necessary information available to assess what people are like. According Zebrowski (2007) the contemporary concept of social perception is considered to be an umbrella term that includes various other traditional and related phenomena such as person perception, impression and attitude formation, social cognition, attribution, stereotypes, prejudice, social categorization, and social comparison and implicit personality theories.

Social perception is the process of perception of the individual to others is a complex process, it does not just depend on what he sees as an individual and what he hears from others, but also depends on the characteristics of the position are the processes of social interaction, and on the type of relations that link between

interacting in that position. There is a pattern of beliefs affect our social perception to others.

The study of perception towards mathematics guide the behavior of the learner about precision and organization, confidence and self-reliance in solving problems, and objectivity in judging the attitudes and things, and the formation of motivation and desire to continue to study and learn (Abdul Hamid, 2012).

From the previous definitions and others, this study defined social perception of mathematics as a method to identify and extract many of the characteristics, behaviors and impressions of ourselves and others, interpret, evaluate and make judgments. The acceptance or rejection responses to a number of items that revolve around the dimensions related to mathematics. Social perception of mathematics measured by a score that obtained by the students when answering a social perception questionnaire that prepared for the purposes of the study, and determined by the following dimensions; nature of mathematics, difficulty of mathematics, the teacher role, anxiety of mathematics, enjoyment of mathematics, usefulness of mathematics.

1.11.3 Profiling Trends

According to the Casio Zavala (1999) demographic trend is the scientific study of characteristics and dynamics pertaining to the human population. Demographic requires the study of specific information that may be gathered from a population census and vital statistic records. Demography is the statistical study of all population. Demographic profile focuses on the age and gender of teachers and school principal (Field, 2002). Demographic trend: possibly the most important non market stimulus to potential demand as they represent the number and categories of potential students (Aziz, 2012).

For this research profiling trend focuses on the characteristics of population (first year students in Jordan Universities) such as gender and geographic location.

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