EFFECTS OF A MATHEMATICS INSTRUCTION ENRICHED WITH PORTFOLIO ACTIVITIES ON SEVENTH GRADE STUDENTS' ACHIEVEMENT, MOTIVATION AND LEARNING STRATEGIES

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ABSTRACT

EFFECTS OF A MATHEMATICS INSTRUCTION ENRICHED WITH PORTFOLIO ACTIVITIES ON SEVENTH GRADE STUDENTS' ACHIEVEMENT, MOTIVATION AND LEARNING STRATEGIES

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The purpose of this study is to investigate the effects of a mathematics instruction enriched with portfolio activities on seventh grade North Cyprus students' mathematics achievement, motivation and learning strategies.

A Doubly Repeated MANOVA measures experimental - control groups pretest-to posttest-to-retention test design was used. Convenience sampling was used in the study. 69 students from 102 formed the experimental and the control groups respectively.

Motivated Strategies for Learning Questionnaire and mathematics achievement test were administered to treatment groups across three time periods. A semi-structured interview was conducted with 28 students in the experimental group.

According to the findings, it was seen that the students who followed a portfolio-enriched instruction performed better in mathematics achievement, critical thinking, metacognitive self-regulation skills and extrinsic goal orientation compared to the students who followed a traditional instruction.

The findings showed that the differences for the post testing between the two groups were greater on metacognitive self-regulation and mathematics achievement test. Besides, differences for the retention testing between the two groups were greater on critical thinking and mathematics achievement test.

Interview results of the study revealed that some students had emotional experiences with the portfolios. Students explained the strengths and weakness of portfolio. Furthermore, they utilized from internet, book or their peer to prepare their porfolios.

The findings revealed that portfolio-enriched instruction is helpful especially in improving students' mathematics achievement, critical thinking, metacognitive self-regulation skills and extrinsic goal orientation. Preparing a handbook and meta-curriculum for teachers is recommended in all educational settings, which may help them to develop classroom instruction according to the students' special needs.

Key Words: Portfolio, Motivation, Learning Strategies, Mathematics Achievement, Students

ÖZ

ÖĞRENCİ ÜRÜN DOSYASI ETKİNLİKLERİ İLE ZENGİNLEŞTİRİLMİŞ MATEMATİK ÖĞRETİMİNİN YEDİNCİ SINIF ÖĞRENCİLERİNİN BAŞARI, MOTİVASYON VE ÖĞRENME STRATEJİLERİ ÜZERİNE ETKİSİ

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Bu çalışmanın amacı öğrenci ürün dosyası etkinlikleri ile zenginleştirilmiş matematik öğretiminin Kuzay Kıbrıs yedinci sınıf öğrencilerinin başarı, motivasyon ve öğrenme stratejileri üzerine etkisini araştırmaktır.

Bu çalışmada Tekrarlı Ölçümler Çoklu Varyans Aanlizi (Doubly Repeated MANOVA)yarı-deneysel desenler arasından öntest-sontest eşleştirilmiş kontrol gruplu desen, kalıcılık testi ile birlikte kullanılmıştır. Bu araştırmada uygunluk örneklemi kullanılmıştır. Çalışma süresince deney grubunda 69 öğrenci, öğrenci ürün dosyası aktiviteleri ile zenginleştirilmiş öğretimin kullanıldığı bir sınıf ortamında eğitim almış ve 33 kişilik kontrol grubu ise geleneksel bir öğretim ortamında eğitim almaya devam etmiştir.

Çalışmada Öğrenmede Motive Edici Stratejiler Ölçeği (MSLQ) ve matematik başarı testi 3 ay aralıklarla 3 kez uygulanmıştır. Bunun yanında, deney grubunda bulunan 28 öğrenci ile dönem sonunda yarı-yapılandırılmış mülakat yapılmıştır.

Elde edilen verilere göre, ürün dosyası ile zenginleştirilmiş sınıfta öğretim gören öğrencilerin, klasik tekniklerle öğretim gören sınıftaki öğrencilere kıyasla, matematik başarısı, kritik düşünme, biliş üstü öz-düzenleme becerileri ve dışsal hedefe yönelme açısından daha iyi performans gösterdikleri belirlenmiştir.

Son-test bulgularına göre, deney ve kontrol grubu arasındaki en büyük fark, matematik başarısı ve biliş üstü öz-düzenleme sonuçlarında görülmüştür. Ayrıca, kalıcılık testi sonuçlarına göre iki grup arasındaki en büyük fark matematik başarısı ve kritik düşünme boyutlarında gözlemlenmiştir.

Mülakat sonuçlarına göre, öğrencilerin ürün dosyası oluşturma sürecinde duygusal deneyimler yaşadıkları ortaya çıkmıştır. Öğrenciler ayrıca ürün dosyası oluşturmanın güçlü ve zayıf yanlarını da ortaya koymuşturlar. Bunun yanında, ürün dosyası oluşturma sürecinde öğrencilerin başvurduğu üç çeşit kaynak, internet, kitaplar ve arkadaşlar olarak kategorize edilmiştir.

Çalışma bulgularına göre, ürün-dosyası ile zenginleştirilmiş öğretim gören öğrencilerin matematik başarısı, dışsal hedefe yönelme, kritik düşünme ve bilişüstü öz-düzenleme boyutlarında ilerleme kaydettikleri görülmüştür. Sonuç olarak, öğrencilerin özel ihtiyaçlarına göre öğretimin yeniden düzenlenmesi ile ilgili uygulamalar içeren bir el kitabı ve müfredatı kullanma kılavuzu hazırlanması önerilmektedir.

Anahtar Kelimler: Ürün dosyası, Motivasyon, Öğrenme Stratejileri, Matematik Başarısı, Öğrenci

To my parents and my late grandmother….

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LIST OF ABBREVIATIONS

MoNE: Ministry of National Education

Math: Mathematics

MSLQ: Motivated Strategies Learning Questionnaire

MACH: Mathematics Achievement

MACH1: Pre-test scores of Mathematics Achievement

MACH2: Post-test scores of Mathematics Achievement

MACH3: Retention test scores of Mathematics Achievement

IGO: Intrinsic Goal Orientation

IGO1: Pre-test scores of Intrinsic Goal Orientation

IGO2: Post-test scores of Intrinsic Goal Orientation

IGO3: Retention test scores of Intrinsic Goal Orientation

EGO: Extrinsic Goal Orientation

EGO1: Pre-test scores of Extrinsic Goal Orientation

EGO2: Post-test scores of Extrinsic Goal Orientation

EGO3: Retention test scores of Extrinsic Goal Orientation

EFF: Self-Efficacy for Learning and Performance

EFF1: Pre-test scores of Self-Efficacy for Learning and Performance

EFF2: Post-test scores of Self-Efficacy for Learning and Performance

EFF3: Retention test scores of Self-Efficacy for Learning and Performance

ELA: Elaboration

ELA1: Pre-test scores of Elaboration

ELA2: Post-test scores of Elaboration

ELA3: Retention test scores of Elaboration

CRT: Critical Thinking

CRT1: Pre-test scores of Critical Thinking

CRT2: Post-test scores of Critical Thinking

CRT3: Retention test scores of Critical Thinking

PL: Peer Learning

PL1: Pre-test scores of Peer Learning

PL2: Post-test scores of Peer Learning

PL3: Retention test scores of Peer Learning

MSR: Metacognitive Self-Regulation

MSR1: Pre-test scores of Metacognitive Self-Regulation

MSR2: Post-test scores of Metacognitive Self-Regulation

MSR3: Retention test scores of Metacognitive Self-Regulation

$\alpha_{D\&M}$: Cronbach alpha reliability calculated by Duncan and McKeachie (2005)

α_{R}: Cronbach alpha reliability calculated by the researcher

CHAPTER 1

INTRODUCTION

In the 21st century we live in an astonishingly changing era. New information, tools, and ways of living, communication and even communicating through mathematics continue to develop and change. Calculators were very expensive in the early 1980s however in this century; they are more commonly used, very low-priced and immensely more powerful. In the past quantitative evidence was available to only a few people but now widely spread through the world (White, 2002). She also stated that, importance of being able to understand mathematics and using it in commonplace is continuingly increasing. National Council of Teachers of Mathematics (NCTM, 2000) also stated that knowing mathematics offer a range of preferences and alternatives. Understanding and doing mathematics will significantly enhance opportunities and options in shaping students' own future. All students should have the opportunity and the necessary support to learn significant mathematics in depth. White (2002) claimed that mathematics is important for various factors; life as a part of cultural heritage, work and scientific environment. This view is also prevailing for the current Turkish Mathematics Curriculum developed by Turkish Republic of Ministry of National Education (MoNE, 2009).

With the new vision and mission of the current curriculum, some aspects of the mathematics education have been changed as well. Changes in the curriculum are strongly related to the vision of the curriculum i.e. “every child can learn mathematics.” (MoNE, 2009, p.22). For instance in order to support teacher’s instruction, and improving students’ mathematical thinking skills alternative assessment techniques have been introduced in the curriculum such as; project, performance task, journal writings, and portfolios. In this study, the researcher will deal with portfolios as an instructional tool because it has some important properties and advantages to achieve some aims of the curriculum. In other words, mathematics curriculum emphasized that, mathematical

skills may allow anyone to analyze the social environment and help students to survive in such an environment. In the curriculum, it is also stated that mathematics skills help people to improve problem solving critical and creative thinking skills (MoNE, 2009) In order to improve these skills, both teacher and student responsibilities has changed in the mathematics curriculum. For instance being able to express own ideas, problem solving, collaboration, self-evaluation are some of these responsibilities. In addition to this, teacher roles have been changed; such as shaping her instruction through the teaching period, guiding students through learning process,

Debra and Meyer (1996) stated that portfolios have different definitions in the literature; however they are mainly considered as learning (student) portfolios (Nunes, 2004; Zubizaretta, 2008) and teaching portfolios (Yang, 2003). Teaching portfolio can be defined briefly as

> *"It is a factual description of a professor's teaching strengths and accomplishments. It includes documents and materials, which collectively represents the scope, development and quality of a professor's teaching performance. Think of the function behind portfolios kept by architects, designers, artists, etc.-to display their best work and the thought process behind their work" (Marolla & Goodell, 1991, p. 1).*

Learning portfolio is defined by Zubizaretta (2008) as "a flexible tool that engages students in a process of continuous reflection and collaboration focused on selective evidence of learning." In this study, portfolios are considered as learning portfolios. Duffy and Thomas (1999) has identified four types of learning portfolios; Level 1 the everything portfolio; that contains anything both drafts and projects, Level 2 the product portfolio; includes examples of students' works for the required products Level 3, the showcase portfolio includes students' works and rationale for the completed tasks; Level 4 objective portfolio; includes teacher's statements about the quality of work. Product portfolio is the portfolio type, which will be discussed throughout the present study.

Use of portfolios has specific implications in the curriculum. It is mentioned in the curriculum that portfolios can be used both for summative purposes and help teachers to make decisions about instructional methods.

Portfolios can be used for many reasons; Gilman et al. (1995) asserted that portfolios could provide more information about student progress and encourage students to be active in the classroom and feel responsible of their own learning that might provide a meaningful communication between the student and the teacher. Meaningful communication between teacher and student is very important since it may influence a remarkable array of educational outcomes such as academic achievement, attitude, behavior, and motivation (Juvonen, 2006). Several research studies claimed that portfolios if used properly by teachers might identify students' learning needs, improve their knowledge and understanding. (Fakude & Bruce, 2003; Finlay, Maughan & Webster, 1998; Grant, Kinnersley, Pill & Houston, 2006; Kurki, Tiitinen & Paavonen, 2001; Lonka, Slotte, Halttunen, Tiwari & Tang, 2003; Rees & Sheard, 2004)

Effects of portfolio have been investigated and researched for many years. Portfolios in education are mainly used as an assessment tool (Cicmanec & Viechnicki, 1994). Karakaş and Altun (2010) investigated the effects of portfolio assessment on fifth grade students' self-regulation skills. Fukawa and Buck (2010) investigated effects of portfolio assessment on students' reading and writing mathematics, mathematical thinking ability. Burks (2010) conducted a research study and examined outcomes of using a portfolio assessment in an undergraduate mathematics classroom on self-efficacy and mathematics achievement factors. Riviera and Bryant (1997) inspected the effectiveness of portfolio assessment on learning disabilities. Similarly, Briggs (1993) has used portfolio assessments and discussed mental processes used by students in finding solutions to mathematics problems in her study. Cutler and Monroe (1999) used portfolio assessment to examine thinking process in mathematics. Wang (2009) studied the effects of using e-portfolio assessments on teacher collaborations. In the present study the portfolio was used to enrich the instruction in the mathematics course instead of assessment techniques.

As mentioned before, portfolios have been used for the purpose of instruction as well. Riviera and Bryant (1997) underlined that some authors use terms instructional portfolios and portfolio assessments interchangeably. However authors stated that they are different in content selections and considerations. Cole and Struyk (1997) stated that portfolios promote student reflection, and provide direction for instruction. Therefore instructional portfolios should be considered under a different title. Robbins and Brandt (1994) used portfolios as an instructional tool to involve teachers in the program. Egan,

McCabe, Butler and Semenchuk (2003) studied effectiveness of portfolios as an instructional method to decrease errors combined with test scoring by graduate students. In the literature, instructional portfolios have been mainly studied as e-portfolios which is defined as a digital evidence which audio-visual content such as manuscript, photo, video and voice (Abrami & Barrett, 2005). Furthermore, instructional e-portfolios mainly have been used to examine the effect on English learning and teaching (Aliweh, 2011; Baturay & Daloğlu, 2010; Huang & Hung, 2010; Mostafa, 2011; Ya-Chen, 2011;). On the other hand there are a few studies concerning mathematics education and portfolio instruction. For instance; Lee, Yeng, Kung and Hsu (2007) investigated the factors affecting the learning effects in a blended e-Learning course for Mathematics, using portfolio as an instructional tool.

As mentioned studies are mainly focused on the effects of portfolio assessment on mathematics achievement and there are little research conducted in the field of portfolio-enriched instruction in a mathematics class. Especially, in North Cyprus there are few research studies conducted about the effects of portfolios for both instructional or assessment dimension of portfolios. This study will be used to enrich instruction of a 7th grade mathematics class; including chapters; Percentages, Inequalities, Geometry Spatial Visualization, Triangles, Circle and Right Cylinder. One of the purposes of the study is to investigate the effect of portfolio-enriched instruction on students' mathematics achievement. Because of the very nature of the portfolio; helping students to see their developmental process, Ediger (2010) mentioned that using portfolio as an instructional material may boost pupil's motivation. Poteet et al. (1993) stated that portfolios could be used to motivate students in relation to goals, facilitate discussions between students and teachers, (as cited in Cole & Struyk, 1997). Dotson and Anderson (2009) found that using portfolio helped students to feel more eager and motivated to take academic responsibility and risk in order to develop himself/herself to strengthen his/her weaknesses. Lirola and Rubio (2009) also examined undergraduate language learners' opinion and found that using portfolio has a motivational impact on students' learning. There are a bunch of research studies from various disciplines that found positive relationships between web-based portfolios and motivation (Bradley 2011; Clark, Chow-Hoy, Herter & Moss, 2001; Driessen, Arno, Jan van & Cees, 2007). However, like these studies, many studies were conducted using a web-based portfolio treatment. Besides motivation were considered as a one-dimensional construct. Pintrich (1993) defined

motivation as a general cognitive view of motivation and investigated motivation under different constructs. Some of the major constructs are intrinsic goal orientation (IGO), extrinsic goal orientation (EGO) and self-efficacy for learning and performance (EFF). Nonetheless authors mentioned above, mainly focused on the effects of portfolio assessment or use of portfolios on motivation as a single oriented construct. In this study, the researcher aimed to study the effects of portfolio use on some of Pintirch's (1993) major components; intrinsic goal orientation, extrinsic goal orientation, and self-efficacy for learning and performance in mathematics classroom.

As the importance of student motivation is emphasized in the curriculum (MoNE, 2009, p.23) it is also underlined that learning strategies such as; critical thinking, self-regulation skills, cognitive skills, and collaboration skills are also significant. Lai-Yeung (2011) claimed that one of the purposes of portfolios is to ascertain student achievement and learning outcomes that might lead to attain better learning strategies. According to Pintrich (1993) elaboration, critical thinking skills, metacognitive self-regulation skills and peer learning are some of the major components.

Since portfolios have some basic attributes mentioned in the curriculum (MoNE, 2009) like improving students' self-discipline and responsibility and helping students to direct his/her own learning, effect of portfolio should be investigated in terms of improving learning strategies (Chang, 2001). Studies in the literature, including both portfolios and learning strategies are limited. There are a few studies indicating the value of using web based- portfolio assessments in order to improve learning strategies (Dorninger & Schrack, 2008; Hung, 2009; Yang, 2003; White, 2004). Since there has been a little research on the relationship of portfolios and learning strategies, this study aims to investigate the effects of using portfolio on particular components of learning strategies; elaboration, critical thinking, metacognitive self-regulation and peer learning defined by Pintrich in 1991.

Consequently, the literature is mainly focused on the effects of portfolio assessment on English language teaching. In addition to these, we reached a few studies including the effect of portfolio as an assessment technique or an instructional method on mathematics achievement, motivation, or learning strategies. Furthermore, we did not come across any research studies about the effect of portfolio as an instructional tool on the sub-dimensions of motivation (IGO, EGO, and EFF) and the sub-dimensions of learning

strategies elaboration (ELA), critical thinking (CRT), peer learning (PL), and metacognitive self-regulation (MSR). In the present study these variables are selected because they are most probably related to the outcomes of instruction enriched with portfolio activities. Therefore, in this study it is aimed to seek answers to the effect of portfolio-enriched instruction the on mathematics achievement, IGO, EGO, EFF, ELA, CRT, PL and MSR. In the current elementary mathematics curriculum in North Cyprus, the use of portfolios in the class is emphasized. Besides, the importance of both motivation and learning strategies are also underlined. Therefore, this study can contribute to mathematics education especially in North Cyprus.

1.1. Research Questions of the Study

Main research questions of the study can be stated as "What is the effect of the mathematics instruction enriched with portfolio on mathematics achievement, motivation and learning strategies.

Below there are research questions related with the first dependent variable; mathematics achievement. Effects of the treatment will be examined in three aspects; main effect of time, main effect of group and group by time interaction will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7^{th} grade students' mathematics achievement across three time periods? (Time effect)
- Is there any significant difference in the mean scores of mathematics achievement test between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7^{th} grade students' mathematics achievement test across three time periods for the experiment and control group? (Interaction effect)

Questions stated below are the research questions related with the *intrinsic goal orientation* scale. Effects of the treatment will be examined in three aspects; main effect of time, main effect of group and group by time interaction will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' intrinsic goal orientation scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of intrinsic goal orientation scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' intrinsic goal orientation scores across three time periods for the experiment and control group? (Interaction effect)

Following research questions are related with the *extrinsic goal orientation* score. Effects of the treatment will be examined in three aspects; main effect of time, main effect of group and group by time interaction will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' extrinsic goal orientation scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of extrinsic goal orientation scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' extrinsic goal orientation scores across three time periods for the experiment and control group? (Interaction effect)

Below there are research questions related with the *self-efficacy for learning and performance* subscale. Treatment effects will be examined in three aspects; main effect of time, main effect of group and group by time interaction will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' self-efficacy scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of self-efficacy scores between students those who have instructed with portfolio-enriched activities and

those who have instructed with traditional methods across three time periods? (Group effect)

- Is there any change in the mean sores of 7th grade students' self-efficacy scores across three time periods for the experiment and control group? (Interaction effect)

Effects of the treatment on learning strategies are analyzed in four dimensions; elaboration, critical thinking skills, peer learning and metacognitive self-regulation. Related research questions are given below, respectively. Following research questions are related with the *elaboration* scale.

- Is there any significant change in the mean scores of 7th grades' elaboration scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of elaboration scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' elaboration scores across three time periods for the experiment and control group? (Interaction effect)

Critical thinking is another dependent variable in this study. Time, group and group by time interaction effects are analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' critical thinking scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of critical thinking scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' critical thinking scores across three time periods for the experiment and control group? (Interaction effect)

Below there are research questions related with the peer learning subscale. Treatment effects on the *peer learning* will be examined in three aspects; main effect of time, main

effect of group and group by time interaction will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' peer learning scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of peer learning scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' peer learning scores across three time periods for the experiment and control group? (Interaction effect)

Metacognitive self-regulation is the last subscale for the learning strategies scale. Effects of the treatment on *metacognitive self-regulation* will be analyzed according to the questions below.

- Is there any significant change in the mean scores of 7th grades' metacognitive self-regulation scores across three time periods? (Time effect)
- Is there any significant difference in the mean scores of metacognitive self-regulation scores between students those who have instructed with portfolio-enriched activities and those who have instructed with traditional methods across three time periods? (Group effect)
- Is there any change in the mean sores of 7th grade students' metacognitive self-regulation scores across three time periods for the experiment and control group? (Interaction effect)

Qualitative data was also obtained for this study. Three questions below will be explored according to the data

- How did students experience portfolio activities?
- How did students perceive about strength and weaknesses of keeping portfolio?
- What is the variation of portfolios prepared by students in terms of source based?

1.2. Definition of Important Terms of the Study

In this section main terms will be defined according to the meanings they are used in the study

Portfolio: The portfolio referred to in this study includes all student productions; activities, exercise sheets, home works, mathematical investigations, pictures, photographs, diagrams of problem solving. Bryant and Riviera (1997) stated that a portfolio contains mathematics problems than on their answers, measure student's academic achievement, provides classroom learning and helps teachers in their instructional evaluations.

Intrinsic Goal Orientation (IGO): It refers to a student's perception of the reasons why she is engaging in a learning task. Intrinsic goal orientation concerns the degree to which the student perceives herself to be participating in a task for reasons such as challenge, curiosity, and mastery.

Extrinsic Goal Orientation (EGO): It concerns the degree to which the student perceives herself to be participating in a task for reasons such as grades, rewards, performance, evaluation by others and competition.

Mathematics Achievement (MACH): It refers to the score obtained from mathematics achievement test.

Self-Efficacy (EFF): According to Bandura (1986) self-efficacy can be defined, as person's decision of his/her aptitude to manage and accomplish routes of action required reaching selected types of performances

Critical Thinking (CRT): Innabi and El Sheikh (2006) explains critical thinking as identifying the focus, analyzing arguments, asking questions of clarification, defining terms, judging the quality of definitions and dealing with equivocation. They also stated that critical thinking is being able to identify unstated assumptions, judging the credibility of a source, observing and judging the quality of observation reports, deducing and inducing.

Metacognitive Self-Regulation (MSR): Metacognition refers to the awareness, knowledge, and control of cognition. In this scale only, control and self-regulation aspects of metacognition on the MSLQ are focused. Metacognitive self-regulation

strategies have three aspects: Planning, monitoring, and regulating. Planning activities refer goal setting and task analysis that activates relevant attributes of prior knowledge, which helps to organize and comprehend the material better. Monitoring activities refer to the tracking of one's attention, self-testing and questioning: Regulating refers to regulate one's cognitive activities. (Pintrich, 1990)

Elaboration (ELA): Elaboration refers to the information into long-term memory by building internal connections between items to be learned (Pintrich, 1990). Elaboration strategies include paraphrasing, summarizing, creating analogies, and generative note taking

Peer Learning (PL): Bound, Cohen and Sampson (2001) simply defines peer learning, where students support each other’s learning.

Previous: Compares levels of a variable with the mean of the previous levels of the variable

CHAPTER 2

LITERATURE REVIEW

In this part of the thesis, related literature review will be demonstrated. Portfolio in education, portfolio in mathematics classrooms, role of portfolios in students' motivation, role of portfolios in learning strategies will be presented respectively

2.1 Portfolio in Education

Defining a portfolio may vary according to its purpose (McMullan, Endacott, Gray, Jasper, Miller, Scholes & Webb, 2003; Seguin, 2005; Brown, 2002). Debra and Meyer (1996) stated that educators do not share a common definition about portfolios. Madeja (2004) stated that the term folio, a subset of portfolio, is usually associated with a grouping of papers in some orderly fashion, such as a folio of photographs, a folio of prints, or a drawing folio. Madeja (2004) also annotated that all of these definitions and the use of the terms folio and portfolio suggest a functional and metaphorical organization of information. They also suggested that, portfolios should be defined considering its theme; "process" or "product" oriented. Simply, portfolios can be defined as a purposeful collection of students' work over a certain period of time (Mullin, 1998; Paulson, Paulson & Meyer, 1991).

As mentioned, portfolios can be used for different purposes in education. Valencia and Calfee (1991) gave examples to explore features and the purposes of portfolio use. They stated that an artist's portfolio contains different artifacts and serves different purposes than a pilot's log or a social worker's casebook. Smith and Tilemma (2003) affirmed that there are many contexts in the use of portfolios considering its purposes. They stated that portfolios are widely used in professional development programs, medical professions, admission programs and etc. They also asserted that portfolios have been

advocated in education as well as in professional activity. Portfolios are widely used in education (Klecka, Donovan, & Fisher, 2007). Chung, Hwang, Chen and Mueller (2011) stated that use of portfolios in education has a long history starting from the progressive education by John Dewy. They also asserted that, in 1950s essentialism movement in discipline-centered curriculum was supported. In 1950s, portfolios were used to help low achiever students. In these days, portfolios are used as an instrument for many purposes such as for professional growth, career guidance, for formative and summative assessment (Beiszhusen et al., 2006). Blackwood and McColgan (2009) suggested a common definition for the term portfolio as an "educational tool" that has benefits for both students and teachers. Therefore these propositions suggest that a portfolio may be a multi-purpose tool to reach quality and provide efficient facilitation of student learning (Joyce & Showers 1988, Norman 2008). In education two main types of portfolio has emerged. For instance, Zou (2002) identified two major types of portfolio; learning portfolio and assessment portfolio. And he stated that learning portfolio is the one that helps students to make decisions on their own profile, whereas portfolio assessments allow teachers to evaluate pupils' performance. Literature commonly focuses on two basic portfolio concepts. For instance; Seldin (2004) deals with teaching portfolios especially, whereas Zubizarreta (2008) deals with learning (student) portfolio. Therefore it is important to specify the type and the purpose of the portfolio. Terwilliger (1997) emphasized that whatever a typology of portfolio would be used, it is essential to clarify the type and the purpose of the portfolios in order to draw meaningful and accurate conclusions. Therefore it is essential to clarify the purpose of a portfolio. The purpose of the portfolio helps one to identify and determine the type of the portfolio. As Valencia and Calfee (1991) underpins, contrasts among the types of portfolios are not trivial, they are all used by different purposes, methods, criteria and audiences. However, Paulson, Paulson and Meyer (1991) stated that a portfolio may have more than one purposes provided that none of the purposes conflict. A student's personal goals and interests are reflected in his or her selection of materials, but information included may also reflect the interests of teacher's, parents and district. One purpose that is almost universal in student portfolio is showing progress on the goals represented in the instructional program (Paulson, Paulson & Meyer, 1991, p. 62).

Zubizarreta (2008) summarized a typical learning portfolio in Figure 2.1.

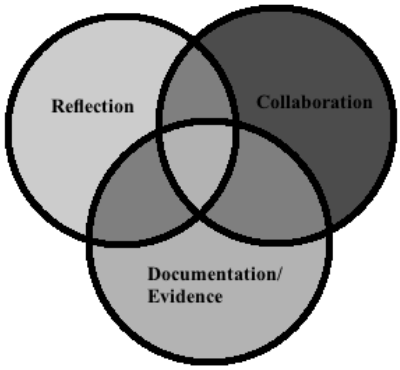

Figure 2.1 The Learning Portfolio Model

Zubizarreta (2008) affirmed that a learning portfolio should include:

1. Philosophy of Learning i.e. learning strategies, reason of learning,

2. Success in Learning i.e. grade reports, transcripts, related certificates, résumés, honors, award

3. Proof of Learning i.e. any outcome, which documents learning.

4. Assessment of Learning i.e. any feedback or score sheets or reports that measures learning.

5. Application of Learning any document or sign of growth that learning has made a difference.

6. Learning Goals i.e. plans about future goals about learning.

7. Appendices i.e. required documents to be added reasonably

In every subject field, contents of portfolio may vary according to its purpose. The important point here is to identify the type and the purpose of the portfolio use.

Contents of a learning portfolio are commonly accepted as Staff (1990) mentioned.

> "Portfolios *can contain anything that reflects the student's strengths, growth, and goals: self-assessments, teacher observations, metacognitive interviews, samples of writing, attitude*

> *and interest surveys, retellings, summaries, journal entries, and samples of the student's best work. For students, the contents of their* portfolios *should reflect "the experiences of the learner*" (Staff, 1990, p.647).

Zubizarreta (2008) also stated that distinguishing student portfolios is very important since they can take many forms, depending on its purpose. He also proposed three fundamental components for learning portfolio, reflection, documentation and collaboration. He also stated that the learning portfolio should contain carefully prepared, comprehensive sequence of events, which has a purpose, defines the scope, advancement, and value of learning. He also added that brief reflection papers should be organized and collected in portfolio as evidence.

On the other hand, Legget and Bunker (2007) proposed teaching portfolio and identified three types portfolio, which are, emergent, virtual and practitioner portfolio. They defined emergent portfolio as collection of works related with teaching, virtual portfolio as a self-endorsing document with evidences of teaching evidences, which is related to a particular criteria and practitioner portfolio as, summarizing, reflective piece work about teacher that describes teaching philosophy of teacher. In addition to this, they also indicated that "mythical portfolio" exists (document that shows teacher's efficiency in an array of purposes) as a teaching portfolio which is not common. Berger (2011) summarized teaching portfolio in a cyclic relationship as follows

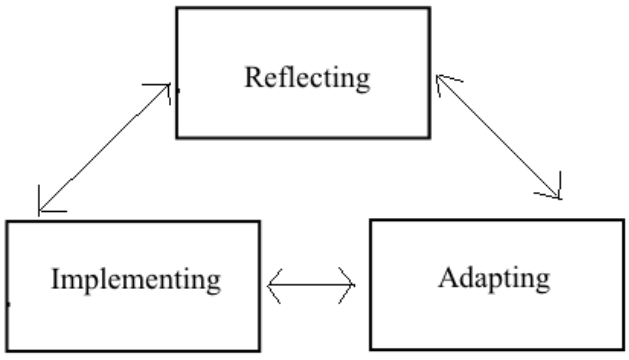

Figure 2.2 Cycle of Reflection in Teaching Portfolio

Berger (2011) stated that self-improvement is the product of the reflection cycle and he underlined that teaching portfolio is a continuous cycle of analyzing, improving, and modifying.

As it was mentioned that type and the purpose of the portfolio is really important to serve its aim. Besides the type of the portfolio is also important in organizing it. For instance, Farrar (2006) stated that a teaching portfolio should consist two major elements; reflection and evidence. Farrar (2006) indicated six specific steps for to organize a teaching portfolio. He mentioned that, in the first step teachers should express their teaching philosophy, since it is important to identify goals and expectations. Secondly, teachers need to collect evidence, which involves his/her roles in teaching environment, responsibilities, videos of teaching, student evaluations, brief description of the courses he/she taught and etc. Besides, graduate thesis, research studies, supervision for students should be added as evidence. As a third step, a teacher should organize and summarize the content of its portfolio based on the purpose. In the fourth step, reflective declaration should be made that describe the teacher's goal in a definite way. Fifth step colleague evaluations or feedbacks should be presented. In the final step teacher should add his/her curriculum vitae to the portfolio.

Smith and Tillema (2003) also introduced 4 types of teaching portfolios; the dossier portfolio, training portfolio, reflective portfolio and personal development portfolio. In Figure 2.3 these portfolios were depicted

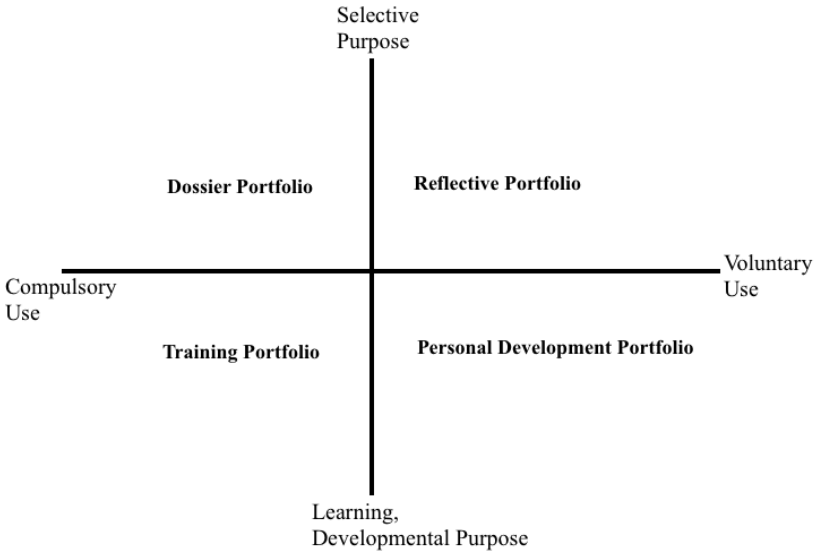

Figure 2.3 Types of Portfolios According to Smith and Tillema

The dossier portfolio is a record of accomplishment or a mandated collected works for selection purposes required to apply a job or program. In this type of portfolio, standards are important and well defined since level of proficiency is the most important detail here. The training portfolio is a necessary or mandated demonstration of efforts kept during the curriculum program. Training portfolio demonstrates a sample of student work especially acquired skills of a person. The reflective portfolio demonstrates an array of tasks that provides evidence of development and achievements. The personal development portfolio is related with the person's self-evaluation and professional development in a long-term process.

Valencia and Calfee (1991) introduced three types of learning portfolios; the showcase portfolio, working portfolio and evaluative portfolio. Paulson et al. (1991) stated that the showcase portfolio can be described as a collection of student's best or favorite work. Valencia and Calfee (1991) pointed that this type of portfolio gives students a chance to pick their works among all and the portfolio becomes a unique portrait of the individual. Second type is the working portfolio. Wortham et al.(1998) working portfolio enables teacher to work with the child and appraise and evaluate the progress together. In this type of portfolio, both the child and the teacher select samples of tasks to show the growth and learning. This type of portfolio can sometimes referred as documentation portfolio.

Duffy et al. (1999) stated another four specific types of learning portfolio with a sequence to move students along a scale over time with an increasing level of responsibility. According to Duffy et al. (1999) the sequence (or level) of portfolio should be as; Level 1, the everything portfolio that contains both works in progress and final drafts of projects. Purpose of this type of portfolio is to provide a physical container for student products; the selection process for items to be entered in the portfolio is not a critical consideration. Level 2, the product portfolio is the one that teacher provides a student with a table of contents that describes the required topics or products. The students include examples of their work in each area of the table of contents. Level 3, the showcase portfolio, the teacher again provides the student with a table of contents with required topics, but in this level of portfolio, the student evaluates the elements for the portfolio and provides a rationale for a particular selection. For this type of portfolio, teacher provides summative feedback about the products included as well as formative feedback about the rationale used in the selection process. Level 4, the

objective portfolio, in this type of portfolio the teacher generates a list of objectives or statements about quality performance. In this final level of portfolio, student is asked to analyze the demands of the tasks, review all possible works, select the best of all representations of skills, and then provide a rationale for the selections. Here, the teacher's role is to acknowledge mastery of the objectives (Duffy et al., 1999, p.36). In this study Level 2 portfolio was used. Students were asked to keep a Level 2 "product portfolio" which requires students to complete a given table of tasks.

Portfolios are suggested teachers to use in two ways; evaluate pupils or review their instruction. In the literature portfolios that are used for evaluation are defined as "portfolio assessments" (Yang, 2003). Although "portfolio" and "portfolio assessment" terms are used interchangeably in the literature, Faust (1995) stated that an assessment is the way of gathering of data about learning whereas evaluation is the way of defining the value of learning. Resnick and Resnick (1993) also emphasized that portfolios can be used both for measurement and instruction and teachers should be sensitive about using portfolios since these two purposes; measurement and instruction can interfere. Namely, they stated that a teacher should be very careful about portfolios if he/she is going to use them as a measurement tool. Since standardization process will come into question. This process requires teachers to find a common ground at implementing portfolios.

Herman et al. (1992) asserted that the "assessment" in portfolio exists only when (1) an assessment purpose is defined (2) criteria or methods for determining the contents of it and (3) criteria for assessing either the collection or individual pieces of work are defined (as cited in Benoit and Yang, 1995). Stecher (1998) highlighted that the terms "portfolio" and "portfolio assessment" have no predetermined definitions among U.S. educators, therefore deliberations about assessments and their effects are somewhat uncertain. Moya and O'Malley (1994) define the difference between a portfolio, which is a collection of a student's work, exhibitions, experiences, self-rankings (i.e., data), and portfolio assessment, which is the procedure used to plan, collect, and analyze the multiple sources of data maintained in the portfolio. It should be noted that, in this study the researcher did not use portfolios as an assessment tool, according to the definitions and explanations given above.

Portfolio assessments are also a part of performance assessments. Rudner and Boston (1994) claimed that a wide variety of assessment fall within the definition of

performance based assessments. Sweet (1993) stated that a performance assessment (known as alternative or authentic assessment) is a kind of testing that requires students to perform a task rather than select an answer from possible answers of list. Sweet explained some examples of performance based assessments that are, a student may be asked to explain historical events, generate scientific hypotheses, solve mathematics problems, converse in a foreign language, or conduct research on an assigned topic and etc. At that point there is an interconnection between a portfolio and a performance-based assessment. Wortham, Barbour, Desjean-Perrotta et al. (1998) stated that a performance based assessment reflects what a person can do and can be observed by teacher the teacher. Authors also stated that performance assessments are based on observation and judgment of the teacher. Assessment purposes supports a new perspective on learning since they document the learners' progress and evaluate with a variety of evidence how learner goals are attained, while at the same time providing an alternative for the growing dissatisfaction with traditional and quantitative assessment (Smith and Tilemma, 2003, p.626). According to Wortham et al. (1998) the purpose of an evaluation portfolio is to allow the classroom teacher in collaboration with school personnel and family members to evaluate the child's progress in line with goals of the program, objectives and standards. Authors stressed that this kind of portfolio could be either summative or formative and may include samples of a students' work (finished or in progress), anecdotal records, checklists, rating scales, test data, conference notes, and parent surveys. Wortham et al. (1998) also listed general purposes of a portfolio assessment as below:

Portfolios can be used:

(a) Provide information about students' interest, character, and feelings
(b) Portray students' growth in any area(s)
(c) Evaluate students' learning relative to individual qualifications
(d) Highlight students' achievements
(e) Keep track of students' developmental process about learning.
(f) Inform parents about students' progress by offering concrete and extensive evidence.
(g) Enable students to make reflections and question their own learning process
(h) Keep records that will supplement students as they move one grade higher.

(i) Present information that may be helpful in determining students' special needs.
(j) Deliver data for teachers, administrators, and family members to evaluate the program effectiveness. (pp.15-16)

As mentioned above instructional purpose is another dimension of the portfolio. Using portfolios, as an instruction tool is very important for two reasons; firstly, it brings an awareness of personal instructional practices, and, it is an important aspect of the scholarship of teaching and learning (Minott, 2010). As stated before, there are plenty of benefits of portfolios and main advantages of portfolios like; supporting students' area of interests, helping students feel independent and responsible for their own learning process, enhancing critical thinking and encouraging them to reflect the process. From this point of view, a teacher can comprehend the students' attitudes, knowledge, and achievement in the designated areas; to monitor the growth of students' knowledge of a determined content area; and to facilitate the teaching process and adjust instructional objectives better (Lee, 1997).

2.2 Portfolio in Mathematics Classrooms

Student portfolios are commonly used in language, arts, history or geography classrooms. For a while, portfolios have been used in mathematics classrooms (Stenmark,1991). New mathematics curricula require students who can construct the knowledge (MoNE,2009). Bryant and Rivera (1997) stated that portfolios in mathematics are supposed to be useful tool in order to monitor students' progress sticking to the new curricula objectives. Stenmark (1991) affirmed that a mathematics portfolio might contain samples of student products, mathematical projects or investigations; pictures and reports, diagrams, statistical studies and so forth. Ediger (1998) stated that a quality portfolio should include the followings:

1. Work samples of everyday achievement
2. Cassette recordings pertaining to oral reports given and participation in ongoing discussions in mathematics lessons and unit of study
3. Videotapes of the learner showing projects of completed collaborative activities in mathematics.

4. Snapshots of individual endeavors, such as art products, ongoing or completed, to show acquired concepts and generalizations
5. Self-appraisal statements of the involved learner in reacting to questions of personal interests and motivation in mathematics achievement
6. Diary entries and logs kept on personal reactions to experiences in a mathematics unit or lesson of study
7. Journal writing to record feelings and values pertaining to ongoing tasks and accomplishments
8. Recorded metacognition endeavors to ascertain what has been learned and what is left to attain in specific tasks in mathematics.
9. Records of progress made on teacher written tests as well as rubric results used to evaluate portfolio entrees.
10. Collection of graphs, diagrams, and charts made by the learner to show mathematical data in the ongoing lesson or unit. (p.203-208)

In a program in Vermont, USA, it is found that mathematics portfolios facilitate learning. Cicmanec and Viechnicki (1994) also noted that report of the Vermont program indicated that portfolios appear to enhance curriculum and instruction, engender teacher enthusiasm for teaching mathematics, and facilitate the students' ability to communicate verbally and in writing about mathematics.

Hughes et al. (1993) also claims that using portfolio use in mathematics classrooms improve students' mathematics skills and provide a communication link to the pupils' parents.

Knight, an algebra teacher expressed her feelings by "I fascinated with the possibility of using something other than the standard assessments in mathematics test for assessment". Knight (1992) introduced portfolios to her class and decided to use this kind of assessment in a semester in her algebra class. The way she decided to use mathematics portfolios was very democratic. She discussed the format of the portfolio with her class and the class made the decision about the whole format and organization of the portfolio. After, Knight collected the portfolios she immediately handed them out the peers of students. She also devised a grading matrix and weighted a portfolio grade equivalent to one fifth of the test grade. At the end of the semester, she concluded that

> "Portfolio assessment is a way to assess, total student performance. Not only do portfolios offer teachers insights maturity, self-esteem, and writing abilities but they are also an important tool for self-evaluation…Mathematics portfolios are enlightening and wonderful way for students to celebrate their learning."

Cohen (2004) stated that portfolios let teachers hear students' thoughts and this makes teacher clear about the strategies they use in classrooms.

Bryant and Rivera (1997) also asserted that using portfolios with a strong assessment background could find value in portfolios. It is because teachers can collect data about the way children think and they can analyze the specific mathematics behaviors. Owings and Follo (1992) conducted a study to reveal the effects of using portfolio in mathematics classroom with 12 fifth-grade students. They gave a survey on attitudes about grading for a 10-week period and they asked students to write their strengths and weaknesses in mathematics and complete their portfolio. At the end of a 10 week-period, no correlation was found on the attitudes about grading; however, five of the six students in receiving traditional assessment stated goals and weaknesses in vague generalizations, while all of the students in the portfolio group described their strengths and weaknesses in detail and provided task specific goals to overcome their weaknesses.

To sum up, a good and qualified mathematics portfolio proposes strong perception to a student's thinking, understanding, and mathematical problem-solving skills. Besides a portfolio have the potential to draw a frame or a picture of the student's progress in mathematics.

Smith and Tilemma (2003) stressed that it is important to identify how users consider the portfolio since the effectiveness of a portfolio may change according to its purpose.

2.3 Role of Portfolios in Students' Motivation

Motivation is a very popular search term for any disciplines. In education, almost all definitions are almost in common ground. Tileston (2004) describes motivation as the demand to do something. In the literature, motivation is usually described as the force within the individual that affects or directs behavior (Marquis and Huston, 2009; Hoffman, 2007; Saemann, 2009). The term "Motivation" can be investigated under two sections; intrinsic motivation and extrinsic motivation. Intrinsic motivation can be

described as the drive that comes within (Tileston, p.3). As an example what intrinsically motivated students do, Lei (2010) gives an example; according to Lei students can develop high regards for learning any piece of information about the course without the inclusion of external rewards or reinforcements (p.153). Therefore if a student has the motive to do something without any kind of reward, we may call him/her intrinsically motivated. According to Schunk (1984) goals, incorporating specific standards of performance may increase motivation and activate self-evaluative reactions than comparatively to the general goals. It is important to distinguish goals as specific and general; because students are more likely to set goals for quicker and easier achievements. Intrinsic goal orientation can be defined as the student's general goals or orientation to the course as a whole (Pintrich, 1991). He also stated that intrinsic goal orientation relates to the degree that a person identifies himself to be contributing a task for causes such as challenge, interest, and mastery. A person who has an intrinsic goal orientation for an academic task specifies that the student's participate task to understand and learn new things even when a high grade is not guaranteed. Zou (2003) claimed that using a learning portfolio may help students to set goals in a less stressful environment and more encouraging. Intrinsic goal orientation is defined as a motivation that stems from mainly interior reasons as an example, being inquisitive, seeking for challenge, mastering the field. Lyke, Kelaher and Young (2006) stated that students with an intrinsic goal orientation are likely to attach importance a broader level of comprehension of assignments than those with an extrinsic goal orientation, and that conversely, those with an extrinsic goal orientation tend to use more surface-level processing strategies such as memorization or guessing

Extrinsic goal orientation is about the degree that a student perceives himself participating a task for rewards rather than concern and curiosity (Pintrich, 1991). He also underlined that a person who has set goal extrinsically participates a task for grades, bonuses and comparison between friends. Extrinsic goal orientation might shift students' concentration away from learning the task to the outward signs of worth and limit the students' attention for learning (Deci & Lens, 2004). They also stated that this strict and strategic situation about the extrinsic goal might lead to memorization and learning the material in a shallow way. Namely it is important to help children orientate intrinsic goals. Smith (2001) emphasized that using portfolios may evoke students' needs and help them to set proximal goals without extrinsic rewards. Tileston (2003) clarifies the

difference between extrinsic and intrinsic goal orientation as rewards and celebrations. She mentioned, "Working only for rewards can be detrimental to learning, while celebrations can have a very positive effect on the learning". (p.5). From this perspective of view, we can conclude that using extrinsic rewards requires special attention and care. Albrecht, Haapanen, Hall and Mantonya (2009) laid stress upon the importance of shift from extrinsic through intrinsic motivation. Albrecht et al. (2009) stated that it is important to help children set goals intrinsically; in this manner they can appraise their capability through the development process. Besides they stated that if teachers offer greater amount of choices to the students, and allow them to take a more active role in their education, of students will get better and approach to learning for mastery as opposed to extrinsic factors will be encouraged. Besides, they also stated that portfolios help students see what they are capable of to achieve.

Another motivational subscale is self-efficacy, which was defined by Pintrich et. al (1993) as a component under motivation. Schunk (1984) stated that as children see and examine their progress on the way to a specific goal, they are more likely to develop a higher sense of self-efficacy; higher self-efficacy helps to sustain task motivation.

As mentioned above, Schunk (1984) emphasized that, if students observe their progress they can sustain higher self-efficacy. Thus, higher self-efficacy results as increased motivation. Bandura defined self-efficacy as the person's belief to achieve something. Self-efficacy help students to one increase motivation for academic achievement (Bandura, 1997).

Eisenberger, Conti-D'Antonio and Bertrando (2005) stated that, self-efficacy concept includes self-discipline, judgment of personal capabilities, regulates acquisition and knowledge and produces goal attainment. In short, self-efficacy may influence learning strategies and motivation that enable educational activities. Self-efficacy belief plays an important role in the self-regulation of motivation (Bandura, 1977, p.6). Zou (2003) found that assigning portfolio, increased students' self-efficacy and performance in the class. Zou (2002) concluded that students should use learning portfolio versus an assessment portfolio, since it lets students to make judgments on the portfolio's construction, content, and process.

2.4 Role of Portfolios in Learning Strategies

Learning strategies is a very important concept in education. Researchers mainly agree the importance of learning strategies but they do not share a common definition for learning strategies (Pintrich et. al, 1985). Student's approach to learning, determine the way of using information. Kirby et al. (2008) mentioned in their study that the concept of approaches to learning was introduced by Marton and Saljo in 1976 and focused on the interaction between a student and the learning context. Pintrich (2000) stated that every person has his/her own strategy for learning and there is not any self-regulatory strategy that works for each individual. Pintrich and Garcia (1995) stated that learning strategies as cognitive strategies. They also offered; cognitive strategies are rehearsal, elaboration, organization and metacognitive strategies. Besides Pintrich, Smith, Garcia, Lin & McKeachie (1993) asserted that there are global and complex strategies in learning strategies. They claimed that, rehearsal, elaboration, organization, and critical thinking are more global; whereas metacognitive strategies are multifaceted processing strategies that involve planning, monitoring, and regulating learning. Livingston (1997) defined metacognition as higher order thinking that requires active control over the cognitive processes engaged in learning. She stated that activities like planning, organizing, approaching a learning task, monitoring understanding, and evaluating the advancement in a task are metacognitive in nature. Dowson and McInerney (1998) defined cognitive strategies as a way of approach to the new information. Self-regulated learning is a learning strategy describes the learning activities students apply to study the learning material (Ferla et al., 2009). As Ferla et. al (2009) stated, students' study strategy is able to combine any learning strategy with any regulation strategy. Pintrich et al. (1985) emphasized that there exists evidence that learning strategies could be taught. They also mentioned that learning strategies should be taught to students in order to create awareness about their approach to learning.

One of the most common learning strategies is the metacognitive self-regulated learning. Karakaş and Altun (2011) stated that portfolios could provide reflections and self-evaluations that might help students to regulate their own learning process.

Many research studies have shown that self-regulation is closely linked to academic outcomes including achievement. For instance, Lewis and Litchfield (2006) found a positive effect and higher academic achievement on students with higher self-regulation

scores on MSLQ. Students with higher score of self-regulated strategies perform better in terms of academic achievement. And as mentioned before, there are certain studies pointing out this issue (Azevedo & Cromley 2004; Kramarski & Gutman 2006; Pintrich & De Groot 1990; Zimmerman 1998; Zimmerman & Schunk 2001, Lizzaraga, Ugarte, Iriarte & Baquedano 2003). Livingston (1997) stated that metacognitive strategies are ordered procedures that a person employ to manage cognitive activities, and to make certain that a cognitive goal like comprehending a passage has been satisfied. She also stated that these processes facilitates regulation of the learning and can help a person to plan or examine his/her cognitive activities, as well as ensuring the conclusions of these activities. Livingston (1997) also discussed a more explicit example; she stated that if a person can question herself/himself about the key points in the passage then his/her cognitive goal is understanding the passage and Self-questioning is his/her metacognitive self-regulation strategy.

Elaboration is another concept that should be dealt as a part of learning strategies. Elaboration can be defined as adding detail or more information (Webster, 2012). Pintrich (1991) defined elaboration as paraphrasing, summarizing, creating analogies and generative note taking. He also stated that elaboration strategies help students to store knowledge in the long-term memory by constructing relations between pieces to be learned. Hall, Hewitt and Cynthia (2000) mentioned that elaboration is the key and in this manner portfolio assessments could optimize learning. Portfolio assessments help students to construct individualized information and improve learning i.e. elaboration (Hall et al, 2000). Kicken et al. (2009) stated that portfolios help teachers to give well-designed feedbacks and feedforwards which might point out, strengths and weaknesses and, specifically, elaboration skills. Kicken et al. (2009) found a positive effect of elaboration on students' performance

Critical thinking is one of the main dimensions of learning strategies. Pintrich (1991) defined critical thinking as making critical evaluations when applying previous knowledge to the new information to solve a problem. He also underpins that the person who has critical thinking abilities, is able to question the cogency of knowledge to standards of excellence. Coleman et al (2002) made a more simple definition of critical thinking as, being broad-minded and being able to find solutions or seek answers to fuzzy problems. Portfolios and critical thinking are partners in educating students to become competent social workers. (Coleman, Rogers & King, 2002).

Coleman et. al (2002) stated that development of critical thinking skills can be enhanced through portfolio assessment process. According to, Coleman et. al (2002) since portfolios show both progress and the product, it is linked with critical thinking. Portfolios require students to take responsibility in order to direct the process. Kish and Sheenan (1997) stated that using portfolios, promote active learning and critical thinking, which makes each student the leading stakeholder in education. Kish and Sheenan (1997) explained that because a portfolio requires each student to select and justify the contents this may lead students to control their own learning. Scaffolding of portfolios enables students to become critical thinkers and evaluators of their work (Duffy, Jones & Thomas, 2002). Hung (2012) also stated that portfolios promote professional development, and cultivate critical thinking.

Hung (2012) found that e-portfolio enriched tasks generate positive washback effects on learning besides; researcher also reported that assigning portfolios facilitate peer learning and enhance content knowledge learning. Portfolios have the power to connect instruction and evaluation. Students can show their progress and improvement in their portfolios. Since students are free to ask for help, they can ask anybody to help them. In this manner, "peer learning" concept gains importance. Peer learning is defined as a person's effort of obtaining information or gaining knowledge by communicating a peer. Yang (2003) found that learning through portfolios is an effective strategy with the dimension; peer learning. Challis, Mathers, Howe and Field (1997) claimed that noted the portfolios are superior tools to encourage interaction with peers, and connection of learning with day-to-day practice.

2.5 Summary

In this section, various definitions of portfolio were given according to the literature. Besides, purposes and contents of various types of portfolios were presented. A common definition of portfolio was made by Paulson, Paulson and Meyer in 1991.

> "A purposeful collection of student work that exhibits the student's efforts, progress and achievements in one or more areas. The collection must include student participation in selecting contents, the criteria for selection, the criteria for judging merit and evidence of student self-reflection."

There are two major portfolios according to the purpose; teaching portfolio and learning portfolio. Teaching portfolios are for teachers to monitor and improve their teaching

(Legett & Bunker, 2006). Learning or student portfolios are used to activate students' interest and stimulate their motivation (Zou, 2003). When considering a portfolio, its type and purpose should be taken into account. However, in a learning (student) portfolio, it is expected to meet reflection papers, videotapes, personal essays or texts, goals and etc. In this study the researcher will use a learning portfolio of "level 2" which was defined as a product portfolio that teacher offers students a list describing the required topics or products and students include examples of their work listed in the table of content that teacher gives.

Portfolios are mainly used for evaluation and instruction purposes, difference between portfolio and portfolio assessment was explored in this part. Portfolio assessment is the term used for evaluation purposes of portfolio, whereas portfolio is used to state the role of portfolios in instruction.

In this chapter, role of portfolios in academic achievement, motivation and learning strategies are expressed. Certain studies were presented that offer positive effects of portfolio use in education. Three dimensions of motivation were presented here; intrinsic goal orientation, extrinsic goal orientation and self-efficacy. Four dimensions of learning strategies were presented in this chapter; elaboration, critical thinking, peer learning and metacognitive self-regulation.

In the present study it is aimed to seek effects of portfolio-enriched instruction on the dimensions, which are mathematics achievement, intrinsic goal orientation, extrinsic goal orientation, self-efficacy for learning and performance, elaboration, critical thinking, peer learning and metacognitive self-regulation.

CHAPTER 3

METHODOLOGY

This chapter presents information about the whole methods and procedures that were taken in this study. This section involves information about research design, sampling, variables, quantitative data analyses, measuring instruments, treatment in the experimental group, treatment in the control group, procedures, qualitative data, assumptions, limitations and delimitations of the study and external threat of the study

3.1 Research Design

This study is a quasi-experimental study. Since the researcher was not able to use random assignment. In other words this design is the matching only pretest posttest control group design (Fraenkel & Wallen, 2006) and can be summarized as follows:

Table 3.1 Research Design of the Study

Group	Pre-test	Treatment	Post-test	Retention Test
Experimental	MSLQ MACH	Instruction Enriched with Portfolio Activities	MSLQ MACH	MSLQ MACH
Control		Traditional		

Although this design lacks of random assignment; the researcher has used report card grades to examine the homogeneity among three groups. Homogeneity is important since it helps the researcher to select accurate statistical methods. Therefore the

researcher has sought evidence to obtain homogeneity before experiment and for this reason, at the very first beginning of the semester; mathematics report card grades were obtained to analyze the variances. One-Way ANOVA was used to provide evidence if mean scores of mathematics report card grades show any statistically significant difference among three groups. According to one-way ANOVA, F-statistics showed ($p > 0.05$) that there is no significant difference among groups in terms of report card grades, as shown in the Table 3.2 below

Table 3.2 ANOVA Results According to the Mathematics Report Card Grades

	df	SS	MS	F	*p*
Between Groups	2	13.05	6.52	2.26	.109
Within Groups	95	273.35	2.87		
Total	97	286.41			

As seen in the Table 3.2 $F(2,95) = 2.26$ and $p = .109$, which states that there are not any significant difference among the mean scores of report card grades of students. In other words null hypothesis cannot be rejected which is $\mu_1 = \mu_2 = \mu_3$.Furthermore, on the report card grades, 7A1 class had a mean score 6.44 (SD = 1.62), 7A2 class had a mean score 6.59 (SD = 1.44), and 7A3 class had a mean score 7.28 (SD = 2.07). In addition to this, students took pre mathematics achievement test at the same time. Similarly, their scores were analyzed with statistics software and researcher did not detect significant difference among groups in terms of pre mathematics achievement test scores. The researcher also analyzed pre MSLQ scores and conducted one-way ANOVA and there also was no significant difference in the mean of pre-MSLQ scores among groups $F(2,95) = .70$, $p = .49$. According to the results experiment and control groups were selected randomly. Names of the classes were written on separate pieces of paper and randomly selected 7A1 and 7 A3 to participate the experiment and 7A2 was selected to take part as control group.

Qualitative data were obtained during the analysis. The researcher conducted interview with every student in the experimental group; however only 28 of them was analyzed and reported in the results

3.2 Population and Sampling

In this study our target population is all 7th graders in Northern Cyprus. However it is accessible population and sample. In this research study, accessible population is the 7th grade students in a Middle School in Famagusta. In this study sample is selected from 7th grade students. Convenience sampling was used in the study since it was extremely difficult to select random or systematic nonrandom sampling (Fraenkel & Wallen, 2006). This study was conducted with 102 students studying in a Middle School, Famagusta, North Cyprus. Participants' age range varies between 13 and 14. Gender distribution of the school is almost half and half. This school is a government school. Medium of instruction is mainly Turkish; however some classes' (academic classes) medium of instruction is English except Turkish language lesson. There are approximately 620 students and 70 teachers. Descriptive data of the sample is summarized in tables 3.3, 3.4, 3.5, 3.6, 3.7 and 3.8 as follows.

Table 3.3 Characteristics of the Sample

Gender	*f*	%
Male	40	39.22
Female	62	60.78
Total	102	100
Mathematics Report Card Grade		
10	13	12.75
9	6	5.88
8	18	17.65
7	17	16.67
6	21	20.59
5	26	25.49
4	1	0.98
Total	102	100

As seen in Table 3.3, there are 40 male students and 62 female students in the sample. Twenty-six of the students (25.49 %) received 5, 21 students (20.59 %) received 6, 17 students (16.67 %) received 7 and 18 (17.65 %) students received 8. Six of the students (5.88 %) received 9 and 13 of the students (12.75 %) received a 10.

Descriptive data about parents' educational level of the sample is given in the Table 3.4

Table 3.4 Parents' Educational Level of the Sample

	Mother		Father	
Educational Level	f	%	f	%
Illiterate	0	0	0	0
Elementary school	8	7.92	5	4.95
Middle School	10	9.90	12	11.88
High School	47	46.54	40	39.70
University	18	17.82	28	27.72
Higher Education	7	6.93	11	10.89
Missing	11	10.89	5	4.95

As seen in Table 3.4, none of the students' parents' were illiterate. Eight of the participants indicated that their mother graduated from elementary school whereas 5 of the subjects stated that their father graduated from elementary school. Ten of the participants stated that their mother graduated from a middle school and 12 students indicated that their mother graduated from middle school. Students stated that 47 of the mothers were graduated from high school and 40 of the fathers were graduated from a high school. Eighteen of the subjects stated educational level of their mother as university and 28 of the subjects' fathers were a graduate. Seven of the students indicate that their mother is a postgraduate and 11of the subjects stated that their father is a postgraduate.

Pocket money opportunity of the sample is given in Table 3.5.

Table 3.5 Socio Economic Status of the Sample

Pocket Money Opportunity	*f*	%
Yes	88	86.27
No	10	9.90
Missing	4	3.93

As given in Table 3.5, most of the subjects (86.27 %) stated that they were able to get pocket money whereas 9.90 % of the students stated that they were not. Four (3.93 %) of the students did not answer the question

In Table 3.6 below students' computer opportunity is given according to their answers

Table 3.6 Computer Attainability of the Sample

Computer at Home	*f*	%
Yes	81	79.41
No	18	17.65
Missing	3	2.94

Only 17.65 % of the students stated that they do not have computer at home and 79.41 % of them indicated that they have a computer. Three (2. 94 %) of the students did not answer the question.

In Table 3.7, students' personal study or bedroom attainability is demonstrated.

Table 3.7 Personal Room Attainability of the Sample

Personal Bedroom or Study Room	*f*	%
Yes	37	36.27
No	61	59.80
Missing	4	3.92

As given in Table 3.7, only 36.27 % of the students indicated that they have a personal bedroom or study room. 59.80 % of the students specified that they do not have personal bedroom or study room. Four (3.92 %) of the students did not indicate any answer.

Income level of parents of the students in sample is given in Table 3.8

Table 3.8 Income Levels of the Parents of Sample

Monthly Family Income	*f*	%
Below 1000 TL	2	1.96
1000 – 1999 TL	21	20.59
2000 – 2499 TL	19	18.63
2500 – 2999 TL	29	28.43
3000 – 3499 TL	4	3.92
3500 – 3499 TL	1	0.98
Above 3500 TL	10	10.78
Missing	15	14.71
Total	102	100

As seen in Table 3.8 monthly income of the parents of sample is given. According to the students' answers, 1.96 % of the participants stated that their income is below 1000 TL.

20.59 % of the students indicated that their monthly family income is between 1000 and 1999 TL. Nineteen of the students (18.63 %) indicated that their monthly family income is between 2000 – 2499 TL. 29 of the students (28.43 %) provided that their family income is between 2500 – 2999 TL. Only 3.92 % of the students provided that their family income falls in 3000 – 3499 TL. One of the students (.98 %) stated that his/her monthly family income is around 3500 – 3499 TL. Ten (10.78 %) of the students provided that their monthly family income is above 3500 TL. Fifteen students (14.71 %) of the students did not answer this question.

In this study researcher worked with a 10 year experienced mathematics teacher. The author chose her classes for various reasons. Since there were two groups in the study, teacher must be the same person in order to avoid from implementation threat (Fraenkel & Wallen, 2006). Besides one of the most important factors of choosing her class is the self-development desire of the teacher.

Teacher is a doctoral student and she has experience and knowledge about collecting data, making research and ethics of a research study. Studying with an experienced teacher is very important. As Valencia and Calfee (1991) stated that, achieving the goals of portfolios requires knowledgeable teachers who are able to handle the challenge of defining high-level achievement outcomes, identifying or constructing portfolio tasks for these outcomes and evaluating these tasks. Further, authors also affirmed that portfolio programs could turn up haphazard collections of student work because of the ill-equipped teachers. Therefore, during the pre-study period, researcher mainly stretched the principle of experienced teacher who also has sufficient knowledge to collect data.

3.3 Variables

Independent variables (IV) of the study were pre 6^{th} grade mathematics report card grades and group. Dependent variables (DV) of the study are post and retention mathematics achievement scores, and post and retention MSLQ scores; IGO, EGO, EFF, CRT, ELA, PL, MSR and. Table 3.9 below shows the characterization of the variables.

Table 3.9 Variables in the Study

Variable Name	Types of Variables	Type of Data	Scale
Group	IV	Categorical	Nominal
6^{th} Grade Mathematics Report Card Grades	IV	Categorical	Ordinal
MACH2 Scores	DV		
MACH3 Scores	DV		
Motivation Scores			
IGO2 Scores	DV	Continuous	Interval
EGO2 Scores	DV	Continuous	Interval
EFF2 Scores	DV	Continuous	Interval
IGO3 Scores	DV	Continuous	Interval
EGO3 Scores	DV	Continuous	Interval
EFF3 Scores	DV	Continuous	Interval
Learning Strategies			
ELA2 Scores	DV	Continuous	Interval
CRT2 Scores	DV	Continuous	Interval
PL2 Scores	DV	Continuous	Interval
MSR2 Scores	DV	Continuous	Interval
ELA3 Scores	DV	Continuous	Interval
CRT3 Scores	DV	Continuous	Interval
PL3 Scores	DV	Continuous	Interval
MSR3 Scores	DV	Continuous	Interval

3.4 Quantitative Data Analyses

In this study, statistics software was used to analyze the obtained data both in descriptive and inferential statistics. In order to identify any possible differences between the experimental and the control group regarding their mathematics achievement, intrinsic goal orientation, extrinsic goal orientation, self-efficacy for learning and performance, elaboration, critical thinking, peer learning and metacognitive self-regulation. Doubly repeated MANOVA (Profile Analysis) procedures were used. Norman and Streiner (2008) stated that, Doubly repeated MANOVA design is used if there are two or more dependent variables, which are measured on two or more occasions. For post-hoc analysis, independent and paired samples *t*-test procedures were used. The level of significance used throughout the study was .05. Besides, Partial eta squared (η^2_p) measures were used to see how much variance was explained by the independent variables. Partial eta squared values were interpreted according to the Cohen's measures. Cohen characterized the effects size intervals as equals or less than .25 small effect size, less than or equal to .50 and up to 1 as a large effect size (Cohen, 1988). Additionally

Cohen's *d* measures were used for the paired and independent samples *t*-tests. In the same way, Cohen characterized $d = 0.2$ as a small effect size, $d = 0.3$ as a medium effect size, and $d = 0.5$ as a large effect size**.** The level of significance used throughout the study was .05.

3.5 Measuring Instruments

In this study there are three measuring instruments, which are, Motivated Strategies Learning Questionnaire (MSLQ), mathematics achievement test and interview. In this section, they will be discussed in detail.

3.5.1 Motivated Strategies and Learning Questionnaire

Johnson and others (1989) stressed that MSLQ is created to assess students' motivational orientations and their use of different learning strategies. This scale is specifically based on cognitive view of motivation and learning strategies. They also mentioned that this scale has also been used to diagnose potential needs of students since diagnosing is of very little value unless a remediation is offered. MSLQ consists of two sections; motivation and learning strategies section. Motivation part includes 31 items and is about to assess students' value for a course, their beliefs about their skills to achieve in a course and their test anxiety. Learning strategies part consists 31 items to explore students' cognitive and metacognitive strategies. Besides this part also consists of 19 questions regarding student management of different sources. MSLQ of Pintrich et al.; consists of total 81 item, 7-point Likert -type scale ranging from 1 (*not at all true of me*) to 7 *(very true of me).* Specifically, this measure comprises the following 15 subscales; 6 motivation scales and 9 learning strategy scales. These are intrinsic goal orientation, extrinsic goal orientation, task value, control over learning beliefs, self-efficacy for learning and performance, test anxiety, rehearsal, elaboration, organization, critical thinking, metacognitive, self-regulation, time and study environment management, effort regulation, peer learning, and help seeking (see Appendix A)

In the validation process of MSLQ, Pintrich et al. (1993) have made a research; 356 Midwestern college students were subjects that were assessed a survey in the process of MSLQ. According to the results of study, alpha reliability for the subscales ranges from 0.52 for the help-seeking scale to 0.93 for self-efficacy. In terms of predictive validity, Pintrich et. al. (1993) found that five of the motivational subscales showed low but

significant correlations ($p < .05$) with final course grade (Intrinsic goal, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning and Questionnaire, Test Anxiety). Nine of the learning strategies subscales, six of them produced low but significant correlations ($p < .05$) with final course grade. Description of the MSLQ scale is shown both on the tables 3.10 and 3.11.

Duncan and In McKeachie (2005) calculated alpha values for each subscale of the MSLQ and the results are given as $\alpha_{D\&M}$ in Table 3.10 and in Table 3.11.

As mentioned above, the researcher had only used 7 subscales from 15 subscales. Reliability values are also calculated for this study and given on the last column of the Table 3.10 and in Table 3.11.

Table 3.10 Motivation Part of MSLQ

Scales	Brief Description	Sample Item	No. of Items	$\alpha_{D\&M}$	α_{R}
Intrinsic goal orientation	Refers to the students' perception of the reasons why she is engaging a learning task.	In a class like this, I prefer course material that really challenges me so I can learn new things	4	.74	.70
Extrinsic goal orientation	This subscale complements intrinsic goal orientation i.e. refers students' reason of studying to the course for rewards, grades etc.	Getting a good grade in this class is the most satisfying thing for me right now	4	.62	.69
Task value	Refers how much students perceive tasks important and useful	I think I will be able to use what I learn in this course in other courses.	6	.90	.83
Control over learning beliefs	Refers what students think about their efforts relating to the course. To what degree they believe their efforts will come positive	If I study in appropriate ways, then I will be able to learn the material in this course	4	.68	.61
Self-efficacy for learning and performance	Refers to the students beliefs to be able to do a task and expect a good performance	I believe I will receive an excellent grade in this class.	8	.93	.83
Test anxiety	Refers to the students anxiety and negative thoughts about succeeding a course	When I take a test I think about items on other parts of the test I can't answer.	5	.80	.76

Reliability of the learning strategies part of MSLQ is given in Table 3.11. The researchers also analyzed items and calculated reliability alpha values of each subscale. These values are also given in the table below.

Table 3.11 Learning Strategies Part of MSLQ

Scales	Brief Description	Sample Item	No. of Items	$\alpha_{D\&M}$	α_{R}
Elaboration	Refers to how students learn a subject in terms of storing information; paraphrasing, summarizing, etc.	I try to relate ideas in this subject to those in other courses whenever possible.	6	.75	.61
Critical thinking	Refers to being able to solve new problems, applying knowledge to new situations and making critical evaluations.	I try to play around with ideas of my own related to what I am learning in this course.	5	.80	.64
Metacognitive Self-regulation	Refers to the degree of students' knowledge, awareness, control of cognition	If I get confused taking notes in class, I make sure I sort it out afterwards.	12	.79	.73
Peer learning	Refers to the dialogue of the peers	I try to work with other students from this class to complete the course assignments.	3	.76	.55
Rehearsal	Refers to the reciting and memorizing names from a list	When I study for this class, I practice saying the material to myself over and over.	4	.69	.58
Help seeking	Refers to students' awareness about seeking help when they don't know something.	I ask the instructor to clarify concepts I don't understand well.	4	.52	.55

Table 3.11 continued

Scales	Brief Description	Sample Item	No. of Items	$\alpha_{D\&M}$	α_{R}
Elaboration	Refers to how students learn a subject in terms of storing information; paraphrasing, summarizing, etc.	I try to relate ideas in this subject to those in other courses whenever possible.	6	.75	.61
Critical thinking	Refers to being able to solve new problems, applying knowledge to new situations and making critical evaluations.	I try to play around with ideas of my own related to what I am learning in this course.	5	.80	.64
Time and study environment management	Refers to the awareness of using time and environment in appropriate ways.	I usually study in a place where I can concentrate on my course work.	8	.76	.70
Effort regulation	Refers to the students' goal commitment.	I work hard to do well in this class even if I don't like what we are doing.	4	.69	.61
Organization	Refers to how students organize information they learn; clustering, outlining etc.	When I study the readings for this course, I outline the material to help me organize my thoughts.	4	.64	.59

The researcher applied a 42- item scale In this research only 7 subscales of the main scale were used in order to deepen the research findings and study more detailed. In addition to this, researcher selected these subscales according to the potential effect that portfolio use might influence. These seven subscales were determined according to the existing literature. A detailed journal research has been made to select subscales to analyze. Besides, opinions of four professors who have expertise at mathematics education and research were taken to decide what subscales should be used. And intrinsic goal orientation, extrinsic goal orientation, self-efficacy, elaboration, critical thinking, peer learning and metacognitive self-regulation subscales were selected to analyze.

In the motivation main scale students can have a maximum 112 point and minimum 16 whereas in the learning strategies scale student can have a maximum 182 points and minimum 26 points. Each scale was calculated and given in the table below.

Table 3.12 Maximum and Minimum Points of MSLQ Subscale

Motivation Subscale	Minimum Point	Maximum Point
IGO	4	28
EGO	4	28
EFF	8	56
Learning Strategies		
ELA	6	42
CRT	5	35
PL	3	21
MSR	12	84

As seen in Table 3.12, students could score maximum 28 points and minimum 4 points in two subscales; IGO and EGO. Maximum and minimum points, a student could get from EFF subscale were 56 and 8 points respectively. A student could get maximum 42 and minimum 6 points from ELA subscale. Students could get a maximum point of 35

and minimum point of 5 from CRT subscale. PL subscale has the lowest range that a student could get i.e. 21 and 3. MSR subscale was including more questions comparing to other subscale in the study. Hence a student could score maximum 84 and minimum 12 points from the MSR subscale.

3.5.2 Mathematics Achievement Test

Mathematics achievement test covered spring semester 7th grade mathematics chapters in the textbook (Cankoy et. al, 2010). These chapters are listed as follows; Percentages, Inequalities, Geometry Spatial Visualization, Triangles, Circle and Right Cylinder. Before preparing multiple-choice test, objectives of 7th grade mathematics units are examined.

Before starting to construct the mathematics achievement test, objectives of the 7th grade of mathematics, which were determined and declared by the Ministry of Education of Turkish Republic of Northern Cyprus, were examined. According to cognitive domain of Bloom taxonomy, level of these objectives ranged from knowledge to application. Before implementing mathematics achievement test, researcher and teacher prepared a Table of specifications (see appendix B). There were no objectives from the analysis, synthesis, and evaluation levels in the curriculum; therefore table of specifications was prepared according to the curriculum. Researcher and teacher developed test questions according to the Table of specifications. The researcher distributed list of objectives and test questions to 8 mathematics teachers and 2 measurement and evaluation experts with the questions. There were 43 items and, experts were asked to rate the compatibility and appropriateness of these questions over a 5 point Likert type scale. Raters were all agree on all of the questions' coherence and suitability. Researcher administered test to 8th graders and according to the results item analysis was made (see Appendix C). However, teacher asked the researcher to select 30 questions among 41 questions (see Appendix D). Hence, researcher selected 30 questions according to the item discrimination and difficulty index considering Table of Specifications. Questions are selected with item discrimination index higher than .30 and item difficulty index between .30-.70. According to Oosterof (1990) item discrimination should be .30 or higher for any item. He also stated that items with .30 or lower difficulty level is accepted for each level of item discrimination i.e. low, medium or high. Students get one

point for each correct answer. Unreached, unanswered and wrong questions are scored as zero. Maximum point of a student could have from this test is 30. It should be noted that students' scores was transformed to a 10-point system. For instance a 24 point scoring student was reported as 8.

The researcher calculated reliability coefficient as .73 which was calculated through Kuder-Richardson-20. Kline (2005) stated that there is not a unique interpretation of reliability there are some commonly accepted interval and he added that .70 are "acceptable". Hence the researcher found reliability as .73, this value is considered as adequate.

3.5.3 Instructional Material

Portfolio is another basic instrument, which was used in this study. As mentioned in previous chapter, in this study a learning portfolio was used (Zubizarreta, 2008). Learning portfolios also have classifications. Hence, Duffy et, al (1999) stated that there are four types of learning portfolios (student portfolios) which has four levels. In this study, the researcher has used "product portfolio". Product portfolios require teacher to provide students a table of contents that describes the required tasks or products. Furthermore the students should include examples of their work in each area of the table of contents. Students were asked to select 8 of the given activities below to keep in his/her portfolio case. Each activity was prepared upon a particular objective. The researcher provided students a table of content with submission deadlines. These tasks are written below with related objectives.

1. ***Imagine and Drive:***

Drive your dream car by using geometrical shapes, write its properties and name it.

Objective(s):

a. Being able to compare or explain attributes of circle, rectangle, triangle and polygons
b. Being able to describe and/or apply parallelism and perpendicularity

2. ***Cultural Buildings:***

Find cultural buildings on the Internet and take its printout. Which geometrical shapes has used in this building? Write their geometrical names and their properties.

Objective(s):

a. Being able to compare or explain attributes of circle, rectangle, triangle and polygons
b. Being able to describe and/or apply parallelism and perpendicularity

3. ***Create a game***

Use geometry, algebra and/or symmetry to invent a game.

Objective(s):

a. Being able to use algebraic expressions to generalize a pattern.
b. Being able to apply symmetry into real life context.

4. ***Photos***

Use your cell phone or camera to take a picture of any symmetric shapes around you.

Objective(s):

a. Being able to apply symmetry into real life context.

5. ***Envelope***

Construct an envelope by using trapezium and quadrilaterals.

Objective(s):

a. Being able to compare and describe attributes of regular trapezium
b. Learn the types of quadrilaterals

6. ***Inequalities in real life***

Research on Google and find out how inequalities used in real life?

Objective(s):

a. Solve inequalities on a number line and finds domain
b. Explains the difference between equality and inequality according to the real life context.

7. ***Vitamins***

Find at least 3 vitamins and the amount that a human need to take everyday. Think of your favorite meals in a course (let say minimum 3 kinds of meals in a course) and create an inequality that gives you the minimum amount of vitamins in grams you need to take each day.

Objective(s):

a. Solve inequalities on a number line and finds domain
b. Explains the difference between equality and inequality according to the real life context

8. ***Festival***

A middle school is having a spring festival. Admission into the festival is 3 TL and each game inside the festival costs 0.25 TL. Write an inequality that represents the possible number of games that can be played having 10 TL. What is the maximum number of games that can be played?

Objective(s):

a. Solve inequalities on a number line and finds domain
b. Explains the difference between equality and inequality according to the real life context

9. ***Honey***

Find natural honey from a market and write an essay why bees prefer to construct hexagons. Draw a regular hexagon and find its interior angles.

Objective(s):

a. Find the measure of the interior angles of a regular polygon

10. ***Construct it***

By using colorful papers try to construct a 3-D hexagon. Find its interior angles

Objective(s):

a. Find the measure of the interior angles of a regular polygon

11. ***Tangram***

By using tangram pieces, draw images below. Use your imagination. Will you notice anything about the areas of these shapes?

Birds, Boats, Buildings, Fish, Faces

Objective(s):

a. Finding perimeter of square, triangle, and trapezium.
b. Improving psychomotor skills

12. ***Mirrors***

Use symmetric shapes to create a compass rose. In what ways compass rose help us? Bring a mirror to the class and draw shapes on your book. See the shapes' reflection on the mirror. Then write a small paragraph why "ambulance" word is written in reverse.

Objective(s):

a. Consider symmetry and reflections by using transformation.
b. Apply symmetry into real life context

13. ***Measure it***

Use colorful papers to cut a square, trapezoid and a triangle. Cut 3 different measures from each shape and find their perimeters. With these pieces design a robot.

Objective(s):

a. Finding perimeter of square, triangle, trapezium.
b. Improving psychomotor skills

14. ***Poster***

Design a poster, which explains attributes of regular polygons. Which polygon(s) do you like more? Why?

Objective(s):

a. Finding perimeter of square, triangle, trapezium.
b. Improving psychomotor skills

15. ***Snowflakes***

Create symmetrical accessories by cutting colorful papers; for instance a snowflake. Use these papers to make decorations

Objective(s):

a. Consider symmetry and reflections by using transformation.
b. Apply symmetry into real life context

16. ***Party***

Make an interview with your friends to go shopping for drinks and cookies. Ask them which kind of drinks and cookies they prefer to have. Demonstrate this in percentages. Where do we use percentages in real life?

Objectives

a. Use of percentages with "%" symbol
b. Apply percentage into real life situations

17. ***Market Research***

Go to the nearest market or shopping center. Make an investigation about the discount on products. Prepare a comparison table

a. Use of percentages with "%" symbol
b. Apply percentage into real life situations

3.5.4 Interviews

Researcher made interview with all participants. Interviews were held in a small room (used by students to make phone calls) in the school campus. Each student was asked to answer ten questions. Each interview lasted 5-10 minutes. Students were a little nervous at the beginning of the interview; since their voice would be recorded. Therefore warm-up questions e.g. how are you; were used in the beginning of the study. This interview was made to explore students' opinions about the portfolio use in their mathematics class. They were asked to state their views if they prefer to keep using portfolios.

Students also asked to share their experiences during the process about portfolios. For the interview questions, see Appendix E.

3.6 Implementation of the Treatment

In this section, implementation of the treatment will be explained both for experimental and control group.

3.6.1 Treatment in Experimental Group

In experimental group the instruction was enriched with portfolio activities. The treatment lasted 13 weeks. In experimental and control groups the teacher was the same person. She accomplished the same cognitive objectives declared by Ministry of Education in both groups. Students were first informed about the process in the beginning of the study. First of all students in the experimental group were given an oral presentation about what a portfolio is. They were also informed about how to organize a portfolio, contents of portfolio and the purpose of the portfolio. Some related samples of portfolios were shown to the students to help them understand the material. Besides, the researcher provided students a mini manual about the definition and purpose of the portfolio. During the process, students were expected to complete minimum 7 tasks.

The tasks set by the researcher depend on the chapter flow and learning objectives of the course. The finished piece of works should have been submitted in 10 days after it was assigned. Students were free to use either a processor like word or handwriting. There was not any restriction for this. Students were allowed to ask questions in the class for 20 minutes (10′+ 10′) each week. Students were also informed about the authenticity of their work and they were also notified that they could repeat the task if the researcher or teacher had a doubt about the authenticity.

In the experimental group teacher noted students' misconceptions, misunderstandings and some particular points, that could not be observed in students' reflection papers and tasks. The teacher was using the same daily lesson plans for years; however she added extra questions and definition of terms to the plan she was using according to the common findings from students' reflection papers. Besides, she necessarily added number of examples, solved in the class. Since some tasks were requiring students to draw geometric shapes, teacher enriched her instruction paying an extra attention to

draw shapes in an expanded way. She also paid extra attention to stimulate and recall old information.

Before assigning tasks to the students, a warm-up task was given before the lessons had started in the school. In the first week of classes, students were all expected to write 3 paragraphs about what life would be without mathematics. This task was related with the main aim of the mathematics curriculum (MoNE, 2009). There is a sample of student work in Appendix F. The detail information on utilizing the portfolio activities during the instruction was given as follows:

First task was about percentages. Main aim of this chapter was to help student use of percentages with "%" symbol and being able to apply percentage into real life situations. Given tasks were "party" and "market research" that were both aiming the same objectives. For each task students are given 10 days to submit their tasks. They were also told that they could submit their tasks before ten days. The researcher went to the school twice a week in order to guide students and answer portfolio related questions. In the first week students generally asked the researcher about the selection of the tasks. And the researcher explained this issue in the class. Students were told to select any task, which is related with the same objectives. For the first task, most of the students submitted their work to the teacher. Teacher and the research provided feedback for each paper and gave it to the students back. Teacher enriched her instruction with added real life problems. For instance, she wanted students to write 2 real life problems about percentages according to their experiences. She wanted students to work together (2 students in each group) and also selected some of these questions to solve in the class. (see Appendix F2).

In the second task, the chapter was inequalities and students were given two tasks to select one and complete. They were also told that they might complete both tasks to keep in portfolios. Festival, inequalities in real life and vitamins are the related tasks for the second activity. Main objectives for this task was about being able to solve inequalities on a number line and finding domain and explaining the difference between equality and inequality according to the real life context For this task students mainly complained about the difficulties of the tasks. They generally asked for help from the researcher and teacher. They also stated that they had difficulties about understanding the question unless problem is rewritten with "<, >" symbols and numbers. After

providing feedback for the students, teacher solved more word problems in the class helping students to transform word problems into mathematics sentence.

In the third task, chapter was related with geometrical shapes, students again were given two tasks in order to select and complete one. Offered tasks were “measure it” and “tangram”. In this task students were supposed to find the perimeter of a square, triangle, and trapezium of their own tangram pieces. In addition to this, they were supposed to find the area of a square, triangle, and trapezium. In this task it was also aimed to improve students’ psychomotor skills. Since this task was requiring students to use material, the researcher helped students to get a discount from the nearest stationary in order to buy needed materials. For this task, students frequently asked for help from the researcher and their teacher. They were mostly asking about the uses of the tangram and the way of constructing their tangram pieces. Most of the students submitted their task before 10 days. The researcher and teacher provided feedback. Some of the students only cut pieces to create tangram pieces and disregarded to find the area and perimeter of the shapes. Therefore provided feedbacks were including mainly the same point mentioned here (see Appendix F3 and F4 to see some samples of student works). She also cut her own tangram pieces to show the students and emphasize the attributes of the geometric shapes.

Fourth task was related about the regular polygons; triangles, squares, trapezoids and pentagons. “Poster” and “Envelope” tasks were given to the students in order to select one of them. Main objectives in these tasks were about finding the perimeter and area of a triangle, square, trapezoid and pentagon. Besides improving psychomotor skills of the children was another main purpose for this task. For this task, almost all students selected to design an envelope. Students asked help from the researcher about the shape of their envelope. And the researcher stated that any shape (provided that it is a regular polygon) was acceptable. Students generally asked their teacher and researcher about decorating their envelopes and the researcher again underlined that they were free to design or construct anything about their envelope. Most of the students submitted their work before the deadline. Some of the students had constructed more than one envelope. Teacher and the researcher provided feedback especially about their reflection paper since some of the students did not provide any information about the perimeter and the area of the shapes that they were used for the envelope. According to the reflection papers, teacher emphasized that what a “regular” and “irregular” polygon was. She also

used an example from a student's work which was a poster explaining attributes of polygons. She also enriched her instruction with more examples adding irregular polygon examples (see Appendix F5, F6, F7, F8 to see samples of student work)

After the fourth task, it was students' midterm week and was lasted 9 days. Fifth task was given week after the end of their exams. Fourth task was related about the hexagons. Students were given two different tasks, each regarding the same objective(s). Tasks were named as "construct a 3-D hexagon" and "honey" which were both requiring students to find the measure of interior angles and attributes of a regular hexagon. For this task, students generally selected the "honey" task and they preferred to draw a 3-D hexagon instead constructing a 3-D hexagon. As mentioned, the researcher went to the school to observe the class and guide the students during the process. For this task most of the students asked researcher about what a natural honey looks like" and the researcher brought a natural honey in jar and various pictures to the classroom to help children for the task. Again, most of the students submitted their portfolios on time. However there were some other students that did not submit their papers. Teacher and the researcher helped these students to complete and submit tasks but a few students did not bring these tasks. After providing feedbacks, teacher taught students why bees are constructing hexagons. She also gave real-life examples about hexagons such as paving and screws. Since almost all students copied finding measure formula from the book, teacher enriched her instruction on the relationship between isosceles triangles and interior measure of a hexagon. After the instruction students were given their tasks to review and made adjustments to keep in their portfolios

Sixth task was related with the concept of symmetry. Tasks were "draw something symmetrical" and "photos". Main objectives for these tasks were about defining what symmetry is and being able to observe any symmetrical pattern or shapes in a real life environment. Most of the students preferred to complete "photos" activity. During the implementation of the task, teacher helped students to define symmetry and brought a mirror to help students comprehend better. Students submitted their work to the teacher in 10 days. Teacher and the researched noticed that most of the students wrote the exact same definition of symmetry and took same pictures to include their tasks. Therefore, the researcher explained students that they needed to complete task with her/his own ideas and not to copy from any other friend. However it was also noted that help seeking was definitely allowed, provided that submitted work should be demonstrating entirely

his or her individual work. Besides, teacher showed her ornament design to the students in order to draw their attention and encourage them for the future tasks. Last 10 minutes of the class she asked students to create symmetrical shapes and pin on the board. At the end of the class she selected a low achiever student to explain what shaped he created and asked him to define the symmetry.

Last task was about the attributes of circle. "Imagine and Drive" and "Cultural Buildings", were two tasks. These were related about being able to solve rectangle, triangle, and polygon problems by considering parallelism and perpendicularity. Students were asked to whether drawing a car by using attributes of related geometrical shapes or investigating cultural buildings in terms of geometrical shaped. Students mainly selected to "imagine and drive" task. After they have submitted their work, it was noted that students did not consider geometrical rules. Teacher asked students to review their work and bring again, however most of the students did not bring or submit their work again. Teacher enriched her instruction by demonstrating a famous building that is constructed in a right cylindrical shape called Rivergate Tower (see Appendix F9, F10)

3.6.2 Treatment in the Control Group

In the control group traditional instruction was utilized. It lasted 13 weeks. Classroom management was teacher oriented. She generally used lecturing method. Teacher stated that students were going to be offered extra optional tasks. She did not mention that they were used in the experimental group. If they would like to complete these tasks, they could complete it for their own learning. However, neither the teacher nor the researcher provided any feedback for these tasks. As a matter of fact none of the students asked help or feedback from the teacher during the process. She used the same textbook to design her instruction. Students in the control group were regularly given paper-pencil tests each week. Teacher was checking students' homework from the textbook but she was not providing feedback as she did for experimental group.

3.6.3 Treatment Verification

The researcher observed the experimental and control group twice in a week to verify their instructions.

In order to verify if experimental group was treated with portfolio-enriched activities or not. Similarly, control group was also observed whether students were instructed with traditional approach or not. In the same way, the researcher visited both groups twice a week. The researcher took field notes during the classes for the realization of the treatment verification. In the experimental group the observations were made according to the properties of learning portfolio such as providing feedbacks to students, applying real-world tasks, writing reflection papers, group working, and their artifacts. On the other hand, in the control group the observation was also made according to the main characteristics of traditional instruction. Consequently, the treatments in the present study were verified by the researcher's observations.

3.7 Procedures

In this part, followed procedure will be explained during the study. Below, the procedure will be explained step by step. However it should be noted that literature review was an ongoing chapter during the study to verify the up-to-dateness of the study

- Research problem is determined
- Keywords are identified
- Search pattern was formulated
- Literature review was done
- Sample area was selected
- Negotiations were held for the sampling (between two schools)
- Permission letter was obtained to conduct the study
- Participants were selected
- Instruments were prepared
- Pilot study of instruments
- Development of mathematics achievement test
- Implementing of mathematics achievement test
- Implementing of MSLQ
- Treatment was given
- Administration of post-tests
- Interviews
- Some students' portfolios were gathered.

- Administration of retention tests
- Data analysis

First of all keywords of the research problem was identified and a search pattern was formulated. Subsequently, Literature review was done. These researches have been performed by surveying, Educational Resources Information Center (ERIC), International Dissertation Abstracts, Ebscohost, Social Science Citation Index (SSCI), Kluwer Online and Science Direct databases, Doctoral and master dissertations published on YÖK (Higher Education Council). This study was prepared by searching certain databases.

Right after completing first step of literature review, main titles and instruments were determined. Afterwards, researcher chose one of the two middle schools in the Famagusta. Conducting a research study in a school in North Cyprus requires a permission letter from Ministry of Education. Therefore, the researcher needed to take this permission letter as a first step.

With the letter of permission, researcher went to the school to explain the study in detail. Principal, data collector and subjects were all informed before study about privacy of the names.

All participants, and parents received information and a grant letter attached with a document, which explains purpose of the study and confidentiality of the names. Grant letter also highlighted that subjects would never be exposed to any psychological harm or discomfort.

A pilot study was conducted to develop mathematics achievement test and item analysis were made according to the results. Development of test was completed according to the item analysis results and Table of Specifications. Both MSLQ and mathematics achievement test were administered to the sample of the study. Treatment was given 13 weeks and post-testing was applied. At the end of the post-testing, interviews were conducted too. Portfolios of 28 students were collected. After 3 months retention testing was administered and data analysis was made.

3.8 Qualitative Part of the Study

As mentioned, in this study the researcher has both used quantitative and qualitative data. Silverman (1993) suggests that conducting a quantitative research is not enough to rely obtained data. According to him, only scientists observe facts and uses statistical data. He also mentions there is not only true or false methods but they are more useful or less useful. Based on this view, the researcher obtained qualitative data too. Qualitative data instruments included student reflection papers, portfolios and interview audiotapes. Content analysis was used in the process. Silverman (1993) defines content analysis;

> *"Content analysis is an accepted method of textual investigation, particularly in the field of mass communications. In content analysis, researchers establish a set of categories and then count the number of instances that fall into each category. The crucial requirement is that the categories are sufficiently precise to enable different coders to arrive at the same results when the same body of material*"

In order to analyze qualitative part, researcher has studied with another expert who has an Ed.D degree and adequate experience with qualitative data.

First of all, audio taped data were first transcribed verbatim and then analyzed through the codes. The researcher and the expert worked together to determine the codes, categories and themes respectively.

3. 9 Assumptions, Limitations and Delimitations of the Study

In this part of the study assumptions, limitations, internal and external validity threats to study will be explored

3.9.1 Assumptions

This study is based on some particular assumptions; (a) no outside event occurred during the study to affect the results, (b) the instructor was not biased during the treatment, (c) Spring semester is long enough to affect students' behaviors and opinions

3.9.2 Limitations of Study

The researcher could not confirm the scale's construct validity since MSLQ scale consists of 81 items, and the researcher was unable to reach 810 people; when the school's population (600 students). Schmidt and Rotgans (2010) conducted a study with 1066 subjects. They concluded that, the construct and predictive validity of the

instrument which were determined by confirmatory factor analysis and by correlating the individual subscales of the instrument with the overall semester grades; results showed that the MSLQ is a reliable and valid instrument to determine students' motivational beliefs and learning strategies. Also Garner (2009) stated that MSLQ has a good internal consistency reliability and construct validity of each measure that has been documented (Pintrich et al., 1991, 1993; Spinella, 2005). The MSLQ, in particular, has secured a well-known place in the literature on self-regulated learning. As Burlison et. al stated (2009), this scale has been referenced more than 129 times. This study was limited to the 7th -grade students in a Middle School, Famagusta, North Cyprus during the 2010-2011 academic year Only three groups were used in the study. The participant classrooms were selected from the public middle school, any other school is not in the scope of this study.

3.10. Internal and External Validity of the Study

In this section issues related with the internal and external study will be explored in terms of possible threats to the study

3.10.1 Internal Validity of the Study

Fraenkel and Wallen (2006) stated that a study should be internally valid which means any relationship detected between two or more variables should be explicit. In other words, they stated that internal validity means that observed differences on the dependent variable are directly related to the independent variable and not due to some other unintended variable (Frankel & Wallen, 2006, p.169). There might be possible internal validity threats to this study; subject characteristics, mortality, location, instrumentation, testing, history, maturation, attitude of subjects, regression, and implementer threats. There is a list below indicating some possible threats to internal validity and the controlling strategies.

Mortality could be a threat because in a classroom it was a big possibility to lose one or more students, to catch a disease or to experience some difficulties in her/his life. Mortality would likely to affect post-treatment scores. However mortality was not a threat to the study. There were no losses during the study.

"Subject Characteristics" could be a threat because the process those subjects go through has some particular requirements; for instance, gender or socioeconomic

background. Besides, intact groups were used. In this study distribution of boys and girls in the classes are almost equal. As mentioned above, pre-MSLQ scores and 6th grade report card grades were analyzed to see if groups are homogenous. Therefore, groups were almost equal on these characteristics.

Testing could be a threat because students' post-test scores might be biased, since they know the experiment from the pre-test and thus students may perform better in the post-test. However, same set of question was used both in the experimental and control group, and the duration of this intervention was long enough (an academic year) for the subjects to recall the questions. Therefore testing threat was minimum for this study.

Attitudes of subjects might constitute a threat. A "Hawthorne" effect could be observed if the subjects discover that it was an experimental research. If subjects knew that they were a part of this study, they might show better performance as a result of the feeling that they were receiving some sort of special treatment. Nonetheless, an opposite effect could occur if the subjects in control group had discovered that they did not receive any treatment. Therefore they could be demoralized and performed poorly comparing to the experimental group. To control this threat, students were told that this study was an ordinary part of the instruction

Data collector characteristics, was not a threat to the study since there was only one teacher. Data collector bias is the possibility that data collector may mistakenly corrupt the data to make certain outcomes (Fraenkle & Wallen, 2006). However, the teacher was informed about the process. The researcher asked her to allow the exact time for tests. Besides, the researcher was in the classes with the teacher during the administration of the tests. Therefore any cheating behavior was prevented.

MSLQ scale was a Likert-type scale and achievement test was a multiple-choice test. Therefore, scoring procedure did not change. Multiple-choice test is robust to control instrument decay threat. Since scoring procedure was standard and objective.

Location was not a threat in this study. Three groups of the study almost had equal sizes of students (33,34 and 35 students) so the classes were not crowded. Classrooms were almost same and they were located next to each other. In other words, physical condition of the classes was almost same. All interviews were held in the same room also. So, there was a minimum risk for the location threat.

History threat was not a threat during the study. Teacher did not report any unexpected incident or unplanned event that might have affected study results. Therefore, history was not a threat for this study.

Maturation also was not a threat for this study. Study was completed in 3.5 months, and subjects were 13-14 years old. For that reason, there were not any factors related with the passing of time that might have affected study results.

Regression was not a threat in this study since there were three groups in the study. As Fraenkel and Wallen (2006) suggested, regression could be due to the change in a group if they have exceptionally low or high scores in preintervention performances

Implementation threat might occur in two ways; first, if different persons are assigned to implement different methods, second, if these individuals have a personal bias (Fraenkel & Wallen, 2006). In this study research did not implement the treatment. In other words, the researcher did not interfere with the instruction or the instructor.

3.10.2 External Threats to the Study

This study has 102 participants who were not randomly selected from the population. Therefore findings of the study are only generalizable to the groups that have same or similar characteristics. Hence the studies' generalizability is limited.

CHAPTER 4

RESULTS

In this section, both qualitative and quantitative results will be reported. In the first part, quantitative results will be displayed.

A Doubly repeated multivariate analysis of variance was performed on mathematics achievement, learning strategies and motivation over three time periods. Groups were defined as the between subjects factor: experiment group and control group. The within subjects factors was time period: (a) pre-test (b) post-test and (c) retention test. The sample sizes for two experimental groups were 69 and control group was 33 students. There were no missing data and no outliers were found. Cell means and standards deviations for the eight dependent variables across all time periods are shown in Table 4.1, Table 4.2 and Table 4.3

In order to observe any potential differences between control group and experimental group regarding the effect of portfolio use on dependent variables Doubly repeated MANOVA (as mentioned) procedures were used. Independent samples t-test does not produce any statistically significant differences between groups on pre-tests (See Table 4.2).

Table 4.1 Descriptive Statistics of MACH Test

DV	Group	M	SD	N
MACH1	Experiment	2.48	0.79	69
	Control	2.18	0.89	33
MACH2	Experiment	8.15	1.29	69
	Control	6.85	0.89	33
MACH3	Experiment	7.31	1.15	69
	Control	5.99	0.84	33

Table 4.2 Descriptive Statistics of Motivation Subscales

DV	Group	M	SD	N
IGO1	Experiment	19.72	4.04	69
	Control	20.24	3.60	33
IGO2	Experiment	21.22	4.16	69
	Control	20.33	3.63	33
IGO3	Experiment	20.35	4.08	69
	Control	20.12	3.59	33
EGO1	Experiment	22.16	4.88	69
	Control	24.12	2.64	33
EGO2	Experiment	23.55	3.69	69
	Control	24.82	2.62	33
EGO3	Experiment	22.75	4.25	69
	Control	24.85	2.65	33
EFF1	Experiment	40.57	8.95	69
	Control	38.64	7.68	33
EFF2	Experiment	42.48	9.80	69
	Control	40.09	8.15	33
EFF3	Experiment	42.77	9.76	69
	Control	40.12	9.28	33

Table 4.3 Descriptive Statistics of Learning Strategies Subscales

DV	Group	M	SD	N
ELA1	Experiment	26.41	6.90	69
	Control	29.55	5.83	33
ELA2	Experiment	27.29	6.51	69
	Control	30.42	5.39	33
ELA3	Experiment	27.49	6.90	69
	Control	30.67	5.98	33
CRT1	Experiment	20.09	5.03	69
	Control	18.85	3.50	33
CRT2	Experiment	21.96	4.73	69
	Control	19.21	3.46	33
CRT3	Experiment	21.06	4.76	69
	Control	19.12	3.28	33
PL1	Experiment	8.12	3.71	69
	Control	8.91	3.55	33
PL2	Experiment	10.86	3.02	69
	Control	11.24	2.81	33
PL3	Experiment	9.52	3.29	69
	Control	10.55	3.31	33
MSR1	Experiment	50.62	10.38	69
	Control	59.76	7.42	33
MSR2	Experiment	54.87	10.66	69
	Control	60.15	7.13	33
MSR3	Experiment	53.25	10.27	69
	Control	60.27	7.08	33

4.1 Assumptions of Doubly Repeated MANOVA

In order to be able to conduct a Doubly repeated MANOVA, underlying assumptions should be tested. Barret, Leeach and Morgan (2005) stated that the independence of observations, normality, multicollinearity, homogeneity of variance, sphericity, sample size and linearity are the assumptions to be tested.

In order to test homogeneity of variance assumption, Box's M test (see Table 4.4) is considered and since the assumption is not met, Pillai's Trace statistics was used throughout the study (Tabachnick & Fidell, 2007).

In the study the researcher was unable to study with groups of equal sizes. Barrett et al. (2005) stated that if the number of levels of within subject times number of variables approaches to the sample size, then the researcher should select another method to analyze the data. They also stated that, Box's M statistics should be checked for unequal

sample sizes. For both assumptions; homogeneity of variance and sample sizes, Box's M test was run (see Table 4.4)

Table 4.4 Box's Test of Equality of Covariance Matrices

Box's M	1223.80
F	2.79
df1	300
df2	13144.54
p	.000

Thirdly, all observations and measures were done independently that is, measurements were not influenced by any other observation or measurement

Sphericity assumption was checked through Mauchly's W test. As shown in Table 4.5 sphericity assumption had been violated for 7 DV all *p* values were larger than .05 except Elaboration.

Table 4.5 Mauchly's W Test for Dependent Variables

						Epsilon		
Measure		Mauchly's W	χ^2	df	p	Greenhouse Geisser	Huynh-Feldt	Lower-bound
Time	MACH	.928	7.44	2	.024	.933	.959	.500
	IGO	.908	9.56	2	.008	.916	.941	.500
	EGO	.839	17.3	2	.000	.862	.884	.500
	EFF	.422	.04	2	.000	.904	.645	.500
	ELA	1.000	85.4	2	1.00	1.000	1.000	.500
	CRT	.894	11.1	2	.004	.634	.929	.500
	PL	.700	35.2	2	.000	.769	.787	.500
	MSR	.171	174.	2	.000	.547	.554	.500

The assumption of multivariate normality is that scores on predictors are independently and randomly sampled from a population, and that the sampling distribution of any linear combination of predictors is normally distributed. (Tabachnick & Fidell, 2007, pp. 382). Hoyle (2003) stated that checking skewness and kurtosis values should be the initial process. A distribution having skewness and kurtosis values between -2 and +2 can be accepted as normal distribution (George & Mallery, 2003, pp.98-99). All values in the study were analyzed and the results can be seen in the Table 4.6. As seen on the

table, all values are in between -.994 and .697, which falls between -2 and +2. Therefore this assumption was met.

Table 4.6 Skewness and Kurtosis Values of Dependent Variables

	N	Skewness	SE	Kurtosis	SE
MACH1	102	.103	.239	-.341	.474
MACH2	102	.086	.239	-.881	.474
MACH3	102	.021	.239	-.650	.474
IGO1	102	-.498	.239	.326	.474
IGO2	102	-.417	.239	.349	.474
IGO3	102	-.480	.239	.419	.474
EGO1	102	-.994	.239	.697	.474
EGO2	102	-.895	.239	.507	.474
EGO3	102	-.886	.239	.145	.474
EFF1	102	-.571	.239	-.159	.474
EFF2	102	-.567	.239	-.105	.474
EFF3	102	-.532	.239	-.269	.474
ELA1	102	-.346	.239	.149	.474
ELA2	102	-.272	.239	.062	.474
ELA3	102	-.286	.239	.091	.474
CRT1	102	.202	.239	-.201	.474
CRT2	102	.232	.239	-.170	.474
CRT3	102	.212	.239	-.153	.474
PL1	102	.455	.239	.324	.474
PL2	102	.403	.239	-.043	.474
PL3	102	.487	.239	.254	.474
MSR1	102	-.212	.239	-.335	.474
MSR2	102	-.176	.239	.051	.474
MSR3	102	-.214	.239	-.116	.474

In order to check linearity assumption, each pair of DV was examined through scatter plots. In other words, all pre, post and retention score pairs were examined and no non-linearities were encountered.

Multicollinearity assumption is related with the correlation among related dependent variables. Tabachnick and Fidell (2007) stated that standards for the principles of

multicollinearity are quite different, especially for the multivariate approach to repeated measures. They also stated that correlations among DVs are likely to be quite high if they are on the same measure taken from the same cases over time. Leech et. al. (2005) also stated that unless correlations among DVs are too high, correlation among dependent variables should exist from low to moderate level. In this study, all correlations are analyzed and this assumption was met. For the correlation table see Appendix G, Table G1.

4.2 Doubly Repeated MANOVA Results

In this section, treatment effect will be analyzed for the main effect of time, main effect of group and time by group interaction.

Multivariate tests through a Doubly repeated MANOVA with group as between subjects and time as within subject factors revealed significant main effects of group $F(8,93) = 11.080$, $p = .000$, $\eta^2_P = .488$ and time $F(16,85) = 301.013$, $p = .000$, $\eta_p^2 = .983$ and interaction effects of group and time, $F(16, 85) = 19.761$, $p = .000$, $\eta_p^2 = .788$ on the linear combination of mean scores on the linear combination of mean scores that resulted from mathematics achievement, self-efficacy for learning and questionnaire, intrinsic goal orientation, extrinsic goal orientation, critical thinking, elaboration, peer learning and metacognitive self-regulated learning scores across all measures. Table 4.7 summarizes Multivariate test results below.

Table 4.7 Multivariate Test Results

Source	*F*	df	Error df	*p*	η^2_P
Time	301.013	16	85	.000	.983
Group	11.080	8	93	.000	.488
Time x Group	19.761	16	85	.000	.788

Since a significant result was detected, a follow up Univariate analysis was conducted for each dependent variable. As shown in Table 4.5 sphericity assumption had been violated for 7 DV all *p* values were larger than .05 except Elaboration. Field (2000) stated, using Huynh-Feldt generates more accurate results and Lower-bound and Greenhouse-Geisser gives more conservative values, therefore, Huynh-Feldt correction were used throughout the analysis.

For the following sections, each dependent variable will be considered under a separate section and related statistical analysis results will be given under each title.

4.2.1 Results Obtained from Mathematics Achievement Test (MACH)

In this section, the researcher sought evidences in order to detect significant differences in the mean scores of mathematics achievement between groups across three time periods if any (group effect). Besides, the researcher also sought evidences for any change in the mean scores of 7th graders' mathematics achievement scores in three time periods and a significant group by time interaction.

A Doubly repeated MANOVA analysis, with group as between subjects and time as within subjects factors revealed significant main effects for time $F(1.92, 191.81) = 1848.24$, $p=.000$ and $\eta^2_P = .949$ (*time effect*). A time x group interaction was also found statistically significant with a small size effect; $F(1.92, 188.26) = 20.52$, $p = .000$ and $\eta^2_P = .170$ (*time x group interaction*) Information is summarized in Table 4.8.

Table 4.8. Univariate Test on MACH Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	1371.40	1848.24	1.92	191.81	.000	.949
Time x Group	15.22	20,52	1.92	188.26	.000	.170

For the main effects of time, a significant difference was found between experimental and control group (*group effect)*, $F(1,100) = 25.85$, $p = .000$, $\eta^2_P = .205$. For the main effect of time, within subjects contrasts have shown that pre and post mathematics achievement scores differed significantly. $F(1,100) = 3144.96$, $p = .000$, $\eta_p^2 = .969$. A significant difference was also detected between pre-test and retention test $F(1,100) = 269.26$, $p = .000$, $\eta_p^2 = .832$. Besides, a significant time x group interaction was detected $F(1,100) = 29.47$ $p = .000$, merely; it has a small effect size $\eta_p^2 = .228$. as seen in Table 4.9

Table 4.9 Tests of Within Subjects Contrast for MACH Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	2383.79	3144.96	1	.000	.969
	Retention vs Previous	269.26	494.48	1	.000	.832
Time x Group	Pre-test vs Post-test	22.34	29.47	1	.000	.228
	Retention vs Previous	6.09	11.17	1	.001	.101

Because of the significant time x group interaction an independent samples t-test was run to compare the means of mathematics achievement between post-test and retention test scores. Therefore, the researcher analyzed mathematics achievement scores if there is a statistically significant difference between experimental and control groups as seen in Table 4.10

Table 4.10 Independent Samples t-test Results with respect to MACH Scores

Variable	F	*p*	*t*	df	*p*	MD	SE	*d*
MACH2	7.65	.007	5.21	100	.000	1.30	.249	1.17
			5.91	87.23	.000	1.30	.219	
MACH3	4.89	.29	5.90	100	.000	1.32	.224	1.31
			6.58	83.57	.000	1.32	.201	

As Table 4.10 shows, there is a statistically significant difference in MACH2 scores measures, between experimental (M= 8.15, SD = 1.29) and control group (M = 6.85, SD = .89) and there is a statistically significant difference in MACH3 scores measures, between experimental (M= 7.31, SD = 1.15) and control group (M = 5.99, SD = .84) in the favor of experimental group, $t(87.23) = 5.91$, $p < .05$ and $t(83.57) = 6.58$, $p < .05$ respectively. Paired samples t-test also was run to see the difference between post-test (mathematics achievement test) and retention test scores of the experimental group. Furthermore, differences between pre-test and post-test and pre-test and retention test were analyzed as seen in Table 4.11.

Table 4.11 Paired Samples t-test Results of Experimental Group with respect to MACH Scores

	Paired Differences						
Pairs	M	SD	SE	*t*	df	*p*	*d*
MACH1-MACH2	-5.67	1.06	.127	-44.59	68	.000	-5.3
MACH2-MACH3	.836	.85	.102	8.20	68	.000	.88
MACH1-MACH3	-4.83	1.11	.133	-36.27	68	.000	-4.9

As given in Table 4.11, paired samples *t* tests indicated a significant increase from pre-testing (M = 2.48, SD = .79) to post-testing (M = 8.15, SD = 1.29), $t(68) = -44.59$, $p < .05$ $d = 5.3$ in the mean scores of the MACH and a significant slight decrease from post-testing (M = 8.15, SD = 1.29) to retention-testing (M = 7.31, SD = 1.15)**,** $t(68) = 8.20$, $p < .05$ $d = .88$ Also there is a significant increase from pre-testing to retention testing. $t(68) = -36.27$, $p < .05$**.** $d = -4.9$

A paired samples t-test was also conducted to analyze control group's mathematics achievement scores across three measures (see Table 4.12)

Table 4.12 Paired Samples t-test Results of Control Group with respect to MACH Scores

	Paired Differences						
Pairs	M	SD	SE	*t*	df	*p*	*d*
MACH1-MACH2	-4.67	.005	.001	-56.00	32	.000	-4.54
MACH2-MACH3	.858	.480	.084	10.28	32	.000	-.85
MACH1-MACH3	-3.81	.480	.084	-45.59	32	.000	-4.4

As seen in Table 4.12, Paired samples *t* tests for control group indicated a significant increase from pre-testing (M = 2.18, SD = .89) to post-testing (M = 6.85, SD = .89), $t(68) = -56.00$, $p < .05$, $d = -4.54$ in the mean scores of the MACH and a significant decrease from post-testing (M = 6.85, SD = .89) to retention-testing (M = 5.99, SD =

.84)**,** $t(68) = 10.280$, $p < .05$, $d = -.85$ Also there is a significant increase from pre-testing to retention testing. $t(68) = -45.586$ $p > .05$ $d = -4.4$

Estimated marginal means of mathematics achievement scores are analyzed in order to see the increases or decreases over time see (Figure 4.1).

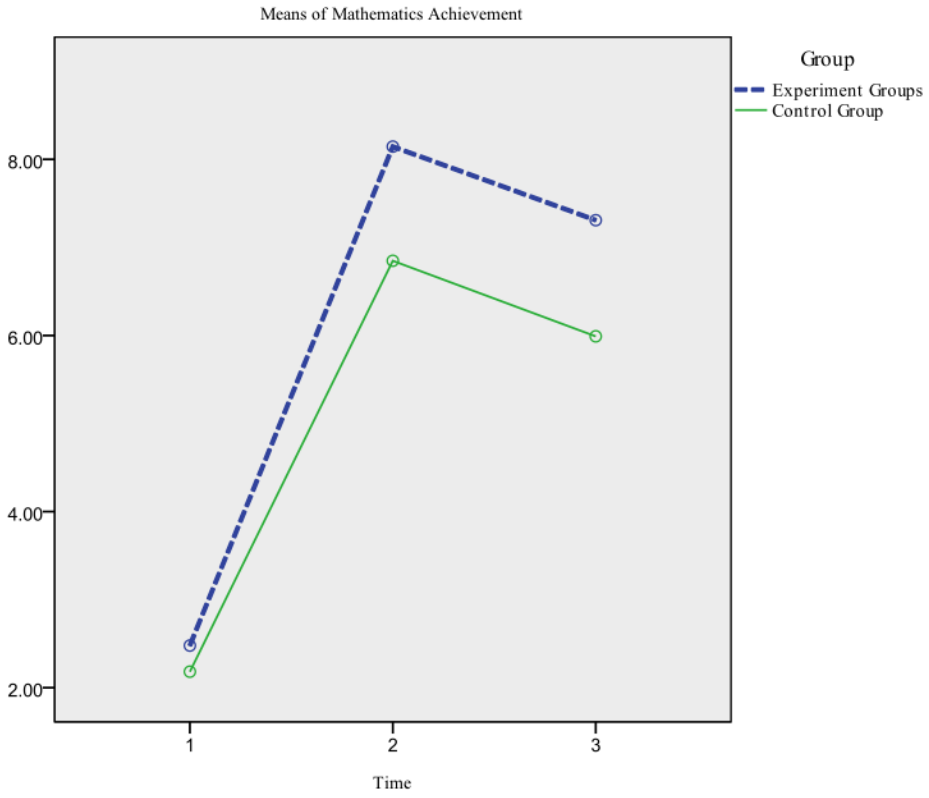

Figure 4.1 The Comparison of Estimated Marginal Means of Mathematics Achievement Scores Between Groups Across Three Time Periods

As seen in Figure 4.1, both groups showed a significant increase from pre-test to post test. Experimental groups' mathematics achievement test scores fluctuated between time periods 2 and 3. Both groups scored highest after the implementation of post-test. However, both groups' scores decreased in the retentions test. As it can be seen on the figure, experimental group scored higher in the retention test

4.2.3 Results Obtained from Intrinsic Goal Orientation Acores (IGO)

In this section, the researcher sought evidences in order to detect significant differences in the mean scores of IGO between groups across three time periods if any (group effect). Besides, the researcher also sought evidences for any change in the mean scores of 7th graders' mathematics achievement scores in three time periods and a significant group by time interaction.

A Doubly repeated MANOVA with group as between subjects and time as within subjects factors revealed significant main effects of time $F(1.88, 188.26) = 59.67$ $p = .000$ and $\eta^2_P = .374$. (*time effect*). Besides a significant time x group interaction was also found, (1.88, 188.26) = 44.81 $p = .000$ and $\eta^2_P = .309$. (*time x group interaction*). Information is summarized in Table 4.13.

Table 4.13. Univariate Test of IGO Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	29.24	59.67	1.88	188.26	.000	.374
Time x Group	21.963	44.81	1.88	188.26	.000	.309

For the main effects of time, a significant difference could not found between groups (*group effect*). F (1,100) = .057, $p = .812$, $\eta^2_P = .001$. For the main effects of time, within subjects contrasts have shown that pre-testing and post-testing scores differed significantly. $F(1,100) = 155.634$, $p = .000$, $\eta_p^2 = .609$. A significant difference was also detected between pre-test and retention test $F(1,100) = 4.030$, $p = .000$, $\eta_p^2 = .039$. In Table 4.14 tests of within-subjects contrasts are given.

Table 4.14 Tests of Within Subjects Contrast for IGO Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	55.99	155.63	1	.000	.609
	Retention vs Previous	1.88	4.03	1	.000	.039
Time x Group	Pre-test vs Post-test	43.87	121.95	1	.000	.549
	Retention vs Previous	.042	.091	1	.764	.001

As seen in Table 4.14, for time x group interaction effect, within-subjects contrasts also have shown that pre-test and post-test IGO mean scores differed significantly $\eta_p^2 = .549$. There was not any significant interaction between pre and retention test IGO mean scores.

Since there was no significant difference between groups, there was no need to run an independent samples t-test to compare the means of IGO scores between post-test and retention test scores. However, since a time effect has been detected, a paired samples t-test was run to see the differences in the mean scores of IGO within groups. In other words, independent samples t-test also did not produce statistically significant difference between experimental and control groups $t(100) = 1.045$, $p > .05$ and $t(100) = .272$, $p > .05$. However a paired samples t-test was run to see the difference among test scores both for experimental group and control

In Table 4.15, paired samples t-test for experimental group with respect to IGO scores,

Table 4.15 Paired Samples t-test for Experimental Group with Respect to IGO Scores

	Paired Differences						
Pairs	M	SD	SE	*t*	df	*p*	*d*
IGO1-IGO2	-1.49	.008	.08161	-18.29	68	.000	-.366
IGO2-IGO3	.87	.068	.06820	12.75	68	.000	-.155
IGO1-IGO3	-.62	.009	.09023	-6.91	68	.000	.211

As seen in Table 4.15, paired samples *t* tests indicated a significant increase from pre-testing (M = 19.72, SD = 4.04) to post-testing IGO scores (M = 21.22, SD = 4.16)**,** *t*(68) = -18.292, $p < .05$ d = .366 which can be considered as a medium effect. Gravetter and Vallnau (2009) stated that Cohen's d can be a negative value however it is reported as a positive number in the mean scores of the IGO and a significant decrease from post-testing (M = 21.22, SD = 4.16), to retention-testing IGO scores (M = 20.35, SD = 4.08), *t*(68) = 12.750, $p < .05$ d = .155 small effect size , *t*(68) = 12.750, $p < .05$. Also there is a significant increase from pre-testing to retention testing. *t*(68) = -6.906, $p > .05$**.** Table 4.16 demonstrates paired samples t-test for control group with respect to IGO scores

Table 4.16 Paired Samples t-test for Control Group with Respect to IGO Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
IGO1-IGO2	.091	.384	.067	-18.29	32	.184	-.02
IGO2-IGO3	.212	.927	161	12.75	32	.198	.058
IGO1-IGO3	.121	.857	.149	-6.91	32	.423	.033

As seen in Table 4.16, there was not any statistically significant difference between pre-testing (M = 20.24, SD = 3.60), and post-testing IGO mean scores (M = 20.33, SD = 3.63), There also was not any statistically significant difference between IGO2 (M = 20.33, SD = 3.63), and IGO3 (M = 20.12, SD = 3.59). All *p* values were bigger than .05 i.e. $p > .05$. There also was not any statistically significant difference between pre-testing M = 20.24, SD = 3.60), and retention testing (M = 20.12, SD = 3.59)

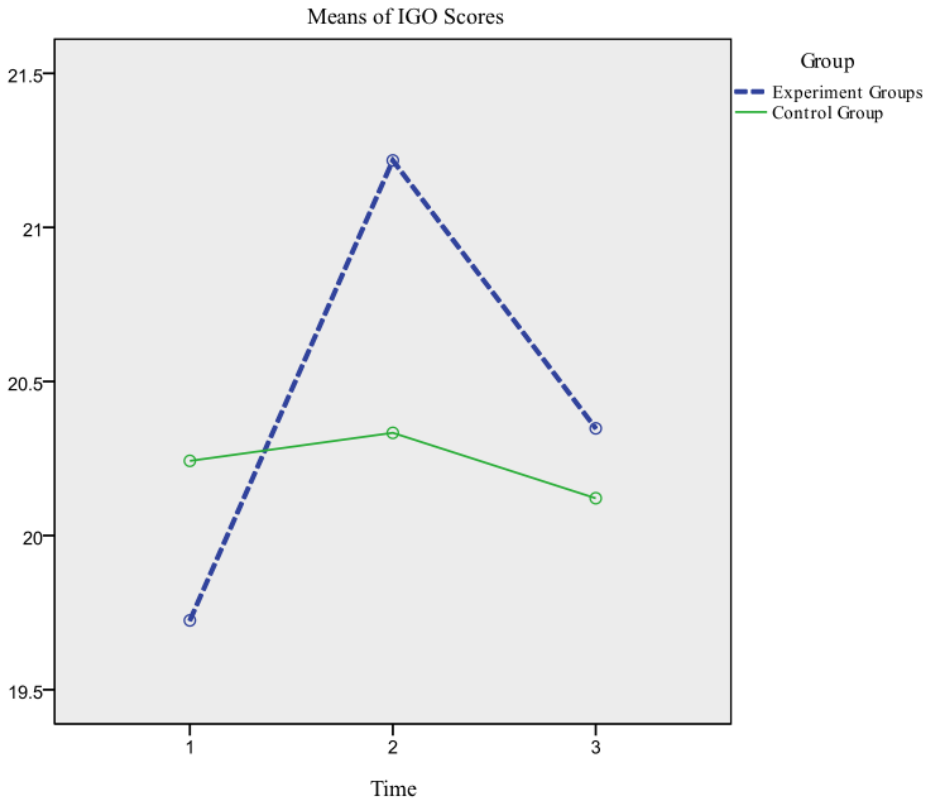

Figure 4.2 The Comparison of Estimated Marginal Means of Intrinsic Goal Orientation Scores Between Groups Across Three Time Periods

As seen in Figure 4.2, mean scores of IGO did not significantly change over time (see also table 4.16). However, mean scores of students in experimental group has significantly changed between time 1 and time 2, time 2 and time 3 and time 1 and time 3. Experimental group mean scores were the highest after post-testing but their mean scores decreased in the retention testing. However, their mean scores were higher comparing to the pre-testing (see Table 4.1)

4.2.4 Results Obtained from Extrinsic Goal Orientation Scores (EGO)

Univariate analysis produced a statistically significant main effect for time F(1.768, 176.82) = 19.49, p =.000 and η^2_P = .163. (*time effect*). Besides a significant time x group interaction was also found, F(1.77, 176.82) = 3.45 p =.040 and η^2_P = .033. (*time x group interaction*). See Table 4.17

Table 4.17. Univariate Test of EGO Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	49.82	19.49	1.77	176.82	.000	.163
Time x Group	255.57	3.45	1.77	176.82	.040	.033

For the main effects of time, between subjects contrast produced a significant result, $F(1,100) = 1.48$, $p = .027$, $\eta_p^2 = .048$ (group effect). Table 4.18 summarizes results of within subjects contrast for EGO scores.

Table 4.18 Tests of Within Subjects Contrast for EGO Scores

Source	Time	SS	F	df	*p*	η^2_P
Time	Pre-test vs Post-test	97.35	27.24	1	000	.214
	Retention vs Previous	1.72	1.48	1	.225	.015
Time x Group	Pre-test vs Post-test	22.34	121.95	1	.000	.549
	Retention vs Previous	6.09	.091	1	.764	.001

As seen in Table 4.18, within subjects contrasts have shown that pre and post EGO scores differed significantly. $F(1,100) = 27.24$, $p = .000$, $\eta_p^2 = .214$. A significant difference was also detected for time x group interaction between pre-test and post-test $F(1,100) = 121.95$, $p = .000$, $\eta_p^2 = .549$. On the other hand, previous and retention test scored did not differ significantly. Likewise, there is no statistically significant difference for the time x group interaction for the retention-test versus pre-test scores of EGO.

In order to see the difference between groups, an independent samples t-test was run to compare the means of extrinsic goal orientation scores between post-test and retention test scores see Table 4.19

Table 4. 19 Independent Samples t-test with Respect to EGO Scores

Variable	*F*	*p*	*t*	df	Sig	MD	SE	*d*
EGO2	4.07	.046	-1.77	100	.080	-1.27	.716	-.403
			-1.99	85.51	.049	-1.27	.636	
EGO3	7.71	.007	-2.60	100	.011	-2.10	.806	-.609
			-3.04	92.99	.003	-2.10	.688	

As Table 4.19 shows, Levene's test indicated that variances could not assumed to be equal since p < .05 for both analyses. There is a statistically significant difference in the mean scores of post-EGO between the experimental (M = 23.55, SD = 3.69) and control groups (M = 24.82, SD = 2.62). *t*(85.514) = -1.992, *d* = .403 For the retention test there is a statistically significant difference in the mean scores of EGO, the experimental (M = 22.75, SD = 4.25) and control groups (M = 24.85, SD = 2.65). *t*(92.981) = -3.043, *p* = .003 and *d* = .609 (a large effect size)

Paired samples t-test also was run to see the difference between post-test and retention test scores for both control and experimental groups. Table 4.20 gives related statistical data for experimental group below.

Table 4.20 Paired Samples t-test Results of Experimental Group with respect to EGO Scores

Pairs	Paired Differences						
	M	SD	*p*	*t*	df	*p*	*d*
EGO1-EGO2	-1.39	1.99	.239	-5.81	68	.000	-0.324
EGO2-EGO3	.79	1.77	.213	3.74	68	.000	0.202
EGO1-EGO3	-.59	1.23	.148	-4.02	68	.000	-0.129

Paired samples *t* tests indicated a significant increase from pre-testing (M = 22.16, SD = 4.88) to post-testing (M = 23.55, SD = 3.69)**,** *t*(68) = -5.81, *p* < .05, *d* = .324 in the mean scores of the EGO and a significant decrease from post-testing (M = 23.55, SD =

3.69) to retention-testing (M = 22.75, SD = 4.25) (see Figure 4.3), $t(68) = 3.74$, $p < .05$ $d = .202$ Also there is a significant increase from pre-testing (M = 22.16, SD = 4.88) to retention testing (M = 22.75, SD = 4.25), $t(68) = -4.02$, $p > .05$**.** $d = .129$

Table 4.21 displays the paired samples t-test results of control group with respect to EGO scores

Table 4.21 Paired Samples t-test Results of Control Group with Respect to EGO Scores

Pairs	Paired Differences						
	Mean	SD	SE	*t*	df	*p*	*d*
EGO1-EGO2	-.69	1.67	.29	-2.40	32	.022	-.266
EGO2-EGO3	-.03	.17	.030	-1.00	32	.325	-.01
EGO1-EGO3	-.73	1.70	.29	-2.46	32	.020	.-276

As seen in Table 4.21, paired samples *t* tests for control group indicated a significant increase from pre-testing (M = 24.12, SD = 2.64) to post-testing (M = 24.82, SD = 2.62)**,** $t(32) = -2.40$, $p < .05$ $d = .266$ which can be considered as small effect and a non-significant decrease from post-testing (M = 24.82, SD = 2.62) to retention-testing (M = 24.85, SD = 2.65), $t(68) = -1.000$, $p > .05$ $d = -.01$ very small effect size. Also there is a significant increase from pre-testing (M = 24.12, SD = 2.64) to retention testing (M = 24.85, SD = 2.65). $t(68) = -2.46$, $p > .05$**,** $d = .276$

The estimated marginal means of EGO graph illustrated that the mean scores of EGO in experimental group increased over time. Mean scores of EGO in experimental group also increased between the pre-test and post-test. However their mean scores decreased between post-testing and retention testing. As shown in Figure 4.3, mean scores of EGO in the experimental group almost remained same between post-test and retention-test.

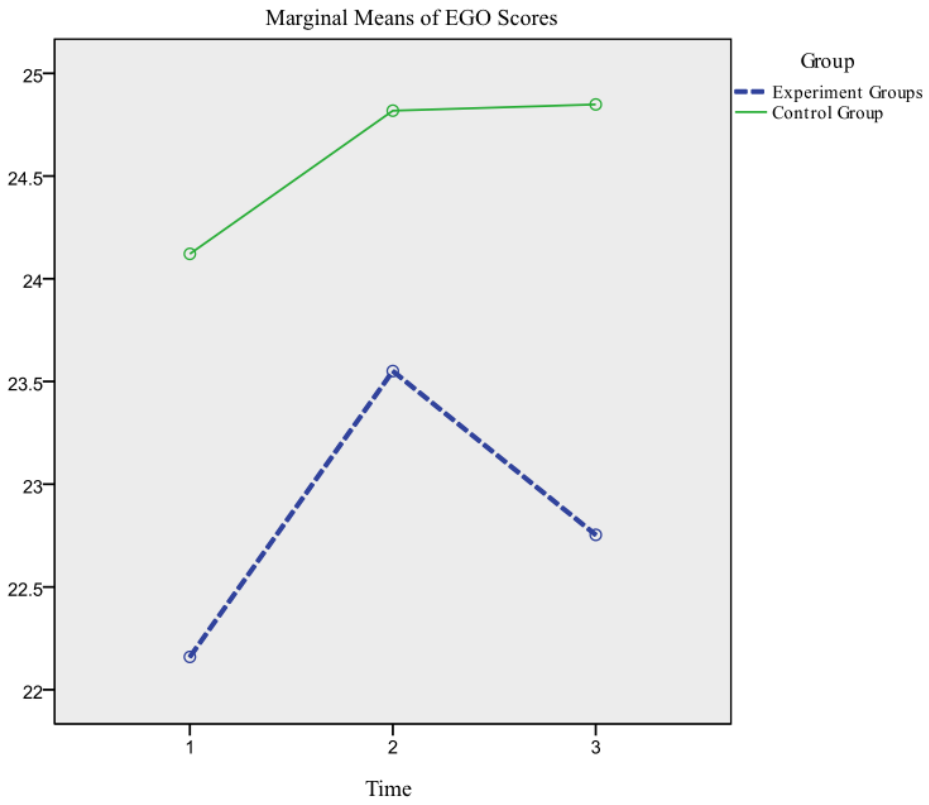

Figure 4.3 The Comparison of Estimated Marginal Means of Extrinsic Goal Orientation Scores Between Groups Across Three Time Periods

4.2.5 Results Obtained from Self-Efficacy for Learning and Performance (EFF)

Self-efficacy for learning and performance scores are analyzed for group, time and group x time interaction effects. Univariate results did not produce significant main effect for time $F(1.24, 1.88) = 59.46$ $p = .170$ and $\eta^2_P = .018$ (*time effect*) On the other hand, time x group interaction results revealed a significant difference, $F(1.24, 1.88) = 14.12$, $p = .000$ $\eta^2_P = .124$ *(time x group interaction)* Information is summarized in Table 4.22.

Table 4.22 Univariate Test of EFF Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	186.35	59.46	1.24	1.88	.170	.018
Time x Group	55.71	14.12	1.24	1.88	.000	.124

For the main effects of time, between subjects contrasts did not differ significantly; $F(1,100) = 1.481$, $p = .226$, $\eta_p^2 = .015$ (*group effect*). Results of within subjects contrasts for self-efficacy for learning and performance is shown in Table 4.23

Table 4.23 Tests of Within Subjects Contrast for EFF Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	253.16	57.58	1	.000	.365
	Retention vs Previous	89.64	63.86	1	.000	.390
Time x Group	Pre-test vs Post-test	4.69	1.06	1	.304	.037
	Retention vs Previous	5.33	3.80	1	.054	.011

As Table 4.23 for within subjects contrast have shown that pre and post EFF scores differed significantly $F(1,100) = 57.582$, $p = .000$, $\eta_p^2 = .365$. A significant difference was also detected between pre-testing and retention testing. $F(1,100) = 63.864$, $p = .000$, $\eta_p^2 = .390$. Interaction effect was found statistically insignificant.

Since there was no difference between groups, independent samples t-test also showed that, there was not a statistically significant difference for both post and retention test, between experimental and control groups respectively, $t(100) = 1.212$, $p > .05$ and $t(100) = 1.343$, $p > .05$ in the mean scores of self-efficacy for learning and performance. A paired samples t-test was run to see the difference among test scores of both the experimental group and control group (see Table 4.24)

Table 4.24 Paired Samples t-test Results of Experimental Group with respect to EFF Scores

Pairs	Paired Differences						
	M	SD	*p*	*t*	df	*p*	*d*
EFF1-EFF2	-1.91	1.96	.237	-8.07	68	.000	-.204
EFF2-EFF3	-.29	.92	.111	-2.60	68	.000	-.030
EFF1-EFF3	-2.20	1.77	.214	-10.28	68	.000	-.235

As given in Table 4.24, paired samples *t* tests indicated a significant increase from pre-testing (M = 40.57, SD = 8.95) to post-testing (M = 42.48, SD = 9.80)**,** *t*(68) = -8.073, *p* < .05 *d* = .204 in the mean scores of the EFF and a significant decrease from post-testing (M = 42.48, SD = 9.80) to retention-testing (M = 42.77, SD = 9.76), as seen in Figure 4.4, *t*(68) = -2.602, *p* < .05. *d* = .003. Also there is a significant increase from pre-testing testing (M = 40.57, SD = 8.95) to retention testing (M = 42.77, SD = 9.76), *t*(68) = -10.287, *p* < .05**,** *d* = .235.

Results of paired samples t-test for EFF scores of control group is shown in Table 4.25

Table 4.25 Paired Samples t-test Results of Control Group with respect to EFF Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
EFF1-EFF2	-.12	3.06	.533	-.23	32	.821	-.180
EFF2-EFF3	-.03	.39	.069	-.44	32	.662	-.003
EFF1-EFF3	-.15	3.27	.569	-.26	32	.792	-.185

As seen in Table 4.25, Paired samples *t* tests did not indicate significant difference from pre-testing (M = 38.64, SD = 7.68) to post-testing (M = 40.09, SD = 8.15)**,** *t*(68) = -8.073, *p* < .05 *d* = .204 in the mean scores of the EFF and no significant difference

from post-testing (M = 40.09, SD = 8.15) to retention-testing (M = 40.12, SD = 9.28), (as also seen in Figure 4.4), $t(68) = -2.602$, $p < .05$. $d = .003$. Also there is not any significant difference from pre-testing testing (M = 38.64, SD = 7.68) to retention testing (M = 40.12, SD = 9.28), $t(68) = -10.287$, $p < .05$**,** $d = .235$.

Marginal means of EFF scores are depicted in Figure 4.4

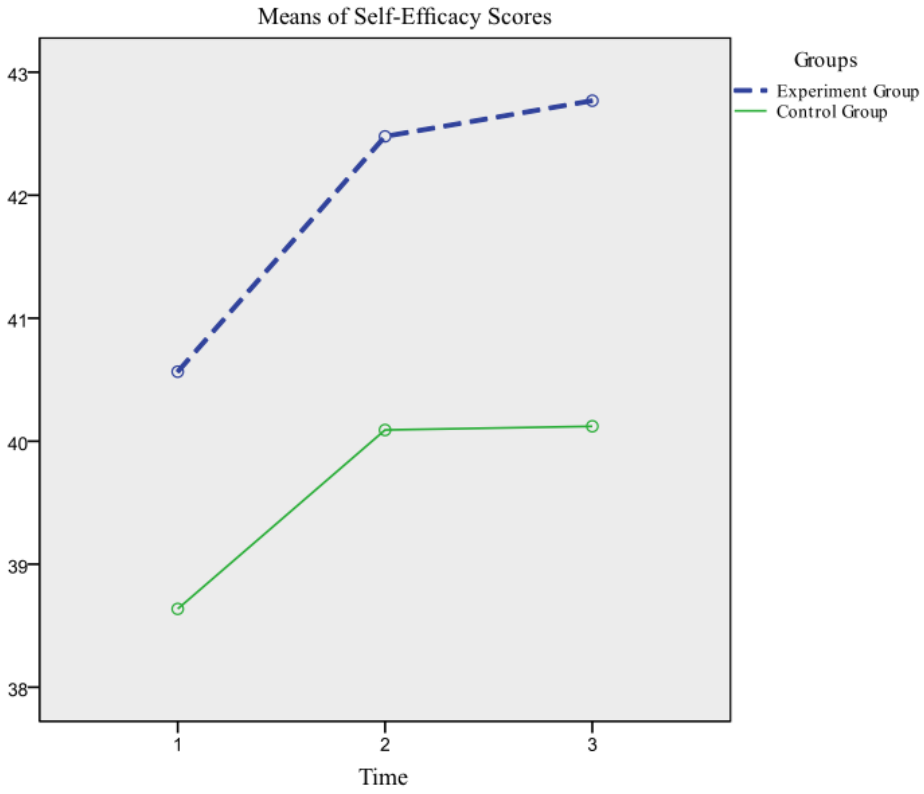

Figure 4.4 The Comparison of Estimated Marginal Means of Intrinsic Self-Efficacy Scores Between Groups Across Three Time Periods

As can be seen in Figure 4.3, the estimated marginal means of EFF graph illustrated that the mean scores of EFF both in experimental and control group increased between time1 and time 2. Mean scores of EFF in experimental group also fluctuated slightly between the second and third time periods whereas control group scores almost remained same between the second and third time periods.

4.2.6 Results Obtained from Elaboration Scores (ELA)

The researcher sought evidence to show if there is significant difference between groups those, who instructed with portfolio enriched activities and those who instructed with traditional methods in the mean scores of Elaboration across three time periods (*group effect*). Change in the mean scores of elaboration was also analyzed to detect time effect, if any *(time effect).* Besides, researcher also sought evidences if there is any significant change in the mean scores of elaboration across three time periods for both groups *(time x group interaction)*. Univariate test results for ELA is given in Table 4.26

Table 4.26 Univariate Test of ELA Scores

Source	SS	F	df	Error df	*p*	η^2_P
Time	21.20	12.88	2	200	.000	.114
Time x Group	27.28	16.58	2	200	.000	.142

A can be seen in Table 4.26, Univariate test, with group as between subjects and time as within subjects factors revealed a significant main effect for time $F(2, 200) = 12.88$, $p = .000$ and effect size was measured as $\eta^2_P = .114$ (*time effect*). Elaboration scores also differed significantly in terms of time x group interaction, $F(2,200) = 16.580$ $p = .000$, $\eta^2_P = .142$ (*time x group interaction*)

Tests of between subjects effects revealed non-significant results between the two groups; $F(1,100) = .399$, $p = .529$, $\eta_p^2 = .004$ (*group effect*). For the main effects of time, within subjects contrasts have shown that pre and post ELA scores differed significantly. $F(1,100) = 10.35$, $p = .002$, $\eta_p^2 = .094$

Results of tests of within subjects contrast for ELA are given in Table 4.27.

Table 4.27 Tests of Within Subjects Contrast for ELA Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	17.34	10.35	1	.002	.094
	Retention vs Previous	18.80	15.52	1	.000	.134
Time x Group	Pre-test vs Post-test	22.44	13.39	1	.001	.118
	Retention vs Previous	24.09	19.99	1	.000	.166

As seen in Table 4.27, a significant difference was also detected between post-testing and retention testing $F(1,100) = 15.52$, $p = .000$, $\eta_p^2 = .134$. A group by time interaction was also detected as statistically significant for the difference between pre-test and post-test scores, $F(1,100) = 13.39$, $p = .001$ $\eta_p^2 = .118$. Besides, there was a statistically significant time x group interaction between post-testing and retention testing for the mean scores of ELA scores. $F(1,00) = 19.99$, $p = .000$, $\eta_p^2 = .166$

There was not a statistically significant difference for both post and retention tests, between experimental and control groups respectively, $t(100) = -.886$, $p > .05$ and $t(100) = -.86$, $p > .05$ in the mean scores of ELA. However, it was found that there is a statistically significant difference in the mean sores of 7th grade students' ELA scores across three time periods time x group interaction a paired samples t-test was run to see the difference among test scores of the groups. Paired samples t-test was run for both groups (see Table 4.28 and Table 4.29). Table 4.28 shows paired samples t-test for experimental groups with respect to their ELA scores

Table 4.28 Paired Samples t-test Results of Experimental Group with respect ELA Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
ELA1-ELA2	-.94	1.36	.16	-5.57	68	.000	-.187
ELA2-ELA3	-.29	.93	.16	-3.27	68	.002	-.100
ELA1-ELA3	-2.20	1.78	.17	-8.67	68	.000	-.281

As given in Table 4.28, paired samples *t* tests indicated a significant increase from pre-testing **(**M = 26.41, SD = 6.90) to post-testing **(**M = 27.29, SD = 6.51) in the mean scores of the ELA**,** *t*(68) = -5.57, $p < .05$ $d = .187$, a significant increase from post-testing **(**M = 27.29, SD = 6.51) to retention-testing **(**M = 27.49, SD = 6.90) is also detected *t*(68) = -3.27, $p < .05$ $d = .100$. Also there is a significant increase from pre-testing **(**M = 26.41, SD = 6.90) to retention testing **(**M = 27.49, SD = 6.90) *t*(68) = -8.67, $p < .05$**,** $d = .280$

Table 4.29 shows paired samples t-test for control groups with respect to their ELA scores

Table 4.29 Paired Samples t-test Results of Control Group with respect to ELA Scores

Pairs	Paired Differences						
	Mean	SD	SE	*t*	df	*p*	*d*
ELA1-ELA2	.061	1.14	.199	.30	32	.763	.02
ELA2-ELA3	.030	1.21	.211	.14	32	.887	.06
ELA1-ELA3	.091	1.01	.176	.52	32	.609	.02

As shown in the Table 4.29, no significant difference was found among three pairs of measures in the means of ELA scores of the control group. Namely, There is not any

significant difference between pre-test (M = 29.55, SD = 5.83) and post-test (M = 30.42, SD = 5.39) scores of control group in the mean scores of elaboration. Similarly, there is not any significant difference between post-testing (M = 30.42, SD = 5.39) and retention testing (M = 30.67, SD = 5.98) and between pre-testing (M = 29.55, SD = 5.83) and retention testing (M = 30.67, SD = 5.98)

Marginal means of ELA scores of both groups is depicted in Figure 4.5

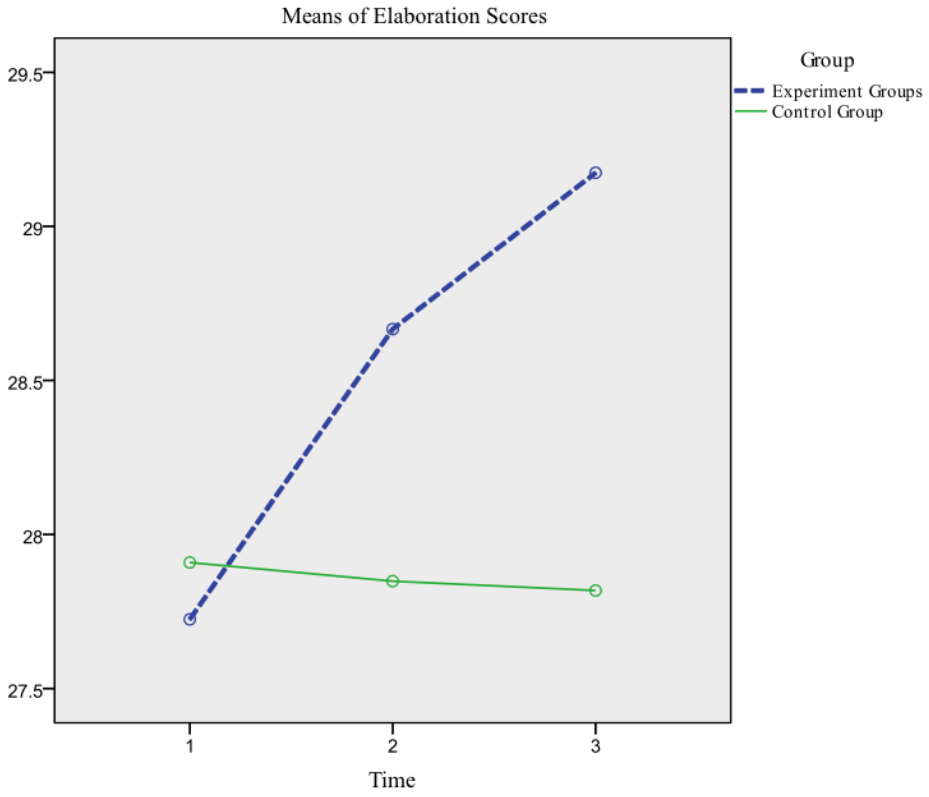

Figure 4.5 The Comparison of Estimated Marginal Means of Elaboration Scores Between Groups Across Three Time Periods

The estimated marginal means of elaboration scores illustrated that the mean ELA scores of the students in the control group did not change over time. However ELA scores of the students in the experimental group increased over time. According to the illustration in Figure 4.6, it can be said that after retention test, ELA scores of students in experimental group has reached to the highest score.

4.2.7 Results Obtained from Critical Thinking Scores (CRT)

Three main effects were also analyzed for critical thinking scores of the students. The researcher sought evidence if there is any significant difference in the mean scores of critical thinking scores between students those who have instructed with portfolio enriched activities and those who have instructed with traditional methods across three time periods? (Group effect). Mean scores of 7th grades' critical thinking scores across three time periods were also analyzed in order to catch a significant change if any. (Time effect). Besides, the researcher sought evidence if there is any change in the mean sores of 7th grade students' critical thinking scores across three time periods for the experiment and control group? (Interaction effect)

Univariate test results for CRT scores is given in Table 4.30

Table 4.30 Univariate Test of CRT Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	55.91	37.03	1.86	185.73	.000	.270
Time x Group	25.36	16.79	1.86	185.73	.000	.144

Doubly repeated MANOVA with group as between subjects and time as within subjects factors revealed a significant main effect for time $F(1.86, 85.73) = 37.03$ $p = .000$ and effect size was measured as $\eta^2_P = .270$ (*time effect*) which can be considered as a small effect size. Critical thinking scores also differed significantly in terms of time x group interaction, $F(1.86, 85.73) = 16.79$ $p = .000 < .05$, $\eta^2_P = .144$ (*time x group interaction*)

Tests of between subjects effects showed that there is a statistically significant difference between groups, $F(1,100) = 4.536$, $p = .036$, $\eta_p^2 = .043$ *(group effect).* Test of with subjects contrast is given in Table 4.31

Table 4.31 Tests of Within Subjects Contrast for CRT Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	111.33	94.78	1	.000	.487
	Retention vs Previous	.36	.261	1	.000	.003
Time x Group	Pre-test vs Post-test	50.63	43.10	1	.001	.301
	Retention vs Previous	.067	.048	1	.827	.000

As seen in Table 4.31, for the main effects of time, within subjects contrasts have shown that pre and post critical thinking scores differed significantly. $F(1,100) = 94.78$, $p = .000$, $\eta_p^2 = .487$. A significant difference was also detected between post and retention test $F(1,100) = .261$, $p = .000$, $\eta_p^2 = .003$. A group by time interaction was also detected as statistically significant for the difference between pre-test and post-test scores, $F(1,100) = 10.88$, $p = .001$ $\eta_p^2 = .098$. Besides, there was a statistically significant time x group interaction between pre and retention tests of the means of critical thinking scores. $F(1,00) = 43.10$, $p = .001$ $\eta_p^2 = .301$

To examine the mean difference between experimental and control groups with respect to critical thinking scores, an independent sample t-test was run. In Table 4.32 results of the independent samples t-test of the mean scores of critical thinking is shown.

Table 4. 32 Independent Samples t test Results with respect to CRT Scores

Variable	*F*	*p*	*t*	df	*p*	MD	SE	*d*
CRT2	3.24	.075	2.97	100	.004	2.74	.923	.672
			3.31	83.32	.001	2.74	.829	
CRT3	5.69	.019	2.11	100	.038	1.94	.919	.483
			2.40	87.34	.019	1.94	.809	

As Table 4.32 shows, there is a statistically significant difference for post testing between experimental (M = 21.96, SD = 4.73) and control groups (M = 19.21, SD = 3.46), $t(100) = 2.97$, $p > .05$ $d = .672$. There is a statistically significant difference for

retention testing between experimental (M = 21.06, SD = 4.76) and control groups (M = 19.12, SD = 3.28), $t(87.335) = 2.40$, $p < .05$ $d = .483$ in the mean scores of critical thinking. In the lights of information given above, in order to examine the change in the mean scores of students in both experimental and control groups over time, paired t-test were conducted. In Table 4.33, paired samples t-test for experimental group with respect to critical thinking scores are given.

Table 4.33 Paired Samples t-test Results of Experimental Group with respect to CRT Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
CRT1-CRT2	-1.87	1.12	.135	-13.82	68	.000	-.383
CRT2-CRT3	.899	1.56	.188	4.77	68	.000	-.190
CRT1-CRT3	-.971	1.22	.147	-6.58	68	.000	-.198

As can be seen in Table 4.33, paired samples *t* tests indicated a significant increase from pre-testing (M = 20.09, SD = 5.03) to post-testing (M = 21.96, SD = 4.73)**,** $t(68) = -13.82$, $p < .05$ in the mean scores of the critical thinking and significant decrease from post-testing (M = 21.96, SD = 4.73) to retention-testing (M = 21.06, SD = 4.76), $t(68) = 4.773$, $p < .05$ $d = -.190$. Also there is a significant increase from pre-testing to retention testing. $t(68) = -6.58$, $p < .05$, $d = -.198$**.** Paired samples t-test for the control group with respect to the mean scores of critical thinking is given in the Table 4.34.

Table 4.34 Paired Samples t-test Results of Control Group with Respect to CRT Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
CRT1-CRT2	-.36	.99	.173	-2.10	32	.044	-.103
CRT2-CRT3	.09	1.01	.176	.52	32	.609	.026
CRT1-CRT3	-.27	1.04	.181	-1.51	32	.141	-.077

As given in Table 4.34, paired samples *t* tests indicated a slightly significant increase from pre-testing (M = 18.85, SD = 3.50) to post-testing (M = 19.21, SD = 3.46)**,** *t*(32) = -2.10, $p = .044$ $d = -.103$ in the mean scores of the critical thinking and no other significant difference was found between pairs. The estimated marginal means of critical thinking scores is given in Figure 4.6

Figure 4.6 The Comparison of Estimated Marginal Means of Critical Thinking Scores Between Groups Across Three Time Periods

As shown in Figure 4.6, the estimated marginal means of critical thinking scores graph illustrated that mean CRT scores of students in control group did not almost change over time. On the other hand, mean scores of students in experimental group increased after the treatment period. However, mean scores of retention testing showed that there was a decrease between the post-testing and the retention testing.

4.2.8 Results Obtained from Peer Learning Scores (PL)

The researcher sought evidence if there is any significant difference in the mean scores of peer learning between students those who have instructed with portfolio enriched activities and those who have instructed with traditional methods across three time periods? (*Group effect*). Mean scores of 7th grades' peer learning across three time periods were also analyzed in order to catch a significant change if any. (*Time effect*).

Besides, the researcher sought evidence if there is any change in the mean sores of 7th grade students' peer learning scores across three time periods for the experiment and control group? (*Interaction effect*). Univariate results of PL scores is given in Table 4.35

Table 4.35 Univariate Test of PL Scores

Source	SS	*F*	df	Error df	*p*	η^2_P
Time	307.92	137.30	1.61	161.39	.000	.579
Time x Group	11.54	5.15	1.61	161.39	.011	.049

As can be seen in Table 4.35, univariate results showed that there is a significant main effect for time $F(1.61, 161.39) = 137.30$, $p=.000$ and $\eta^2_P = .579$ (*time effect*). And time x group interaction was also found statistically significant $F(1.61, 161.38) = 5.15$ $p=.000$ and $\eta^2_P = .049$ (*time x group interaction*) is summarized in Table 4.35

For the main effects of time, between subjects contrasts did not differ significantly; $F(1,100) = .665$, $p = .417$, $\eta_p^2 = .007$ (*group effect)* whereas for within subjects contrast have shown that pre and post PL scores differed significantly (see Table 4.36)

Table 4.36 Tests of Within Subjects Contrast for PL Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	614.44	261.67	1	.000	.724
	Retention vs Previous	1.04	.65	1	.422	.006
Time x Group	Pre-test vs Post-test	7.50	3.19	1	.077	.031
	Retention vs Previous	7.28	3.80	1	.008	.068

As can be seen in Table 4.36, $F(1,100) = 261.675$, $p = .000$, $\eta_p^2 = .724$ A significant difference was also detected between post-testing and retention testing $F(1,100) = 11.679$, $p = .008$, $\eta_p^2 = .068$ for the time x group interaction

As mentioned, tests of between subject effects indicated that there is no statistically significant difference in the means of peer learning scores between groups. Therefore, there was no need to run independent samples t-test. Accordingly, in order to examine the change in the mean scores of peer learning, a paired samples t-test was run. Table 4.37 gives related statistical data below.

Table 4.37 Paired Samples t-test results of Experimental Group with respect to PL Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
PL1-PL2	-2.74	1.40	.169	-16.25	68	.000	-.810
PL2-PL3	1.33	1.55	.182	7.33	68	.000	-.400
PL1-PL3	-1.41	.84	.102	-13.81	68	.000	.424

Table 4.37 depicts that paired samples *t* tests indicated a significant increase from pre-testing (M = 8.12, SD = 3.71) to post-testing (M = 10.86, SD = 3.55)**,** $t(68) = -16.25$, $p < .05$ $d = -.810$ in the mean scores of the PL and a significant decrease from post-testing (M = 10.86, SD = 3.55), to retention-testing (M = 9.52, SD = 3.29), $t(68) = -7.33$, $p < .05$. $d = -.400$. Also there is a significant increase from pre-testing (M = 8.12, SD = 3.71) to retention testing (M = 9.52, SD = 3.29), $t(68) = -13.81$, $p < .05$**,** $d = .424$. Paired samples t-test for control group was also run (see Table 4.38)

Table 4.38 Paired Samples t-test Results of Control Group with respect to PL Scores

Pairs	Paired Differences						
	M	SD	SE	*t*	df	*p*	*d*
PL1-PL2	-2.33	1.34	.233	-10.01	32	.000	-.702
PL2-PL3	.697	1.55	.270	2.58	32	.015	-.372
PL1-PL3	1.64	.96	.168	9.77	32	.000	-.173

As seen in Table 4.38, paired samples *t* tests indicated a significant increase from pre-testing (M = 8.91, SD = 3.55) to post-testing (M = 11.24, SD = 2.81), $t(32) = -10.01$, $p < .05$ $d = -.702$ in the mean scores of the PL and a significant decrease from post-testing (M = 11.24, SD = 2.81) to retention-testing (M = 10.55, SD = 3.31), $t(32) = 2.582$, $p < .05$. $d = -.372$. Also there is a significant increase from pre-testing (M = 8.91, SD = 3.55) to retention testing (M = 10.55, SD = 3.31), $t(32) = 9.768$, $p < .05$, $d = -.173$. The estimated marginal means of peer learning scores' graph is given in Figure 4.7

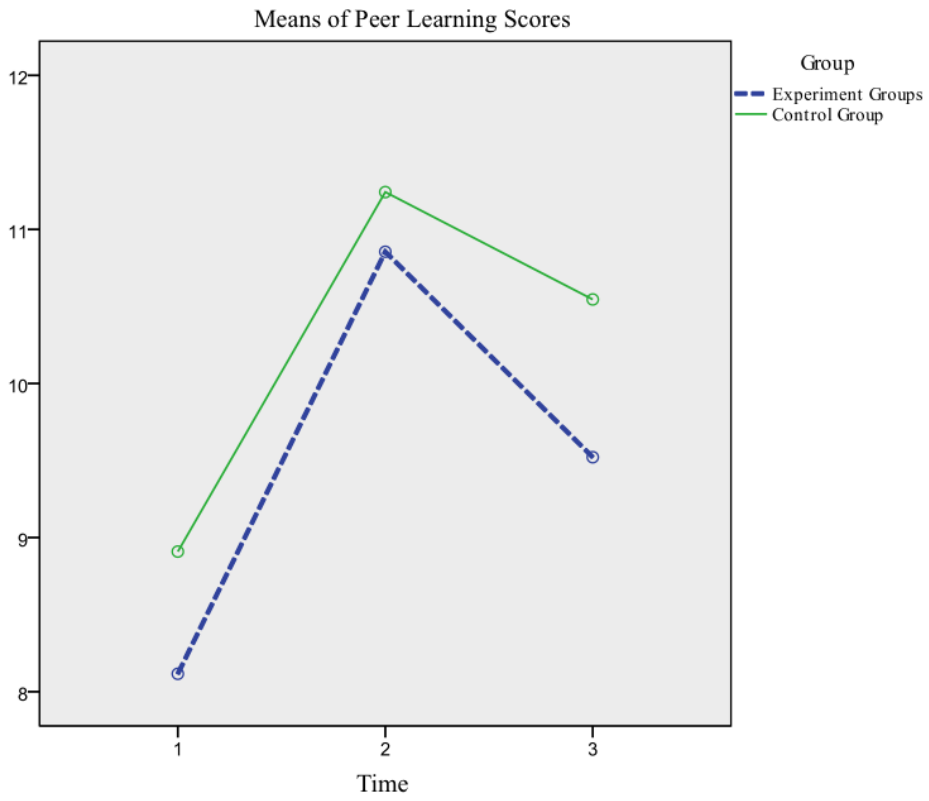

Figure 4.7 The Comparison of Estimated Marginal Means of Peer Learning Scores Between Groups Across Three Time Periods

According to the Figure 4.7, the estimated marginal means of peer learning scores' graph illustrated that mean PL scores of students of both control group and experimental group showed an increase between pre-testing and post-testing. But, mean scores of students in both groups showed a decrease in retention testing. Although scores of

students in experimental group were higher than the students in control group, mean difference between groups was not statistically significant.

4.2.9 Results Obtained from Metacognitive Self-Regulation Scores (MSR)

The researcher sought evidence if there is any significant difference in the mean scores of metacognitive self-regulation between students those who have instructed with portfolio enriched activities and those who have instructed with traditional methods across three time periods? (Group effect). Mean scores of 7th grades' metacognitive self-regulation across three time periods were also analyzed in order to catch a significant change if any. (Time effect). Besides, the researcher sought evidence if there is any change in the mean sores of 7th grade students' metacognitive self-regulation scores across three time periods for the experiment and control group? (Interaction effect)

Univariate test results of metacognitive self-regulation scores are given in Table 4.39.

Table 4.39 Univariate Test of MSR Scores

Source	SS	F	df	Error df	*p*	η^2_P
Time	415.34	18.33	1.36	191.81	.000	.155
Time x Group	388.52	17.14	1.36	191.81	.000	.146

For the main effects of time, a significant difference was found between groups. F (1,100) = 4.418, p = .000, η^2_P = .042 (*group effect*). Results of tests of within subjects contrasts is shown in Table 4.40.

Table 4.40 Tests of Within Subjects Contrast for MSR Scores

Source	Time	SS	*F*	df	*p*	η^2_P
Time	Pre-test vs Post-test	773.23	26.25	1	.000	.208
	Retention vs Previous	43.09	3.62	1	.060	.035
Time x Group	Pre-test vs Post-test	593.94	20.16	1	.000	.168
	Retention vs Previous	137.23	11.53	1	.001	.103

As can be seen in Table 4.40, there is a statistically significant difference between pre-test and post-test, $F(1,100) = 26.25$, $p = .000$, $\eta_p^2 = .208$. There was not statistically significant difference between post-testing and retention testing, $F(1,100) = 3.62$, $p = .060$, $\eta_p^2 = .035$. A significant difference was also found for time x group interaction for between pre-test and retention test $F(1,100) = 20.16$, $p = .000$, $\eta_p^2 = .168$ and for between post and retention test, $F(1,100) = 11.53$, $p = .001$, $\eta_p^2 = .103$.

Since it was detected that there was a statistically significant group effect an independent samples t-test was run to compare the means of mertacognitive self-regulation scores between post-test and retention test scores. Analysis is shown in the Table 4.41

Table 4.41 Independent Samples t test Results with Respect to MSR Scores

Variable	F	*p*	*t*	df	*p*	MD	SE	*d*
MSR2	5.37	.222	-2.58	100	.011	-5.28	2.04	4.54
			-2.58	89.07	.004	-5.28	1.78	
MSR3	4.89	.29	5.89	100	.000	-7.02	1.98	4.4
			6.57	83.56	.000	-7.02	1.74	

As Table 4.41 shows, there is a statistically significant difference between experimental (M = 54.87, SD = 10.66) and control groups (M = 60.15, SD = 7.13), $t(100) = -2.58$, $p < .05$ in the mean of post-MSR scores. Furthermore, there is a statistically significant difference between experimental (M = 53.25, SD = 10.27) and control groups (M = 60.27, SD = 7.08) in terms of retention testing for MSR scores, and $t(100) = 6.57$, $p < .05$.

Paired samples t-test also was run to see the difference among three pairs of measures of both the experimental and control group. Table 4.42 shows paired samples t-test for experimental group with respect to MSR.

Table 4.42 Paired Samples t-test Results of Experimental Group with respect to MSR Scores

	Paired Differences						
Pairs	M	SD	SE	*t*	df	*p*	*d*
MSR1-MSR2	-4.18	9.66	1.15	-3.62	68	.001	-.400
MSR2-MSR3	1.60	1.05	.126	12.68	68	.000	.154
MSR1-MSR3	-2.58	9.53	1.13	-2.27	68	.026	-.252

As shown in Table 4.42, paired samples *t* tests indicated a significant increase from pre-testing (M = 50.62, SD = 10.38) to post-testing (M = 54.87, SD = 10.66)**,** *t*(68) = -4.18, $p < .05$ $d = -.40$ in the mean scores of the MSR and a significant slight decrease from post-testing (M = 54.87, SD = 10.66) to retention-testing (M = 53.25, SD = 10.27), *t*(68) = 1.60, $p < .05$ $d = .154$ Also there is a significant increase from pre-testing (M = 50.62, SD = 10.38) to retention testing (M = 53.25, SD = 10.27),. *t*(68) = -2.58, $p < .05$**.** $d = -.252$. Paired samples t-test was also run for control group's MSR scores (see Table 4.43)

Table 4.43 Paired Samples t-test Results of Control Group with Respect to MSR Scores

	Paired Differences						
Pairs	M	SD	SE	*t*	df	*p*	*d*
MSR1-MSR2	-.39	.65	.11	-3.43	32	.002	-.190
MSR2-MSR3	.84	3.14	.54	1.55	32	.131	-.130
MSR1-MSR3	.45	3.29	.57	.79	32	.434	-.008

As given in Table 4.43, Paired samples *t* tests for control group indicated a significant increase from pre-testing (M = 59.76, SD = 7.42) to post testing (M = 60.15, SD = 7.13) , *t*(32) = -3.43, $p < .05$, $d = -.190$ in the mean scores of the MSR. There is not any statistically significant difference between post-testing (M = 60.15, SD = 7.13) and retention-testing (M = 60.27, SD = 7.08), in the mean scores of MSR, *t*(32) = 1.55, $p > .05$, $d = -.130$**.** Similarly, there is not any statistically significant difference between pre-

testing (M = 60.15, SD = 7.13) and retention testing (M = 60.27, SD = 7.08), , $t(32)$ = .79, $p > .05$, d = -.008. Figure 4.8 depicts the marginal means of MSR scores.

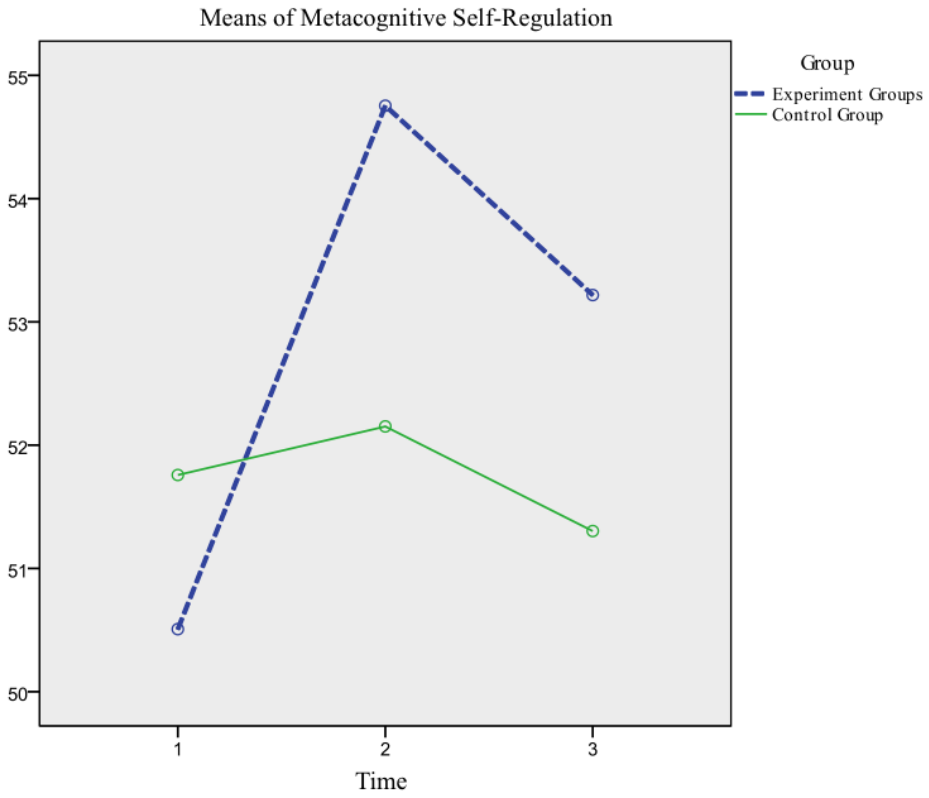

Figure 4.8 The Comparison of Estimated Marginal Means of Metacognitive Self-Regulation Scores Between Groups Across Three Time Periods

According to the figure 4.8, the estimated marginal means of metacognitive self-regulation scores' graph illustrated that mean MSR scores of students of both control group and experimental group showed an increase between pre-testing and post-testing. Mean scores of students in experimental group, showed a significant increase at the post-testing. Although means scores of MSR, decreased in both groups, mean scores of students in experimental group were higher comparing to the pre-testing scores.

4.3 Qualitative Findings

As mentioned earlier, subjects in experimental group were given two different tasks to select only one and each task was about the same objective. They were told to have 10

days to complete the task. They also wrote reflection papers about their experiences and gains. At the end of the process, researcher made an interview with each student to explore subjects' experience about the whole process. In this section, researcher will present interview results. These results will be presented under certain themes. To be more specific, researcher will try to explore students' experiences through their keeping portfolio process.

In this study two themes were detected. Themes and categories are shown in Table 4.44 below.

Table 4.44 Themes and Categories According to the Interview Results

Emotion	Strength	Weakness
Fun	Beneficial	Time Consuming
Love	Important	No weight in the evaluation
Surprising	Useful	Limits effective study time
Motivation		
Enjoyment		

4.3.1.Emotions

Spielberger (2004) defined emotions as anger, anxiety, sadness, embarrassment, happiness, love and sadness. Carlson and Hatfield, (1992) defined emotions as feeling declared with physiological, cognitive, and behavioral elements. Ekman (2003) offered some basic emotions as "anger, disgust, fear, happiness, sadness, surprise, amusement, contempt, contentment, embarrassment, excitement, guilt, pride in achievement, relief, satisfaction, sensory, pleasure and shame". As there is not a specific definition of emotion; "Behaviors elicited in the context of emotional picture perception also covary with motivational parameters" (Lang, Bradley and Cuthbert, 1998; Bradley,2000). From this point of view, during the conceptual content analysis, these emotions; fun, love and surprise and motivation considered to be counted under the theme of "emotions".

Fun is coded as an emotion in the study. Ekman (2003) defined amusement as a basic emotion, "fun" is considered as an emotional construct. Eighteen students out of 28 have expressed their emotions about portfolios as fun. Following scripts are exemplified these views:

> H.Ö said that "I really had fun while preparing a portfolio, it was different than our usual homework, I did not feel tired when doing this."

> Z.K said that "It was the funniest homework type I have ever done, all the activities were very entertaining".

> B.K said that "I wish I had homework like these for other courses, it was funny to keep a portfolio and complete tasks we were given."

> B. Ö said "While organising my portfolio, I had a great time which was not usual for me. Because drill and practice homework texts are not funny at all"

> A.R. said, "…preparing a portfolio was very funny because my friends and I were thinking different and we were feeling free to write and complete the task".

> L. C. "In my opinion, portfolios are the funniest homework ever"

The second category love was considered as an emotional construct stated by Spielger (2004). Seven of the students stated that they loved keeping a portfolio. Therefore, love is another category under the emotion theme in the study. Students stated that, they loved keeping a portfolio for various reasons such as sharing their works, improving handcraft and paintings. The following excerpts support these views.

> F.K said that "I love the idea of keeping a portfolio because in the future I will be able to show my grandchildren what I was doing in 7th grade".

> Y.N. said that "I loved the portfolio that we made because I have the chance to think different and improve handcraft"

> A.R.said that "I love portfolio tasks because I love painting and drawing. Portfolios gave me chance to paint and draw"

The third category which was explored under emotion theme is enjoyment. Seven of the students stated that they enjoyed the process as illustrated below:

L.N said that “Cultural buildings task was very entertaining for me, I knew that my grandfather’s historical knowledge was very good so I asked him to help me found a building and took its photo”

F.H said that “Most of the tasks were entertaining; I especially loved creating an envelope”

L,C. said that “At the end of the semester I was amazed. Actually we have learned a lot this year and my portfolio helped me to realize what we have done in 7th grade”

Ş.D. said that “I enjoyed and had great time while preparing portfolio tasks. They were not boring like any other tasks”

A.R. said that “I hope, in the 8th grade we will be collecting portfolios again because me and my friends had great time while preparing these tasks”

They enjoyed the portfolio activities since this was a great opportunity for them because they had great time. Some of the students stated that the process was entertaining and interesting.

Motivation is the fourth category for the emotion theme because Lang et al. (1998) stated that motivation is shaped by emotions, “Although emotions may come in many forms, shaped by genetics and learning to fit the demands of local context, their fundamental organization is motivational. Thus, their primary description is in terms of affective valence (i.e., appetitive or aversive) and arousal (intensity of activation)”. Five of the students stated that they were motivated during the treatment period. The following excerpt illustrated these views:

G.Y. said that “As I completed tasks and collected work in my portfolio, I was motivated for the next tasks because I wanted to add new tasks more to make it richer”.

A.İ. also stated that “These portfolio tasks made me like mathematics more, I feel motivated and want to study more”.

L.C said that “Portfolio tasks motivated me to study mathematics. I realized mathematics was fun”

> Ş. F. said that, " At the beginning I did not aware what we were doing or why we were keeping a portfolio. But then, I realized that I was enjoying it and reading chapters harder to achieve the task. Achieving task and adding it to portfolio was motivating me to study mathematics more"

Last category of the emotion theme is surprise. Surprise is defined as a basic emotion according to Ekman (2003). It is defined as being astonished, feel amazed or the feel of wonder (Webster, 2012). Five of the students stated that they found portfolio keeping process surprising as illustrated below:

> Y.N said that "In the final exam I was able to answer a question and I was surprised of being able to solve it. I have learnt this geometry rule while creating a game task. This is really amazing"

> L.C said that "At the end of the semester I was astonished. Actually we have learned a lot this year and my portfolio helped me to realize what we have done in 7^{th} grade"

> L.N said that, "I really had good time in the process. Portfolio tasks were very interesting and I enjoyed during the portfolio collecting process"

Below, Table 4.45 explains "emotion" theme according to the frequencies and categories.

Table 4.45 Categories under Emotion

Category	*f*
Fun	18
Love	7
Surprising	5
Motivation	5
Enjoyment	7

As seen in Table 4.45, emotion "fun" was expressed 18 times among 28 students. In other words "fun" was the most common emotion students shared. "Love" was another

category that was mentioned 7 times among student. Both “surprising” and “motivation” have been used 5 times by the participants to express their feelings.

4.3.2 Strength and Weaknesses

In this study, students’ perceptions through strength and weaknesses were explored. The researcher found that students’ perceive keeping a portfolio is very useful for future and some students mentioned that portfolio in mathematics class is very valuable because of the difficulty of mathematics. Students reported that, mathematics could be more engrossing with such activities and they would study mathematics harder for their portfolio. Besides students reported that, practice drill questions help them solve similar questions but portfolio tasks and keeping a portfolio showed them how to learn and remember mathematics. Students thought that “keeping portfolio” process was beneficial, important and useful.

4.3.2.1. Strength

Students have mainly used three words to explain their perceptions about the portfolio keeping process. Students generally used “Beneficial, important and useful” to explain the process. Eleven of the students perceived this process as “Beneficial”. The following scripts exemplified these views:

> M.H. said that “Actually I liked the idea of keeping a portfolio they were beneficial for our exams.
>
> S.T. said that “All tasks in this portfolio were very useful for me. Because mathematics does not need to be numbers only, according to me mathematics education should cover such activities alike in the portfolio. I think me and my friends would study harder mathematics if we were given such homework”.
>
> M. Y. said that, “According to me keeping a portfolio was more instructive and beneficial

“Important” was the second category under strength. Six of the students also specified that keeping portfolio was very important for them. Six of the students indicated that keeping portfolio process was important for them. These views of the students are exemplified below:

A.A said that “Keeping a portfolio was very important for me and with five words my portfolio experience can be defined as helpful, important, fun, useful and instructive”

F.K said that “The most important thing about keeping a portfolio is that tasks can help you to see how mathematics is used in real life”

E.A.said that “I have learned that equations in real life are commonly used in meteorology, dietetics and engineering. I think this is very important for mathematics because it tells us why we need to learn mathematics.”

Last category was identified as useful. Some students indicated that both portfolio tasks and keeping a portfolio was useful. Ten out of 28 students stated that they perceive keeping portfolio and tasks as “useful. Some of the expressions are given below:

Z.K said that “Portfolio tasks and keeping a portfolio were very useful for me because I have learnt very useful rules of geometry”

G.M said that “Portfolio tasks were more useful than any other homeworks”

L.N. said that “I think portfolio tasks were very useful since one thing I have learnt is I can use mathematics knowledge in real life. Keeping portfolio was very useful for me”

A.İ said that “I have made a compass rose as a part of the task and learnt a lot about symmetry. This task helped me to think detailed on symmetry. I guess I will be able to answer any symmetry questions in the final exam.”

H.B said that “One of our tasks were about hexagons and beehives and I was amazed at the time I have learned why bees prefer to construct hexagons instead of squares or circles. I found this pretty useful and it helped me to see the linkage between real life and mathematics.”

4.3.2.2 Weaknesses

In general, students reported that they had fun during the process. Also they have mentioned that the process was meaningful and instructive. When they are asked to identify advantages and disadvantages of the portfolio; almost all of them pointed out

that, portfolio tasks are time consuming and very demanding. Students stated that, portfolios should be considered as assessments and should have a weight in the evaluation process. In spite of this, students also indicated that they were willing to keep a portfolio. In addition to this, students also indicated that if portfolio would have graded this would help them study portfolio harder and rigorously.

In this study students also criticized the type of the homework since they were expected to complete standard drill and practice questions too. Students were asked to compare portfolio tasks and worksheets. Mostly, students concluded that they liked the idea of a portfolio and enjoyed preparing it. However they complained about questions asked in midterm and final exams since portfolio requirements and tasks were irrelevant with the tasks given. Students also reported that, if they had given an option to choose any kind of task, they would have selected portfolio tasks. Sample student responses are given below.

Time consuming is the first category under weaknesses of keeping portfolio. Students were asked to indicate difficulties and weaknesses of portfolio keeping process. Nine students indicated that this process was time consuming for them. The following scripts exemplified these views:

> H.M said that "Actually I liked the idea of keeping a portfolio because I enjoyed it, but other drill and practice questions were more beneficial for our exams and preparing a portfolio was time consuming"
>
> A.İ said that "Worst part of preparing a task is that it was time consuming"
>
> L.C. said that "I spent a lot of time to complete these tasks and besides, collecting and preparing this portfolio was a very time consuming process"

Another category was coded as "limiting effective study time". Students mentioned that these tasks were limiting their effective study time for other courses. Four of the students stated that keeping portfolio limited their effective study time and their responses are given below:

> R.E said that "I would have preferred to study for the exams instead of preparing portfolio tasks since studying were more effective and portfolio tasks were wasting my study time"

K.L said that “Since portfolio tasks have no weight in the evaluation it was limiting our study time since we have plenty of homework to do from other courses.”

Last category was found as “no weight in the evaluation”. Some students emphasized the importance of grading system. Hence their portfolio was not graded; they stated that they would study harder if portfolio had weight in the evaluation. Five of the students stated that excluding portfolio from the evaluation was a weakness. The following scripts are illustrated:

Ş. B. said that “Keeping a portfolio requires an important amount of time, all of the activities were time consuming and it was disappointing that it has no weight for our grades”

İ. Y. said that “Drill and practice worksheets were not taking that long time, but portfolio completing was very time consuming and it was a shame that our teacher told us that we would not get any extra point”

D.D. said, “ I wish I could complete more tasks and get a grade or any extra point because it was fun. All tasks were taking longer time than usual. If it had a weight in the evaluation I might want to keep portfolios for all courses”

Table 4.46 demonstrates the frequencies of how students perceived keeping a portfolio according to its strengths and weaknesses.

Table 4.46 Frequencies of the Answers Related to Students’ Perception of Strength and Weaknesses of Keeping Portfolio Process

Categories	*f*
Strength	
Beneficial	11
Useful	10
Importance	6
Weakness	*f*
Time Consuming	9
Limits effective study time	4
No weight in the evaluation	5

According to Table 4.46, it can be seen that 11 of the students found treatment as a beneficial process, 10 of the students stated that keeping portfolio was useful and 6 of them said that the process was important for them. On the other hand, some students (9 out of 28) stated that treatment was very time consuming. Four of the students indicated that completing portfolio tasks were limiting their effective study time. Besides, 5 of the students stated that weakest part of this process is that portfolio did not have weight in the evaluation.

4.4 Variation of Portfolios According to Sources

In this section, variation of portfolios according to the sources, which were used by students in experimental group, will be examined. The researcher has identified three main sources that students took advantage; Internet, textbook and peers.

Students mainly stated that they used Google, Google images, YouTube, newspapers to collect ideas before completing tasks. Some of them also mentioned that they both looked up Turkish and English websites. They especially underlined that Google images has helped them a lot. In student portfolios, there were a few students that did not look up on Internet. Besides, students stated that they used their textbooks to recall information. For the peer-based category, it was explored that students mainly asked help from their mothers, fathers, neighbors and cousins. In this section related scripts will be displayed.

4.11.1 Internet Based

Students completed portfolios mainly by using 3 different sources; Internet, book and peers. Students mostly preferred using Internet to search key terms via Google or Bing. For instance; in the Tangram task, students mostly used Google images to create shapes by using Tangram pieces.

> L.S said that “Before starting to complete the task, I always checked web. I wrote the name of the task and searched for related pages. I also checked the images for useful ideas.”

A.Y. said that “I look it up on the Internet, there were lots of images, in a website, I found that anything could be formed with these pieces, so I wanted to create cats and rabbits”

Ö.Y. said that “Google was the most important tool in this task, I always used Google to help me and it really did” Ö.Y

K.L said that “I drew my dream car by using Google images, it helped me a lot”

(see Figure 4.9)

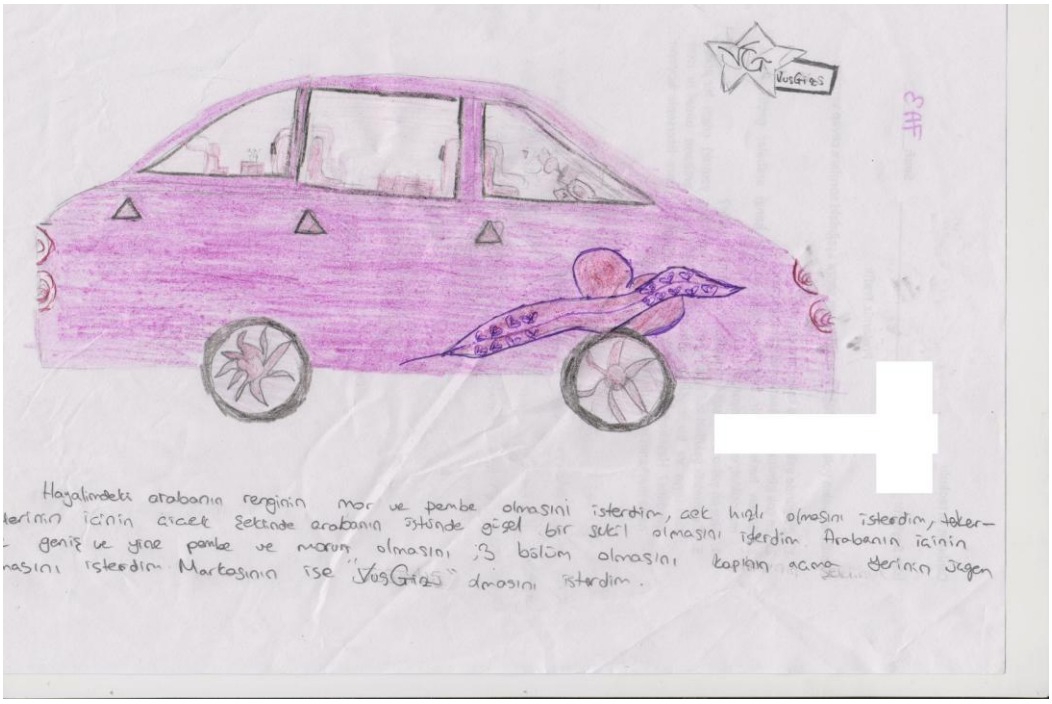

Figure 4.9 Sample Student Work from Imagine and Drive Task

In this work of the student she tried to use triangles, rectangles and circles to draw her dream car.

4.4.2 Textbook Based

Some of the students used textbooks to complete a task. At the same time, some participants have used other books to make research and quotate. For instance,

A.A said that “When I was expected to complete the task “create a game”, my first attempt was looking up my mathematics books and mathematics exercise books. In my textbook, there was a section at the end of the chapter, “Did you know this”. And I then created a game. Textbook helped me to create this game”

M.A. said that “I created symmetrical shapes by reading the related chapter of a friend’s textbook. According to the book, I fold a paper into two and draw a shape’s half part onto it a tree, star, heart, car and butterfly. Then I only cut it off and a symmetrical shape was formed”

In Figure 4.10, there is a sample student work of M.A

Figure 4.10 Sample Student Work for the Snowflakes Task

In Figure 4.10, the student used a textbook to create symmetrical shapes by using colorful papers. She also drew axis of symmetry for some of the forms she created.

4.11.2.2 Peer Based

In this section “peer” word has been used to indicate another person his/her social environment; including mothers, sisters, neighbors, friends and etc.

> “Cultural buildings task was very entertaining for me, I knew that my grandfather’s historical knowledge was very good so I asked him to help me found a building and took its photo” L.N (see Figure 4.11)

> “ I prepared interview questions with my sister, she helped me to design an interview, we asked questions like what was the most compelling math subjects when you are in middle school, how was life could be without mathematics” A.K.

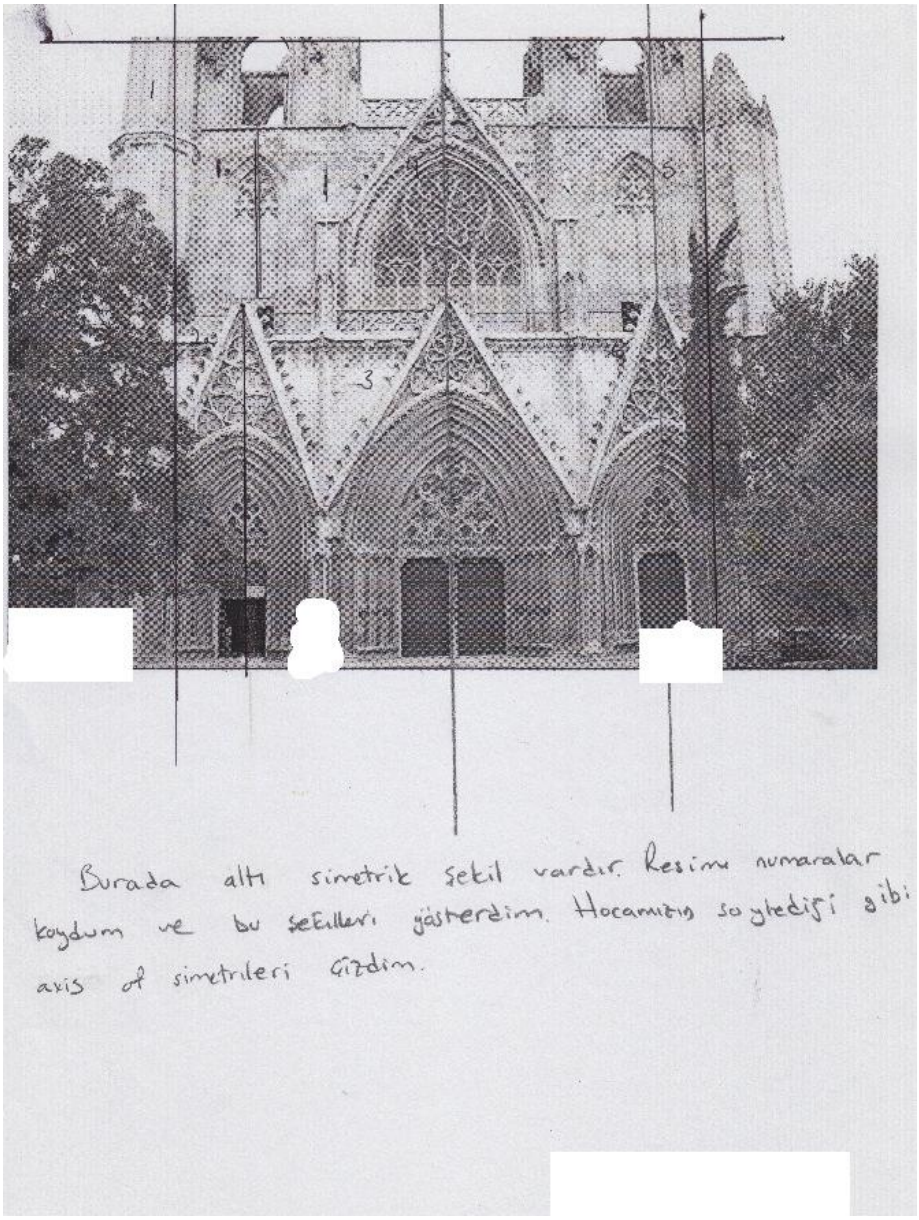

Figure 4.11 A Sample Student Work from Cultural Buildings Task

As shown in Figure 4.11, student took a cultural building (located in Famagusta, North Cyprus) and stated axes of symmetries.

CHAPTER 5

DISCUSSION, CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS FOR THE STUDY

In this chapter, the researcher will explain the reasons of findings and implications. Possible reasons of results and future implications will also be discussed. Main purpose of this study is to explore the effects of using portfolio enriched activities on students' mathematics achievement, motivation and learning strategies.

5.1 Effect of Portfolio-Enriched Instruction on Mathematics Achievement

In this study, it was found that students who were taught with portfolio-enriched instruction achieved mathematics statistically significantly better than the students who were taught with traditional instruction. Similarly, Ediger (1998) claimed that portfolio use might increase students' mathematics achievement if portfolios and other measurements were used together. Owings and Follo (1992) found that students who were measured with portfolio assessment could succeed better since they would make connections between their failures and successes. Rhodes (2011) also found that using portfolio, fosters learning and empowers students' student growth. Knight, Hakel and Gromko (2008) found that undergraduate students with e-portfolio artifacts achieved better than the other students who did not keep e-portfolio.

It should also be noted that mathematics achivement was measured with a multiple-choice test and chapters were Percentages, Inequalities, Geometry Spatial Visualization, Triangles, Circle and Right Cylinder. Therefore, students in experimental group performed better both in post-testing and retention testing with a large effect size containing the chapters listed above. Portfolio tasks were created according to the

objectives of the chapters, included in the study and students were supposed to read to be able to complete the tasks. This significant difference might be due to the extra effort of students to learn the objective to be able to complete the tasks. Besides, since some of the students stated that they found the process funny, they might have learnt the material easier and more effective. As mentioned, retention testing also produced significant results in favor of the experimental group, activities might help students to go over the information repeatedly in order to learn the objective to be able to complete the task and this might probably helped students to improve their mathematical knowledge. Dreissen et al. (2007) also found that students are more likely to succeed if they have enough time to study on the material. Qualitative data in the present study also points similar findings. Some of the students also indicated that they had to spend more time on studying to be able to complete tasks and they also expressed that studying longer time than the usual helped them to learn better.

5.2 Effect of Portfolio-Enriched Instruction on Motivation

In this section, findings related with intrinsic goal orientation, extrinsic goal orientation and self-efficacy for learning and performance will be discussed.

Researcher could not find a significant difference for the IGO scores between the groups in the study. However it should be noted that a slight increase in scores of the experimental group was reported in the study. Although there is not any significant difference over three time periods in IGO scores, a moderate effect of the treatment was found in post-testing, whereas control group remained same across three-time periods. In other words, scores of students in experimental group were improved; such as (for pre testing, $M = 19.72$, $SD = 4.04$, for post-test $M = 21.22$, $SD = 4.16$ and for retention testing, $M = 20.35$, $SD = 4.08$). On the other hand, mean scores of control group was almost stable (for pre testing, $M = 20.24$, $SD = 3.60$, for post-test $M = 20.33$, $SD = 3.63$ and for retention testing, $M = 20.12$, $SD = 3.59$). Therefore treatment might have affected IGO scores since experimental group's IGO seems to be improved though, there is not any statistically significant difference between groups.

As Kiessel, Besim and Tozan (2011) suggested, Turkish Cypriots live in a consumerist culture that wealth, physical appearance and social status are important and this might

have led students not to set intrinsic goals. Besides, students might be seeing mathematics as a one-solution process; and this might obstruct them to value for a deeper learning in mathematics . However as Hruska (2011) affirmed, finding a best solution instead of finding an absolute solution might help students' to set intrinsic goals. On the other hand, Yari (2000) emphasized that students' intrinsic directions might be related with the structure of instruction. And as he mentioned, if more choices of tasks were offered to students, enjoyment and interest in learning might have increased. In this study students were offered to select 7 tasks among 17 tasks to complete. Perhaps, students might not like, or find all tasks intriguing and they might have felt lack of sense of control. In other words, students might not have found a task, which would help them to complete tasks for their own sake.

Another possible reason to these insignificant results might be due to the positive learning environment in the class or school. As Dewey (1933) stressed, student-teacher contact is important. He stated that, habits of the teachers can influence the learning environment. Therefore, students' intrinsic needs might not be fulfilled related with the cultivation of the teacher

According to the findings of this study, extrinsic goal orientation mean scores were found significantly higher in the experimental group. Treatment had a moderate effect for the post-testing scores. Besides, retention testing produced a large effect size between groups on the extrinsic goal orientation scores. This might due to several reasons. As it was mentioned before, Turkish Cypriots live in a consumerist environment where social status is very important and this result might be due to students' extrinsic needs. Deci and Lens (2006) stated that setting intrinsic goal is different than setting an extrinsic goal. As an example intrinsic goals can be related with the individual growth, whereas extrinsic goals can be related to reputation or economic success. Thus, students in experimental group might have used their portfolios to boast about their success to their friends, family or teachers.

Birenbaum and Rosenau (2006) also found that using portfolios increased subjects' motivation in terms of IGO and EGO. Over and above, students especially stated that they loved the idea of keeping a portfolio to show another people what she/he is capable of doing. In Turkish Cypriot community, people tend to compare themselves to others. Besides, for Turkish Cypriot people, others thoughts and opinon on them is more

important than how they feel or think about themselves. As Kesici and Erdoğan (2010) suggested, students attach importance to social comparison, and this may obstruct them to set an objective criteria related to the motivation for achievement. Bandura (1997) states that if one lacks significant prior experiences with the task at hand, social comparison gains a critical importance. Although students were instructed by both non-conventional and traditional methods in the process, they were administered a normative comparison. Since normative comparison may prevent a student to achieve his/her potential difference and may lead a person to set extrinsic goals. Portfolio is a personal collection of work and concrete evidence that a person may exhibit his/her own personal style. In such a competitive system these students might be exposed to a comparison among their friends with respect to their grades. Therefore students might have attached more importance to achieve a better grade, having a reward or comparing his/her performance to other classmates or students. These kind of behaviors might have given rise to set extrinsic goals.

Getting a good grade is an important issue for Turkish Cypriot parents. Besides parents tend to give rewards to their children in case of a high grade. This attitude might lead students to set extrinsic goals instead of setting intrinsic goals.

In this study, self-efficacy scores did not differ significantly between experiment and control groups. Besides, the researcher could not find any significant change over time. However, Kovalchik, Melman and Elizabeth (1998) found that portfolio is a facilitator of self-efficacy skills for pre-service teachers. This result might be due to the classical classroom setting or parental communication since Bandura (1997) stated that building self-efficacy requires building a person's beliefs on his/her capabilities. Therefore, a student might need to be persuaded that he/she can succeed or has capability of succeeding. Hinton, Simpson and Smith (2008) claimed that peer modeling and social persuasion are important factors in order to enhance a person's self-efficacy skills. Hence, maybe these insignificant results might be explained with the lack of social persuasion that might be originated from the teacher, researcher or parents. Perhaps students might not be persuaded to believe what they were capable of succeed.

Bleeker and Jacobs (2004) found that self-efficacy abilities are highly correlated between mothers' perception of how they consider their children mathematics career and self-efficacy. On the other hand, D'amico and Cardaci (2003) found that children of

lower socio-economic status families have lower self-efficacy. Students' parents in this study were mainly from low or middle class. This result might be due to their parents' socio economic status. On the other hand, it should be noted that despite the insignificant differences between groups, experiment groups showed a positive progress in the process i.e. their post-test and retention test score means were higher than the pre-test scores, for pre-testing M = 40.57, SD = 8.95, post-testing M = 42.48, SD = 9.80 and M = 42.77, SD = 9.76. As the mean scores suggests, students in experimental group have scored higher in both pre-testing and retention testing when compared to pre-testing. Control group also scored better in both pre-testing and retention testing (pre-testing M = 38.64, SD = 7.68, post-testing M = 40.09, SD = 8.15 and M = 40.12, SD = 9.28). However mean EFF scores of experimental group remained higher for post and retention testing.

5.3 Effect of Portfolio-Enriched Instruction on Learning Strategies

In this section, findings for critical thinking, elaboration, peer learning and metacognitive self-regulation scores will be discussed according to the results.

Findings revealed that portfolio-enriched instruction were found significant between groups both in post and retention testing on critical thinking scores with large and moderate effects respectively. Literature also supports the effect of using portfolios in order to improve students' critical thinking skills (Coleman et.al, 2002; Smakin & Francis, 2008)

In this study, students were asked to put effort for each task. These tasks were all based on researching or studying. Portfolio activities might have given children time and opportunities to think critically and this might have helped them to think critically to be able to complete tasks. As Samkin and Francis (2008) stated portfolio tasks create intention to understand the material, interact critically and relate ideas to previous ones in order to draw conclusions.

In the present study students were encouraged to write freely about what they have done or how they have felt during the process. As Samkin and Francis (2008) found that creative thinking could be encouraged through free writing. For instance, one of the activities was requiring students to "Create a game" by using geometry, algebra and symmetry rules. To be able to complete this task, students were supposed to research

and list the rules in geometry, algebra and symmetry. Therefore this might led them to research and comprehend related particular rules. Similarly, Carlson, Floto and Mays (1997) also have found that assessing students' activities, which make students an active researcher and learner, have made students cognizant of the fact that mathematics is the part of everyday life. They stated that involving them physically in this process helped students to think critically and increased their awareness about multiple solutions and different thinking strategies, which are valid and accurate for problem solving or completing a task in mathematics. These results might also be valid for the present study.

Students in experimental group mostly emphasized that; these portfolio activities (tasks) helped them to see alternative ways of solving a problem. Besides, students also underlined that, they needed to make their own plan and organize what they have learnt in order to complete the tasks.

Qualitative data in the presents study also supports the results of statistically significant findings about critical thinking. Most of the subjects stated that certain activities made them to think different and find a solution. They also stated that practice and drill tasks were just helping them to memorize the solution way however they stated that they had fun while preparing these tasks because they considered mathematics in a different way and had to think in a different way for the tasks. Besides subjects pointed out that mathematics could be fun and mathematics have spaces to let them think creative. These thoughts of some students might lead to these significant differences between the two groups. Furthermore, these results might be due to the teacher's and the researcher's guidance through the process.

In this study a significant difference was found between groups in terms of metacognitive self-regulation scores. Besides metacognitive self-regulation mean scores were found significant across three time periods within the experiment groups. During the process, students were free to study (which means they were free to make research and complete tasks as they would like to) and think creative. Since students were encourged to complete tasks as they wished to, this might helped them to regulate their learning strategies. Conversely, Karakaş and Altun (2011) could not find a statistically significant effect of portfolio use on students'metacognitive self-regulation skills. This

might be due to their treatment period which was shorter compared to this study. Hence these significant results might be due the longer treatment period.

Students were able to reach their collected products during the process, which might have helped them to evaluate their growth, follow their learning progression and witness personal development by reflecting learning outcomes in reflection papers. This might have helped to improve their metacognitive self-regulation strategies. Similarly, project coordinator in Vrije Universiteit Amsterdam portfolio agreed: 'Portfolios give students the chance to reflect and make the reflection and the learning process or progress visible'. With respect to metacognitive elf-regulation, she argued that the tension between what students had to do and what they were free to do was important (as cited in, Beishuizen, Van Boxel, Banyard Twiner, Vermeij & Underwood, (2006).

Peer learning was another dimension in the learning strategies scale. In this study peer learning was used to refer collaboration among peers such as; classmates, sisters, neighbors, etc. Portfolio-enriched instruction has a positive influence on peer learning scores of experimental group, although it was not statistically significant. Insignificant results might be due to the students' insufficient interaction or communication. Considering the lack of public transportation and dense study hours in the school, students might not have any chance or opportunity to interact with each other. Furthermore, parent approval is also an issue for 13-14 year old students in order to meet and study together. Therefore insignificant results can be explained through the stated reasons and it can be concluded that peer learning is not a simple parameter and has many factors in it. Although results were found statistically insignificant, students have improved their peer learning skills according to the measures; since pre-testing mean scores of the students in experimental group was lower than post-testing and retention testing e.g. for pre-testing M = 8.12, SD = 3.71, post-testing M = 10.86, SD = 3.02, retention testing, M = 9.52, SD = 3.29.

Results also revealed insignificant results in the mean scores of elaboration. There was not any statistically significant difference between groups. On the other hand, students in experimental group have improved their elaboration scores over time with relatively small effect size, (for pre-testing, M = 26.41, SD = 6.99, for post-testing M = 27.29, SD = 6.51, retention testing M = 27.49, SD = 6.90). Similarly control group also improved

their elaboration scores (for pre-testing, M = 29.55, SD = 5.83, for post-testing M = 30.42, SD = 5.39, retention testing M = 30.67, SD = 5.98).

This insignificant results might be due to the reason that teacher mainly preferred to use traditional way of teaching and paper and pencil tests. Students might have tried to recall facts or algorithms instead of understanding conceptually. In other words, students might have studied, based on rote learning. Teacher might have focused on algorithmic procedures rather than concentrating on conceptual understanding. Segal, Chipman and Glaser (1985) found that using related materials and laying stress upon the conceptual learning in the classroom help children to learn and keep information for long term. Segal et. al (1985) also emphasized that this kind of instruction requires a large amount of time which is the most important factor in planning education. Thus, this insignificant finding also might be due to the planning of the course, since teachers are expected to follow a predetermined curriculum, which has a strict schedule. To be able to fulfill the requirements of the curriculum, teachers might not teach in detail since there is a deadline for the curriculum. Therefore, class periods might not be long enough to focus on fulfilling the curriculum deadline. In the same way, since students have loads of homeworks and a busy schedule, they might not have studied with care and in detail and this might be the reason that students could not improve their elaboration skills.

5.4 Conclusions

Conclusions stated here can be broaden to other settings provided that conditions are the same with this study. Conclusions of the study are as follows:

- Students are more aware of the importance of mathematics.
- Portfolio enriched instruction helped students to increase their mathematics achievement and intrinsic goal orientation, extrinsic goal orientation, self-efficacy, elaboration, critical thinking, peer learning and metacognitive self-regulation skills.
- Students in experimental group were more active than the students in control group since students in experimental group has made more research on a specific objective
- Some students had difficulties during the process since they were not able to reach a computer or Internet connection.

- Government schools are not well equipped and could not even offer computer education in schools. Such a deficiency may directly affect students' academic performance, motivation and learning strategies since technology offers great opportunities in order to enhance peer learning, mathematics achievement and critical thinking. Simpson (2010) found that integrating technology into instruction increase student's peer learning and critical thinking skills.
- Portfolio-enriched instruction requires teachers to spend more time on planning.
- Portfolio-enriched instruction requires more periods of mathematics course in a week.
- Portfolio- enriched instruction strengthens the communication among students.
- Portfolio- enriched instruction strengthens teacher-student and student-student interactions.
- Lack of measurement experts in the schools is also a problem that should be handled as soon as possible.

5.5 Implications

Some suggestions emerged according to the results of the study and some educational implications became apparent. In this study the researcher investigated the effects of a portfolio-enriched instruction on motivation; IGO, EGO and EFF and learning strategies; ELA, CRT, PL and MSR. Portfolio-enriched instruction can be used to improve students' mathematics achievement. Besides, teachers can use portfolio-enriched activities in order to help students make connections between real life and mathematics. To promote students' personal growth student portfolios can be evaluated or can be added to the cumulative weight in mathematics. In order to help teachers to guide their students through learning strategies a meta-curriculum can be prepared with added details about the mathematics in real life. Besides a handbook can be prepared for teachers with enriched activities. In addition to this, textbooks can be rearranged with enriched activities to help students be an active learner. School settings should also be considered to guide students more effectively. For instance, teachers should arrange

office hours for students since teachers in North Cyprus do not offer office hours and students hardly find opportunities to take advice and ask questions for help. In addition to this, most of the government schools in North Cyprus are ill-equipped in terms of computer and internet options and related provisions can be made to obtain technological support for schools in order to help students improve their research skills and learning strategies.

Mathematics teacher should work collaboratively and develop questions for measuring critical thinking skills to avoid asking questions including only algorithmic solutions. In connection with this, measurement and evaluation experts should be appointed to the schools in order to help teachers generate set of questions. Besides, teachers from different disciplines can work together to enrich their instruction with related data from other courses. Namely, thematic approach across courses can be designed in order to help students for meaningful learning.

In order to explore students' need to be able to educate them better, help from parents should be asked since use of portfolios and similar process-oriented tools and guiding students through their education process should be built upon a better background. Furthermore, teachers should pay extra attention to use class activities that involves active learning, which students can also learn collaboratively from their peers.

5.6 Recommendations for Future Research

The value of portfolios is emphasized in the curriculum in two dimensions; evaluation and instruction. However it should be considered and implemented by all teachers. Applying portfolio-enriched activities for other courses should also be considered in order to test effectiveness of portfolio.

In this study only learning portfolios were used to test its effectiveness. A study also can be conducted in a similar setting that both teacher and students keep a portfolio in order to make comparisons between these portfolios. Teachers are recommended to help children to value mathematics in their daily lives in the curriculum. However, some teachers might not be considering this point. In such a case,

The main recommendation of this study for future research is about replicating this study for all types of schools and classes. This study should be replicated with larger sample sizes and for longer periods of time. In order o improve students' self-efficacy might require longer periods to help children build confidence about his/her capabilities. Treatment for longer periods may also help children to realize that mathematics is not only a one-solution process which may also help children to set intrinsic goals.

This study also can be replicated with an extra effort on paying attention using active learning methods in the classroom.

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APPENDIX A

MSLQ SCALE

Aşağıda İngilizce yazılmış bir ölçek bulunmaktadır. Bu ölçekte senin matematik dersine ilişkin motivasyonunla ve öğrenme stratejilerinle ilgili bazı ifadeler yer almaktadır. Her bir ifadeyi senin hemfikir olmana gore 1'den 7'ye kadar numaralar vererek doldurmalısın. Eğer yazılan tamamen seni anlatıyorsa, senin için çok doğruysa 7, eğer yazılan ile hemfikir değilsen ve seni hiç anlatmıyorsa 1'i işaretlemelisin.

Lütfen unutma, "Doğru" ya da "Yanlış" cevap diye bir şey yoktur. Her verdiğin cevap benim için çok önemli ve değerlidir. Burada paylaştığın bilgiler kesinlikle gizli tutulacak ve hiçkimseyle paylaşılmayacaktır.

Name Surname and Std. No_____

	Questions	1	2	3	4	5	6	7
1	In a class like this, I prefer course material that really challenges me so I can learn new things							
2	If I study in appropriate ways, then I will be able to learn the material in this course							
3	When I take a test I think about how poorly I am doing compared with other students							
4	I Think I will be able to use what I learn in this course in other courses.							
5	I believe I will receive an excellent grade in this class							
6	I'm certain I can understand the most difficult material presented in the readings for this course							
7	Getting a good grade in this class is the most satisfying thing for me right now.							
8	When I take a test I think about items on other parts of the test I can't answer							
9	It is my own fault if I don't learn the material in this course							
10	It is important for me to learn the course material in this class							
11	The most important thing for me right now is improving my overall grade point average, so my							

	main concern in this class is getting a good grade.							
12	I'm confident I can learn the basic concepts taught in this course							
13	If I can, I want to get better grades in this class than most of the other students							
14	When I take tests I think of the consequences of failing							
15	I'm confident I can understand the most complex material presented by the instructor in this course.							
16	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.							
17	I am very interested in the content area of this course							
18	If I try hard enough, then I will understand the course material.							
19	I have an uneasy, upset feeling when I take an exam.							
20	I'm confident I can do an excellent job on the assignments and tests in this course							
21	I expect to do well in this class.							
22	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.							
24	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.							
25	If I don't understand the course material, it is because I didn't try hard enough							
26	I like the subject matter of this course.							
27	Understanding the subject matter of this course is very important to me.							
28	I feel my heart beating fast when I take an exam.							
29	I'm certain I can master the skills being taught in this class.							
30	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.							
31	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.							
32	When I study the readings for this course, I outline the material to help me organize my thoughts.							
33	During class time I often miss important points because I'm thinking of other things.							

	Questions	1	2	3	4	5	6	7
34	When studying for this course, I often try to explain the material to a classmate or friend.							
35	I usually study in a place where I can concentrate on my course work.							
36	When reading for this course, I make up questions to help focus my reading.							
37	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.							
39	When I study for this class, I practice saying the material to myself over and over.							
40	Even if I have trouble learning the material in this class, I try to do the work on my own,without help from anyone.							
41	When I become confused about something I'm reading for this class, I go back and try to figure it out.							
42	When I study for this course, I go through the readings and my class notes and try to find the most important ideas.							
43	I make good use of my study time for this course							
44	If course readings are difficult to understand, I change the way I read the material.							
45	I try to work with other students from this class to complete the course assignments.							
46	When studying for this course, I read my class notes and the course readings over and over again.							
47	When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.							
48	I work hard to do well in this class even if I don't like what we are doing.							

	Questions	1	2	3	4	5	6	7
49	I make simple charts, diagrams, or tables to help me organize course material.							
50	When studying for this course, I often set aside time to discuss course material with a group of students from the class.							
51	I treat the course material as a starting point and try to develop my own ideas about it.							
52	I find it hard to stick to a study schedule.							
53	When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.							
54	Before I study new course material thoroughly, I often skim it to see how it is organized							
55	I ask myself questions to make sure I understand the material I have been studying in this class							
56	I try to change the way I study in order to fit the course requirements and the instructor's teaching style.							
57	I often find that I have been reading for this class but don't know what it was all about.							
58	I ask the instructor to clarify concepts I don't understand well							
59	I memorize key words to remind me of important concepts in this class.							
60	When course work is difficult, I either give up or only study the easy parts.							
61	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for							
62	I try to relate ideas in this subject to those in other courses whenever possible.							

	Questions	1	2	3	4	5	6	7
63	When I study for this course, I go over my class notes and make an outline of important concepts.							
64	When reading for this class, I try to relate the material to what I already know.							
65	I have a regular place set aside for studying.							
66	I try to play around with ideas of my own related to what I am learning in this course.							
67	When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.							
68	When I can't understand the material in this course, I ask another student in this class for help.							
69	I try to understand the material in this class by making connections between the readings and the concepts from the							
70	I make sure that I keep up with the weekly readings and assignments for this course.							
71	Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.							
72	I make lists of important items for this course and memorize the lists.							
73	I attend this class regularly.							
74	Even when course materials are dull and uninteresting, I manage to keep working until I finish.							
75	I try to identify students in this class whom I can ask for help if necessary							
76	When studying for this course I try to determine which concepts I don't understand well.							

	Questions	1	2	3	4	5	6	7
77	I often find that I don't spend very much time on this course because of other activities.							
78	When I study for this class, I set goals for myself in order to direct my activities in							
79	If I get confused taking notes in class, I make sure I sort it out afterwards.							
80	I rarely find time to review my notes or readings before an exam							
81	I try to apply ideas from course readings in other class activities such as lecture and discussion.							

APPENDIX B

TABLE OF SPECIFICATIONS

Objectives / **Chapters**	**Knowledge**	**Comprehension**	**Application**	**Total**
Chapter 4: Ratio • Percentages	0	0	2	2
Chapter 5: Inequalities	0	0	2	2
Chapter 6: Geometry Spatial Visualisation, Triangles • Triangles, types of triangles • Side and angle relations of triangles • Pythagorean relations of quadrilaterals • Quadrilaterals: paralleogram, rectangles rhombus, trapezium • Symmetry	3	6	8	17
Chapter 7: Circle • Chord and arc circumference and area of circle	3	2	9	14
Chapter 8: Right Cylinder	1	2	3	6
Total	8	10	29	41

APPENDIX C

ITEM ANALYSIS

N = 38	Q1	Q2	Q3	Q4	Q5	Q6
Upper Group (% 27, n = 10)	5	7	7	6	2	5
Lower Group (% 27, n = 10)	1	2	4	1	1	1
Item Difficulty Index, *p*	0.3	0.45	0.15	0.35	0.15	0.3
Item Discrimination Index, *r*	0.4	0.5	0.30	0.5	0.1	0.4

N = 38	Q7	Q8	Q9	Q10	Q11	Q12
Upper Group (% 27, n = 10)	5	7	2	3	4	8
Lower Group (% 27, n = 10)	0	3	0	0	1	2
Item Difficulty Index, *p*	0.25	0.5	0.1	0.15	0.15	0.5
Item Discrimination Index, *r*	0.5	0.4	0.2	0.30	0.5	0

N = 38	Q13	Q14	Q15	Q16	Q17	Q18
Upper Group (% 27, n = 10)	5	4	2	4	4	7
Lower Group (% 27, n = 10)	2	0	0	1	1	1
Item Difficulty Index, *p*	0.35	0.2	0.1	0.15	0.15	0.4
Item Discrimination Index, *r*	0.3	0.4	0.2	0.5	0.3	0.6

N = 38	Q19	Q20	Q21	Q22	Q23	Q24
Upper Group (% 27, n = 10)	7	8	6	4	7	2
Lower Group (% 27, n = 10)	1	3	1	2	2	2
Item Difficulty Index, *p*	0.4	0.55	0.35	0.3	0.45	0
Item Discrimination Index, *r*	0.6	0.5	0.5	0.2	0.5	0

N = 38	Q25	Q26	Q27	Q28	Q29	Q30
Upper Group (% 27, n = 10)	3	5	4	4	7	3
Lower Group (% 27, n = 10)	1	4	0	1	1	2
Item Difficulty Index, *p*	0.2	0.45	0.2	0.25	0.4	0.4
Item Discrimination Index, *r*	0.2	0.1	0.4	0.3	0.6	0.1

APPENDIX D

MATHEMATICS ACHIEVEMENT TEST

Name, Surname:_____

Student Number_____

Questions

1.Given that a $\in \mathbb{N}$, which of the following is correct for $3a + 8 > 11$

A. $a > 19$ C. $a > 3$

B. $19/3$ D. $a > 1$

2. Solve $4x + 3 < 15$. If x is a positive real number, find the sum of all positive x values.

A. *3* C. *5*

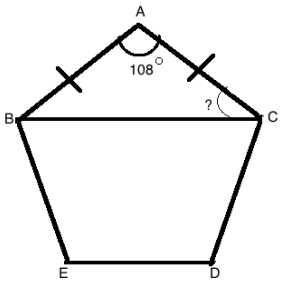
B. *4* D. *6*

3.How many integers are there in the interval $-3 < x < 10$

A. 9 C. 11

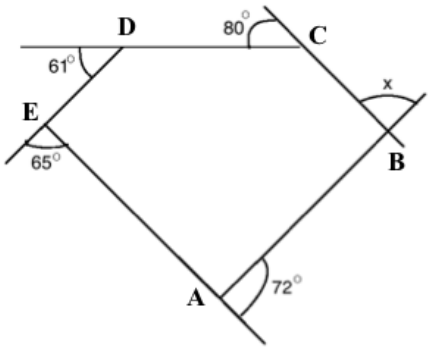
B. 10 D. 12

4.In the regular pentagon below, EDCAB, what is the angle of s(ACB) = ?



A. 108° B. 72° C. 36° D. 18°

5.In the given regular pentagon below, Find the measure of angle B

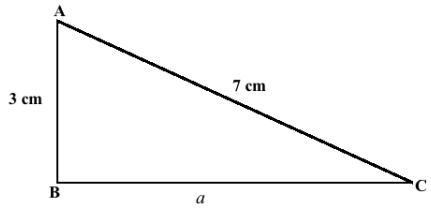


A. 80° B. 81° C. 82° D. 83°

6.How many sides are there in a pentagon whose sum of its interior angles is 1080°

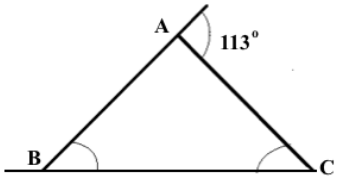
A. 10 B.8 C.7 D.6

7.In ABC triangle IABI = 3 cm, IACI = 7 cm, "a" is a positive integer. What can be the maximum perimeter of ABC triangle?



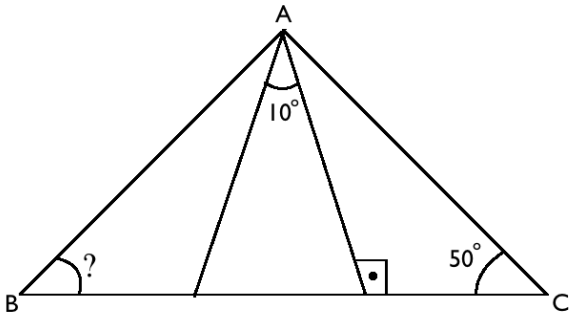
A. 19 B.20 C.21 D.22

8.In the given ABC triangle what is the value of angle B?



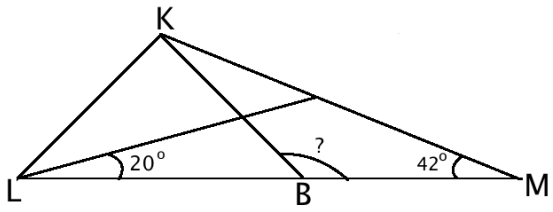
A. 77° B. 79° C. 89° D. 99°

9.AD is median in the given triangle, if AE ⊥ BC, what is the measure of angleB?



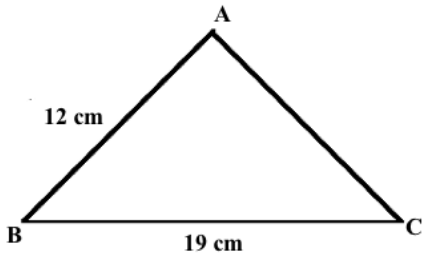
A. 90° B. 70° C. 60° D. 30°

10. In triangle, KLM, |LA| is angle bisector of angle L and |KB| is the angle bisector of angle K is s(ALM) = 20° and s(KML) = 42° what is the measure of angle s(KBM)=?



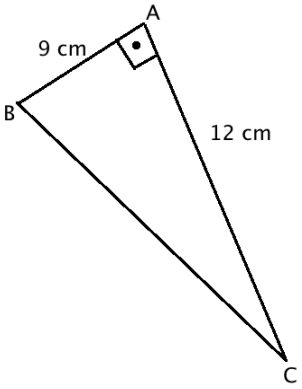
A. 56° B. 66° C. 76° D. 96°

11. What is the possible maximum perimeter of ABC triangle?



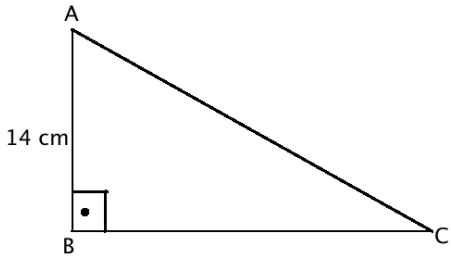
A. 61 cm B. 60 cm C. 59 cm D. 58 cm

12. What is |BC| = ?



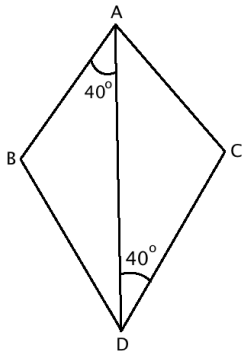
A. √21 cm B. 15 cm C. 21 cm D. 25 cm

13. Area of the given triangle below is 70 cm^2 . What is the length of |BC|?



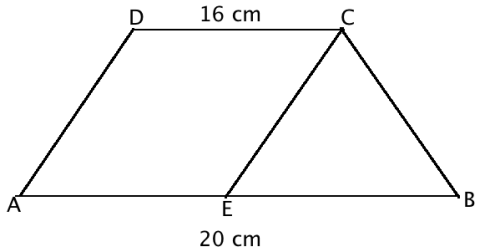
A. 5 cm B. 7 cm C. 9 cm D. 10 cm

14. ABCD is rhombus, s (ADC) = 40° and s(BAD) = 40°. What is the measure of angle C?



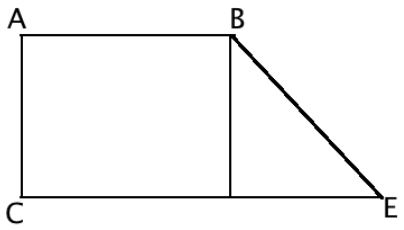
A. 100° B. 80° C. 60° D. 40°

15. Area of the given trapezium ABCD is 180 cm^2. If AD∥EC and |DC| = 16 cm, |AB| = 20 cm, what is the area of triangle CEB?



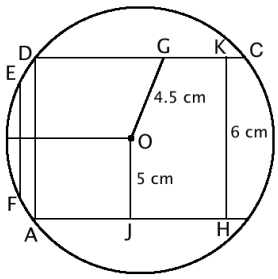
A. 36 cm^2 B. 34 cm^2 C. 30 cm^2 D. 15 cm^2

16. What is the area of given right-trapezium ABCE?



A. 24 cm^2 B. 36 cm^2 C. 42 cm^2 D. 60 cm^2

17. According to the given circle, which one of the following is correct?



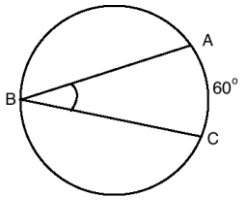
A. $\overset{\frown}{GH} > \overset{\frown}{OJ} > \overset{\frown}{OG} > \overset{\frown}{OK}$

B. $\overset{\frown}{GH} > \overset{\frown}{OG} > \overset{\frown}{OJ} > \overset{\frown}{OK}$

C. $\overset{\frown}{OJ} > \overset{\frown}{GH} > \overset{\frown}{OG} > \overset{\frown}{OK}$

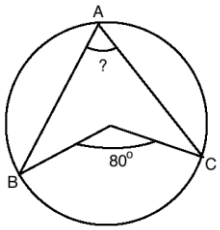
D. $\overset{\frown}{OK} > \overset{\frown}{OG} > \overset{\frown}{OJ} > \overset{\frown}{GH}$

18. In the given circle if s(BC) = 60° what is the measure of BAC?



A. 120° B. 60° C. 30° D. 15°

19. s(BOC) = 80° and what is s(A) = ?

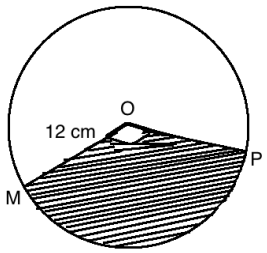


A. 40° B. 60° C. 80° D. 160°

20. What is the area of a circle with perimeter of 42 cm. (Take $\pi = 3$)

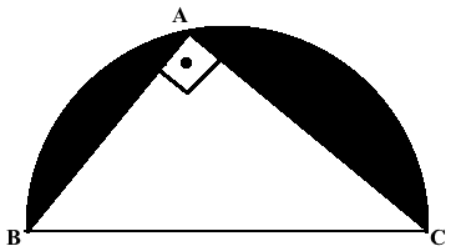
A. 21 cm^2 B. 42 cm^2 C. 49 cm^2 D. 147 cm^2

21. In the given circle, O is the centre. |OM| = 12 cm and s(MOP) = 100° what is the area of shaded region?



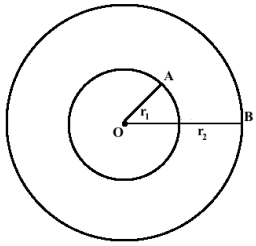
A. 100 cm^2 B. 120 cm^2 C. 140 cm^2 D. 150 cm^2

22. Length of the sides of the right triangle in the semi-circle given are, |AB| =3 cm and |AC| = 4 cm. What is the area of the shaded region? (Take $\pi = 3$)



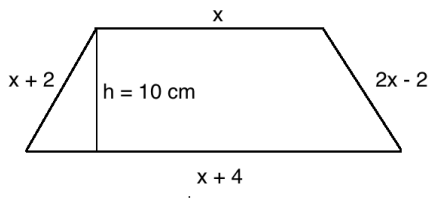
A. 6 cm^2 B. 6.75 cm^2 C. 12 cm^2 D. 12.75 cm^2

23. In the two circles below, O is the center. The difference of the two circles' area is 16 π. What is r_2?



A. 16 cm B. 18 cm C. 20 cm D. 22 cm

24. The height of the given trapezium is 10 cm. And the perimeter is 59 cm^2 . What is the area.



A. 140 cm^2 B. 120 cm^2 C. 100 cm^2 D. 90 cm^2

25. In the cylinder shaped brush, base radius is 15 cm and the height is 80 cm. What is the base area of the brush?

A. 7200 cm^2 B. 7000 cm^2 C. 3600 cm^2 D. 1800 cm^2

26. Which of the following is **<u>incorrect</u>**?

A. A polygon has equal number of sides and corners
B. You can draw six diagonals into a regular pentagon
C. Angle bisector, bisects or divides a line segment or angle into two equal parts.
D. A triangle median is a line segment that joins vertex to the midpoint of the opposite side

27. Ayşe wants to water her flower with a cylindirical bucket. Bucket has a radius of 10 cm, height is 30 cm. Ayşe needs to water the flower 9000 cm^3 once a week. How many times Ayşe needs to fill the bucket?

A. Once
B. Twice
C. Three times
D. Four times

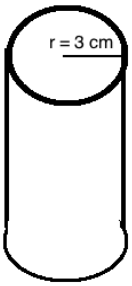
28. Which one of the following has 5 symmetrical axes?

A. Equilateral triangle
B. Rectangle
C. Square
D. Regular pentagon

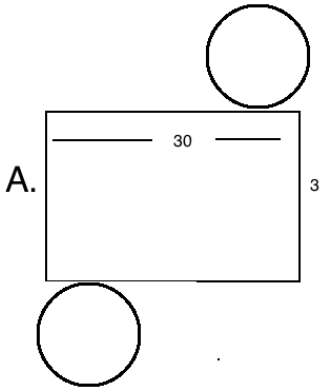
29. An equal sided parallelogram (4-sided) has an area of 39 cm^2 . Estimate an interval about possible side length.

A. 6 – 7 cm
B. 5 – 6 cm
C. 4 – 5 cm
D. 3 – 4 cm

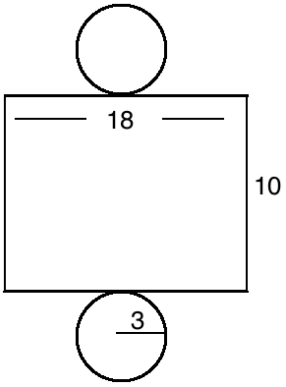
30. Which one of the following is the opened out form of right cylinder? (Take $\pi = 3$)



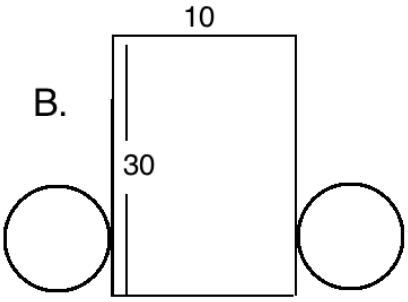
A.



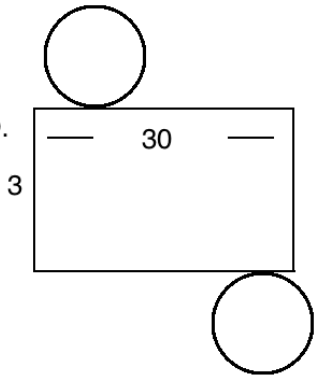
C.



B.



D.



APPENDIX E

INTERVIEW QUESTIONS

1. Do you like mathematics?
2. What do you think about mathematics? Is mathematics important for you? Why or why not? Do you think portfolio has changed your opinions about mathematics? Have your thoughts changed about mathematics lesson in this semester? Why?
3. Can you please define “portfolio activities” in 5 words or with a sentence?
4. Did you like using portfolios? Why?
5. Did keeping portfolios and completing portfolio tasks affect your learning habits? If yes, then in what ways?
6. Have you enjoyed preparing or completing portfolio activities? Why?
7. Did you need help during the portfolio completing process? If yes, whom you asked for help?
8. What are the advantages and disadvantages of using portfolios in a mathematics class?
9. Which assessment do you prefer to study, traditional or portfolio assessments? Why?

APPENDIX F1

SAMPLE STUDENT WORKS

Figure F1. Sample Student Work for Mathematics in Our Lives

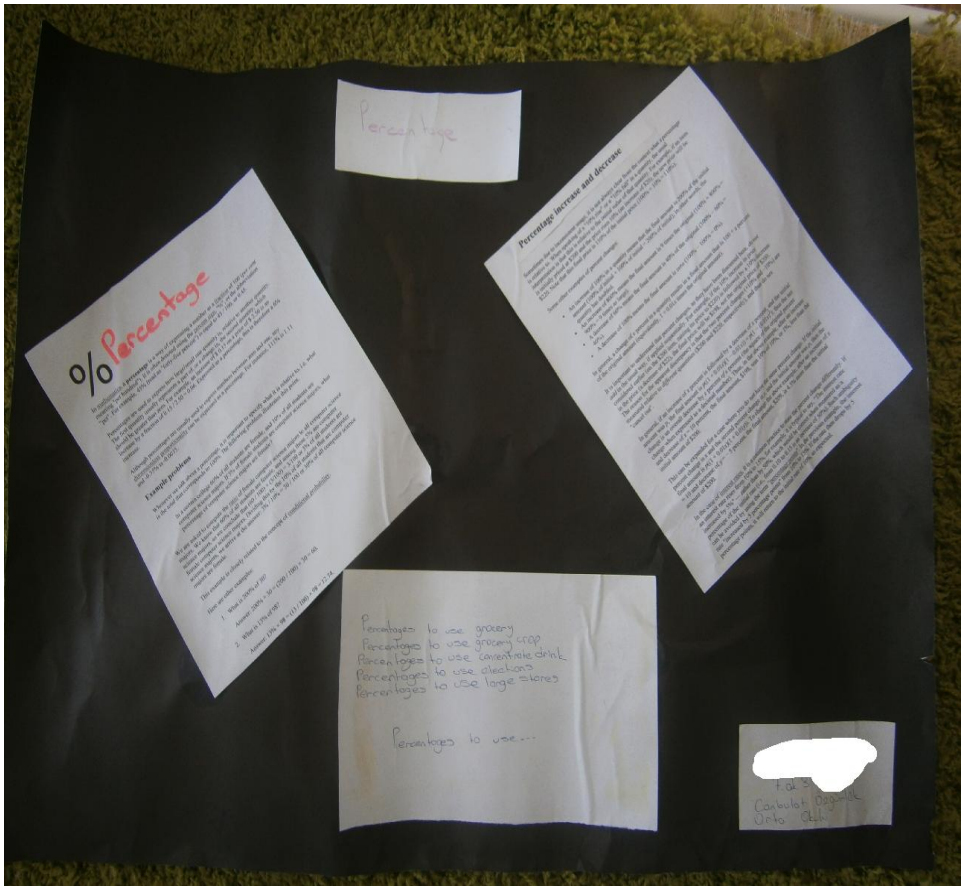


Figure F2. Sample Student Work for Percentages Task

Figure F3. Sample Student Work for Tangram Task

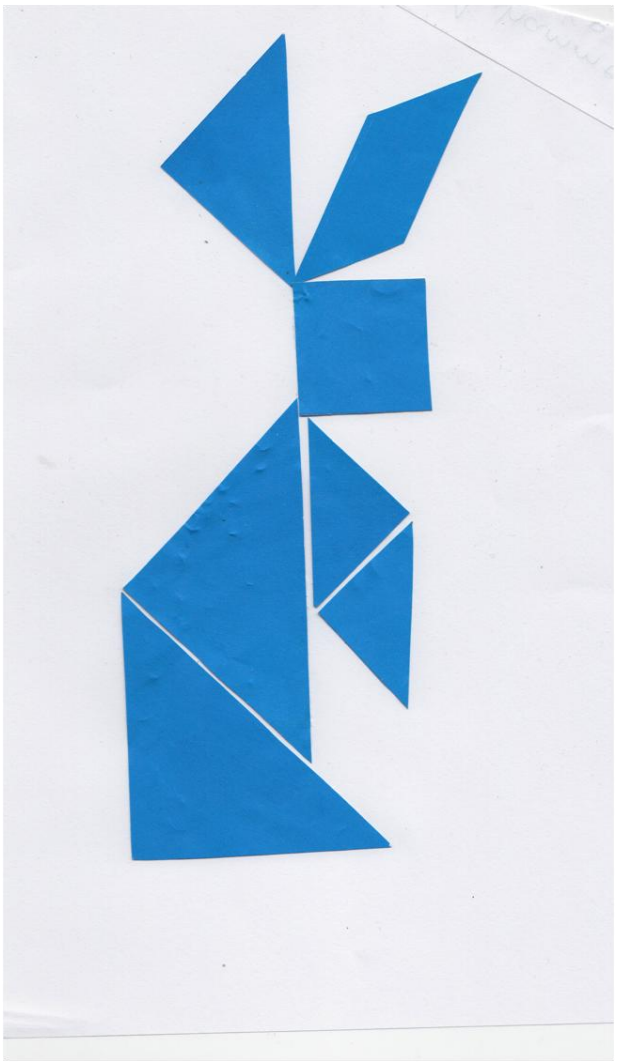


Figure F4. Sample Student Work for Tangram Task

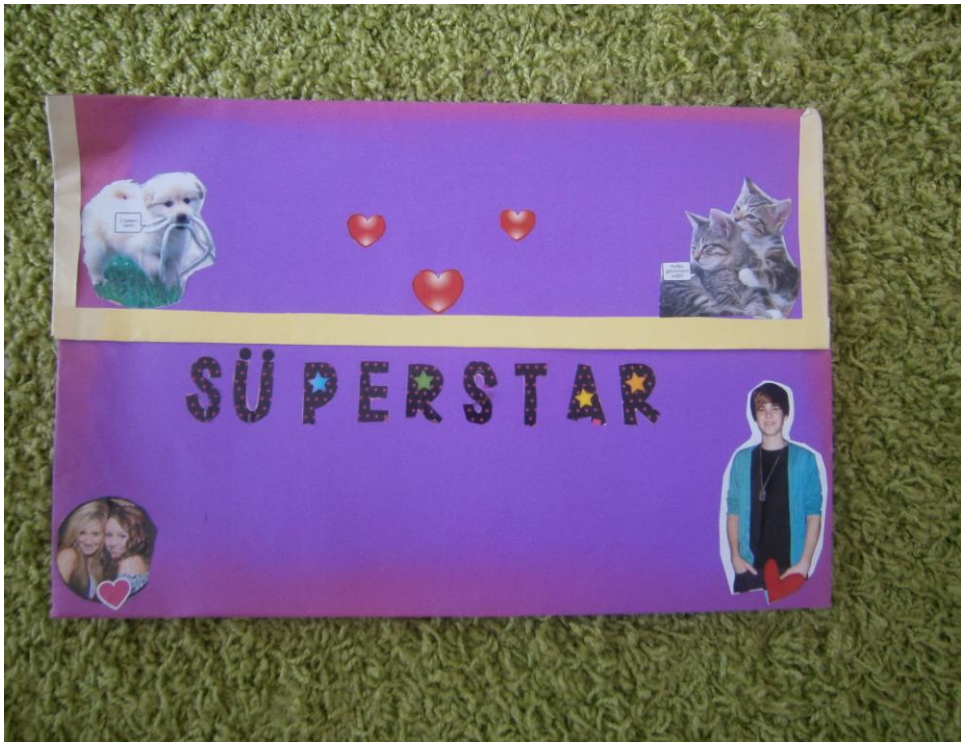


Figure F5. Sample Student Work for Envelope Task

Figure F6. Sample Student Work for Envelope Task

Figure F7. Sample Student Work for Envelope Task

Figure F8. Sample Student Work for Envelope Task

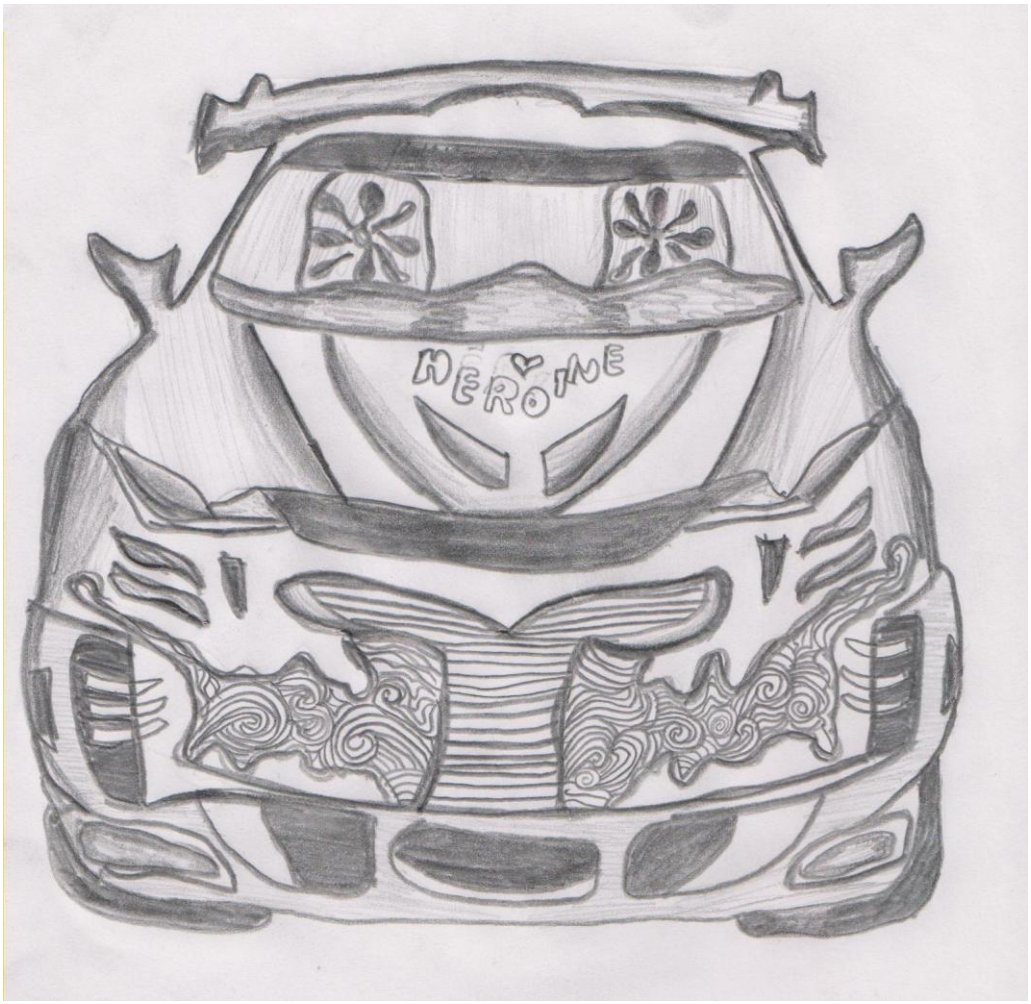


Figure F9. Sample Student Work for Imagine and Drive Task

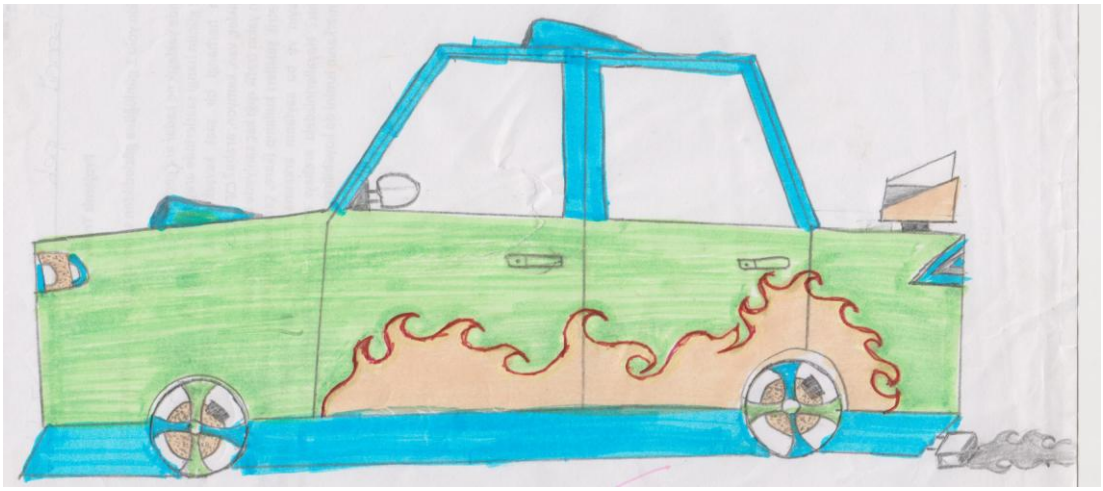


Figure F10. Sample Student Work for Imagine and Drive Task

APPENDIX G

CORRELATION MATRIX OF DEPENDENT VARIABLES

Table G.1 Correlation Matrix of Dependent Variables

	MACH 1	MACH 2	MACH 3	IGO 1	IGO 2	IGO 3	EGO 1	EGO 2	EGO 3
MACH2	0.66	1	0.83	0.17	0.28	0.24	0.32	0.30	0.27
MACH3	0.51	0.83	1	0.03	0.14	0.10	0.26	0.25	0.21
IGO1	0.20	0.17	0.03	1	0.97	0.97	0.08	0.08	0.04
IGO2	0.25	0.28	0.14	0.97	1	0.98	0.04	0.06	-0.01
IGO3	0.24	0.24	0.10	0.97	0.98	1	0.03	0.05	-0.01
EGO1	0.27	0.32	0.26	0.08	0.04	0.03	1	0.90	0.94
EGO2	0.29	0.30	0.25	0.08	0.06	0.05	0.90	1	0.92
EGO3	0.26	0.27	0.21	0.04	-0.01	-0.01	0.94	0.92	1
EFF1	0.19	0.29	0.24	0.43	0.47	0.43	0.17	0.17	0.13
EFF2	0.22	0.32	0.28	0.42	0.47	0.43	0.13	0.15	0.09
EFF3	0.23	0.33	0.30	0.43	0.48	0.44	0.12	0.15	0.09
ELA1	0.21	0.27	0.28	0.23	0.23	0.26	0.13	0.10	0.10
ELA2	0.21	0.28	0.31	0.22	0.23	0.25	0.08	0.05	0.05
ELA3	0.22	0.31	0.30	0.18	0.20	0.22	0.10	0.09	0.09
CRT1	0.25	0.33	0.28	0.33	0.35	0.34	0.09	0.12	0.10
CRT2	0.21	0.35	0.35	0.27	0.30	0.28	0.05	0.07	0.05
CRT3	0.26	0.37	0.34	0.35	0.38	0.37	0.06	0.07	0.06
PL1	0.04	0.06	0.11	0.09	0.04	0.07	0.12	0.11	0.12
PL2	0.03	0.08	0.15	0.08	0.06	0.08	0.02	0.03	0.01
PL3	0.00	-0.01	0.03	0.09	0.03	0.07	0.09	0.09	0.09
MSR1	0.16	0.26	0.11	0.31	0.34	0.33	0.18	0.23	0.16
MSR2	0.31	0.48	0.36	0.38	0.46	0.44	0.20	0.26	0.15
MSR3	0.28	0.47	0.36	0.36	0.44	0.42	0.16	0.24	0.12

Table G.1 Correlation Matrix of Dependent Variables (continued)

	EFF1	EFF2	EFF3	ELA1	ELA2	ELA3	CRT1	CRT2	CRT3
MACH2	0.29	0.32	0.33	0.27	0.28	0.31	0.33	0.35	0.37
MACH3	0.24	0.28	0.30	0.28	0.31	0.30	0.28	0.35	0.34
IGO1	0.43	0.42	0.43	0.23	0.22	0.18	0.33	0.27	0.35
IGO2	0.47	0.47	0.48	0.23	0.23	0.20	0.35	0.30	0.38
IGO3	0.43	0.43	0.44	0.26	0.25	0.22	0.34	0.28	0.37
EGO1	0.17	0.13	0.12	0.13	0.08	0.10	0.09	0.05	0.06
EGO2	0.17	0.15	0.15	0.10	0.05	0.09	0.12	0.07	0.07
EGO3	0.13	0.09	0.09	0.10	0.05	0.09	0.10	0.01	0.06
EFF1	1	0.96	0.96	0.32	0.29	0.25	0.38	0.36	0.38
EFF2	0.96	1	0.99	0.34	0.34	0.30	0.36	0.34	0.37
EFF3	0.96	0.99	1	0.35	0.34	0.30	0.37	0.36	0.38
ELA1	0.32	0.34	0.35	1	0.96	0.95	0.35	0.32	0.31
ELA2	0.29	0.34	0.34	0.96	1	0.96	0.29	0.28	0.26
ELA3	0.25	0.30	0.30	0.95	0.96	1	0.29	0.29	0.26
CRT1	0.38	0.36	0.37	0.35	0.29	0.29	1	0.96	0.96
CRT2	0.36	0.34	0.36	0.32	0.28	0.29	0.96	1	0.94
CRT3	0.38	0.37	0.38	0.31	0.26	0.26	0.96	0.94	1
PL1	0.01	-0.02	-0.01	0.02	-0.01	0.01	0.10	0.08	0.10
PL2	0.02	-0.03	0.01	0.07	0.04	0.04	0.06	0.07	0.07
PL3	-0.02	-0.05	-0.04	-0.02	-0.06	-0.04	0.05	0.04	0.06
MSR1	0.34	0.32	0.33	0.30	0.25	0.29	0.19	0.15	0.18
MSR2	0.42	0.43	0.44	0.43	0.39	0.44	0.30	0.29	0.32
MSR3	0.47	0.49	0.50	0.37	0.34	0.39	0.29	0.28	0.32

Table G.1 Correlation Matrix of Dependent Variables (continued)

	PL1	PL2	PL3	MSR1	MSR2	MSR3
MACH2	0.06	0.08	-0.01	0.26	0.48	0.47
MACH3	0.11	0.15	0.03	0.11	0.36	0.36
IGO1	0.09	0.08	0.09	0.31	0.38	0.36
IGO2	0.04	0.06	0.03	0.34	0.46	0.44
IGO3	0.07	0.08	0.07	0.33	0.44	0.42
EGO1	0.12	0.02	0.09	0.18	0.20	0.16
EGO2	0.11	0.03	0.09	0.23	0.26	0.24
EGO3	0.12	0.01	0.09	0.16	0.15	0.12
EFF1	0.01	0.02	-0.02	0.34	0.42	0.47
EFF2	-0.02	-0.01	-0.05	0.32	0.43	0.49
EFF3	-0.01	0.01	-0.04	0.33	0.44	0.50
ELA1	0.02	0.07	-0.02	0.30	0.43	0.37
ELA2	-0.01	0.04	-0.06	0.25	0.39	0.34
ELA3	0.01	0.04	-0.04	0.29	0.44	0.39
CRT1	0.10	0.06	0.05	0.19	0.30	0.29
CRT2	0.08	0.07	0.04	0.15	0.29	0.28
CRT3	0.10	0.07	0.06	0.18	0.32	0.32
PL1	1	0.91	0.95	-0.01	-0.03	-0.07
PL2	0.91	1	0.83	-0.01	0.02	-0.02
PL3	0.95	0.83	1	-0.03	-0.18	-0.12
MSR1	-0.01	-0.01	-0.03	1	0.77	0.73
MSR2	-0.03	-0.02	-0.08	0.77	1	0.95
MSR3	-0.07	-0.02	-012	0.73		1

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M.Ed	Eastern Mediterranean University, Secondary School Subject Teaching	2004
BS	Eastern Mediterranean University, Applied Mathematics and Computer Science	2000
High School	Gazimağusa Türk Maarif Koleji	1996

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Years	Institution	Enrollment
2001-2002	Eastern Mediterranean University, Faculty of Economics	Research Assistant
2002-2004	Eastern Mediterranean University, Faculty of Education	Research Assistant
2004-2006	Eastern Mediterranean University, Faculty of Education	Part-time Lecturer
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2009-2010	Near East University, Faculty of Education	Part-time Lecturer
2010-Present	Eastern Mediterranean University, Faculty of Education	Part-time Lecturer

FOREIGN LANGUAGES

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